



**Education and New Developments**  
**2023**

**Volume 1**

**Edited by**  
**Mafalda Carmo**

*Edited by* Mafalda Carmo, World Institute for Advanced Research and Science (WIARS), Portugal

*Published by* inScience Press, Rua Tomas Ribeiro, 45, 1º D, 1050-225 Lisboa, Portugal

Copyright © 2023 inScience Press

All rights are reserved. Permission is granted for personal and educational use only.

Commercial copying, hiring and lending is prohibited. The whole or part of this publication material cannot be reproduced, reprinted, translated, stored or transmitted, in any form or means, without the written permission of the publisher. The publisher and authors have taken care that the information and recommendations contained herein are accurate and compatible with the generally accepted standards at the time of publication.

The individual essays remain the intellectual properties of the contributors.

ISSN (electronic version): 2184-1489

ISSN (printed version): 2184-044X

ISBN: 978-989-35106-3-6

Legal Deposit: 428062/17

Printed in Lisbon, Portugal by GIMA - Gestão de Imagem Empresarial, Lda.

## BRIEF CONTENTS

---

Foreword	v
Organizing and Scientific Committee	vii
Sponsor	xii
Keynote Lecture	xiii
Index of Contents	xv



## FOREWORD

---

This book contains the full text of papers and posters presented at the International Conference on Education and New Developments (END 2023), organized by the World Institute for Advanced Research and Science (WIARS).

Education is a fundamental right that accompanies us from the very beginning of our lives. It encompasses every experience we encounter, influencing and shaping our thoughts, emotions, and actions. Whether we engage in formal education within classrooms or learn from the world around us, the process of acquiring knowledge plays a vital role in our personal growth and development. It equips us with the tools to navigate the complexities of life, broadens our perspectives, and empowers us to make informed decisions. This International Conference seeks to provide some answers and explore the processes, actions, challenges and outcomes of learning, teaching and human development. Our goal is to offer a worldwide connection between teachers, students, researchers and lecturers, from a wide range of academic fields, interested in exploring and giving their contribution in educational issues.

We have brought together a diverse group of individuals with various backgrounds to contribute their unique perspectives and knowledge on Education. By including people from different nationalities and cultures, we aim to create a rich plethora of experiences that can broaden our understanding of human nature and behavior. The exchange of ideas and experiences among our participants helps to cultivate personal and academic development, providing a platform for the exploration of new insights and discoveries.

END 2023 received 758 submissions, from more than 45 different countries, reviewed by a double-blind process. Submissions were prepared to take form of Oral Presentations, Posters, Virtual Presentations and Workshops. The conference accepted for presentation 279 submissions (37% acceptance rate).

The conference also includes one Keynote presentation by Dr. Omid Noroozi, Associate Professor of Educational Technology, Wageningen University and Research (WUR), The Netherlands. We would like to express our gratitude to our invitee.

This conference addressed different categories inside the Education area and papers are expected to fit broadly into one of the named themes and sub-themes. To develop the conference program, we have chosen four main broad-ranging categories, which also covers different interest areas:

- In **TEACHERS AND STUDENTS**: Teachers and Staff training and education; Educational quality and standards; *Curriculum* and Pedagogy; Vocational education and Counselling; Ubiquitous and lifelong learning; Training programs and professional guidance; Teaching and learning relationship; Student affairs (learning, experiences and diversity; Extra-curricular activities; Assessment and measurements in Education.
- In **PROJECTS AND TRENDS**: Pedagogic innovations; Challenges and transformations in Education; Technology in teaching and learning; Distance Education and eLearning; Global and sustainable developments for Education; New learning and teaching models; Multicultural and (inter)cultural communications; Inclusive and Special Education; Rural and indigenous Education; Educational projects.
- In **TEACHING AND LEARNING**: Critical, Thinking; Educational foundations; Research and development methodologies; Early childhood and Primary Education; Secondary Education; Higher Education; Science and technology Education; Literacy, languages and Linguistics (TESL/TEFL); Health Education; Religious Education; Sports Education.
- In **ORGANIZATIONAL ISSUES**: Educational policy and leadership; Human Resources development; Educational environment; Business, Administration, and Management in Education; Economics in Education; Institutional accreditations and rankings; International Education and Exchange programs; Equity, social justice and social change; Ethics and values; Organizational learning and change, Corporate Education.

The contributions were published across two volumes, and this is the Volume 1 of the book titled *Education and New Developments 2023*, that showcases the outcomes of dedicated research and developments undertaken by authors who are driven by their passion to enhance research methods that directly relate to teaching, learning, and the practical applications of education in the present day. Within its pages, you will find a diverse array of contributors and presenters who expand our perspectives by delving into various educational matters.

This first volume focuses on the main areas of TEACHERS AND STUDENTS and TEACHING AND LEARNING, being the contributions of the other two areas published in Volume 2.

We would like to express thanks to all the authors and participants, the members of the academic scientific committee, and of course, to our organizing and administration team for making and putting this conference together.

Hoping to continue the collaboration in the future.

Respectfully,

Mafalda Carmo  
World Institute for Advanced Research and Science (WIARS), Portugal  
*Conference and Program Chair*

Lisbon, Portugal, 24 - 26 June, 2023

## ORGANIZING AND SCIENTIFIC COMMITTEE

---

### Organizer

World Institute for Advanced Research and Science (WIARS)  
www.wiars.org

### Conference and Program Chair

Mafalda Carmo  
World Institute for Advanced Research and Science (WIARS), Portugal

### International Scientific Committee

**Aaron R. Deris**, Minnesota State University,  
USA

**Abha Gupta**, Old Dominion University, USA

**Adrián Ponz Miranda**, Zaragoza University,  
Spain

**Ahmad Razak**, University of Malaya, Malaysia

**Ahmet Ok**, Middle East Technical University,  
Turkey

**Alan Singer**, Hofstra University, USA

**Ali Baykal**, Bahcesehir University, Turkey

**Ana Conboy**, College of Saint Benedict and  
Saint John's University, USA

**Ana Hernández Espino**, Autonomous  
University of Madrid, Spain / The Labor  
University of Uruguay, Uruguay / National  
University of Entre Ríos, Argentina

**Ana-Maria Bercu**, Alexandru Ioan Cuza  
University of Iasi, Romania

**Anastasia Gouseti**, University of Hull, UK

**Anca Draghici**, Politehnica University of  
Timisoara, Romania

**Andis Klegeris**, University of British Columbia  
Okanagan, Canada

**Andrea Fiorucci**, University of Salento, Italy

**Andrea Hathazi**, Babeş-Bolyai University,  
Romania

**Angela Piu**, University of Valle d'Aosta, Italy

**Anja María Mackeldey**, Colegio Alemán  
Medellín / Universidad de Antioquia, Colombia

**Anna Lazou**, National & Kapodistrian  
University of Athens, Greece

**Antoni Kolek**, University of Social Sciences,  
Poland

**Aphrodite Ktena**, National and Kapodistrian  
University of Athens, Greece

**Arindam Basu**, University of Canterbury,  
New Zealand

**Aviva Dan**, Ohalo Academic Education  
College, Israel

**Beatriz Carrasquer Álvarez**, Zaragoza  
University, Spain

**Begoña Sampedro**, University of Cordoba,  
Spain

**Birgit Schmiedl**, University College of Teacher  
Education Lower Austria, Austria

**Borja Manzano Vázquez**, University of  
Granada, Spain

**Branka Zolak Poljasevic**, University of Banja  
Luka, Bosnia and Herzegovina

**Burcu Koç**, Sakarya University, Turkey

**Çağla Atmaca**, Pamukkale University, Turkey

**Carolina Bodea Hategan**, Babeş-Bolyai  
University, Romania

**Caroline Akhras**, Notre Dame University,  
Lebanon

**Celia MacDonnell**, University of Rhode Island  
and Brown University, USA

**Cezar Scarlat**, University "Politehnica" of  
Bucharest, Romania

**Chantal Ouellet**, Université du Québec a  
Montreal, Canada

**Charalampos Karagiannidis**, University of  
Thessaly, Greece

**Cheng-Hsuan Li**, National Taichung  
University of Education, Taiwan

**Chiara Uliana**, University of Granada, Spain



- Chien-ming Cheng**, National Academy for Educational Research, Taiwan
- Christian David Quintero Guerrero**, Nueva Granada Militar University, Colombia
- Christos Manasis**, National and Kapodistrian University of Athens, Greece
- Chuang Wang**, University of Macau, Macau
- Colleen M. Halupa**, East Texas Baptist University, USA
- Cory A. Bennett**, Idaho State University, USA
- Cristiana Pizarro Madureira**, ESECS – Instituto Politécnico de Leiria, Portugal
- Cristiano Luchetti**, American University of Ras Al Khaimah, United Arab Emirates
- Dale Kirby**, Memorial University, Canada
- Dalia Hanna**, Ryerson University, Canada
- Daniela Pasnicu**, Spiru Haret University, Romania
- David Aparisi**, University of Alicante, Spain
- David Nocar**, Palacký University in Olomouc, Czech Republic
- Devorah Eden**, Western Galilee College, Israel
- Diana Maria Cismaru**, National University of Political Studies and Public Administration (SNSPA Bucharest), Romania
- Diane Boothe**, Boise State University, USA
- Dimitris Dranidis**, The University of Sheffield International, Greece
- Dimitris Kilakos**, National & Kapodistrian University of Athens, Greece
- Donata Puntil**, Kings College London, UK
- Dorina Anca Talas**, Babeş-Bolyai University, Romania
- Douglas Baleshta**, Thompson Rivers University, Canada
- Ean Teng Khor**, Nanyang Technological University, Singapore
- Elena Baguzina**, Moscow State Institute of International Relations, Russian Federation
- Elena Polyudova**, Peoples Friendship University of Russia, Russian Federation
- Elisa Bertolotti**, University of Madeira; ID+; ITI / LARSyS, Portugal
- Elizabeth Sandell**, Minnesota State University, USA
- Emel Dikbas Torun**, Pamukkale University, Turkey
- Eva Trnová**, Masaryk University, Czech Republic
- Evangelina Bonifácio**, Polytechnic Institute of Bragança, Portugal
- Fausto Brevi**, Politecnico di Milano, Italy
- Gabriella Velics**, Eotvos Lorand University, Hungary
- Gina Chianese**, University of Trieste, Italy
- Gina Aurora Necula**, Dunarea de Jos University of Galati, Romania
- Gráinne Ní Dhomhnaill**, University College Dublin, Ireland
- Grischa Schmiedl**, University of Applied Science St. Pölten, Austria
- Gyöngyi Bujdosó**, University of Debrecen, Hungary
- Hana Vančová**, Trnava University, Slovakia
- Héctor Tronchoni**, Florida Universitaria in Catarroja, Spain
- Helena Skarupská**, Tomas Bata University, Czech Republic
- Helin Puksand**, Tallinn Univesity, Estonia
- Henri Jacobs**, Central University of Technology, Free State (CUT), South Africa
- Huseyin Bicen**, Near East University, Nicosia, Cyprus
- Ilijana Čutura**, University of Kragujevac, Serbia
- Ilona Tandzegolskienė**, Vytautas Magnus University, Lithuania
- Ina Blau**, The Open University of Israel, Israel
- Ioana Velica**, Babeş-Bolyai University, Romania
- Ioana Letiția Șerban**, Babeş-Bolyai University, Romania
- Jacquelyn Baker-Sennett**, Western Washington University, USA
- Janaina Cardoso**, Rio de Janeiro State University, Brazil
- Javier Casanoves-Boix**, Universidad Internacional de Valencia, Spain
- Jeannette Jones**, Texas Lutheran University, USA

**Jenni Sanguiliano Lonski**, Rollins College, USA

**Jitka Hloušková**, Independent Education Professional, Czech Republic

**Joana Romanowski**, UNINTER - Centro Universitario Internacional, Brazil

**Joanna Paliszkievicz**, Warsaw University of Life Sciences, Poland

**Jose Augusto Oliveira Huguenin**, Universidade Federal Fluminense, Brazil

**José Luis Ortega-Martín**, University of Granada, Spain

**Juana Maria Sancho Gil**, University of Barcelona, Spain

**Karel Němejc**, Czech University of Life Sciences Prague, Czech Republic

**Kateřina Vitásková**, Palacký University in Olomouc, Czech Republic

**Konstantinos Kalemis**, National and Kapodistrian University of Athens, Greece

**Kyparisia Papanikolaou**, School of Pedagogical and Technological Education, Greece

**Ladário da Silva**, Universidade Federal Fluminense (UFF), Brazil

**Laura Rio**, University of Bologna, Italy

**Leela Ramsook**, University of Trinidad and Tobago, Trinidad and Tobago

**Lefkothea Kartasidou**, University of Macedonia, Greece

**Lefkothea-Vasiliki Andreou**, University of Ioannina, Greece

**Leila Kajee**, University of Johannesburg, South Africa

**Les Sztandera**, Thomas Jefferson University, USA

**Loreta Chodzkiene**, Vilnius University, Lithuania

**Lorna M. Dreyer**, Stellenbosch University, South Africa

**Lucio G. Veraldo Jr.**, Infinity Academy 3d, Brazil

**Luis Gonzaga Roger Castillo**, Universidad de Granada (UGR), Spain

**Łukasz Tomczyk**, Jagiellonian University, Poland

**Luminita Cocarta**, Al. I. Cuza University of Iasi, Romania

**Lydia Mavuru**, University of Johannesburg, South Africa

**Maciej Debski**, University of Social Sciences, Poland

**Magdolna Chrappán**, University of Debrecen, Hungary

**Maja Seric**, University of Valencia, Spain

**Malgorzata Cieciora**, Polish-Japanese Academy of Information Technology, Poland

**Manfred Meyer**, Westfälische Hochschule, Germany

**Manhong Lai**, The Chinese University of Hong Kong, China

**Marcin Fojcik**, Western Norway University of Applied Sciences, Norway

**Marga Vives Barceló**, University of the Balearic Islands, Spain

**Maria Lopes de Azevedo**, ESECS, Polytechnic Institute of Portalegre, Portugal

**Maria Carme Boqué Torremorell**, Ramon Llull University, Spain

**María José Latorre**, University of Granada, Spain

**Marko Slavkovic**, University of Kragujevac, Serbia

**Marta Talavera**, University of Valencia, Spain

**Marzena Wójcik-Augustyniak**, Siedlce University of Natural Sciences and Humanities, Poland

**Maya Wizel**, Middlebury College, USA / Kibbutzim College, Israel

**Mayara de Carvalho Santos**, Butantan Institute, Brazil

**Megan Purcell**, Purdue University, USA

**Melissa Caspary**, Georgia Gwinnett College, USA

**Michael Reiner**, IMC University of Applied Sciences Krems, Austria

**Milan Kubiátko**, Jan Evangelista Purkyně University, Czech Republic

**Mohammad Ahmad Abdeldayem**, Zagazig University, Egypt

**Mohd Norazmi bin Nordin**, Universiti Kebangsaan Malaysia, Malaysia

**Napak-on Srirakarn**, ILSC & Greystone College, Australia

**Natalie Lavoie**, University of Quebec in Rimousk, Canada

**Nataša Vlah**, University of Rijeka, Croatia

**Nazario Zambaldi**, Free University of Bolzano, Italia

**Omid Noroozi**, Wageningen University & Research, The Netherlands

**Onur Ergünay**, George Mason University, USA

**Özgün Koşaner**, Dokuz Eylul University, Türkiye

**Paolo Sorzio**, University of Trieste, Italy

**Pascal Marquet**, University of Strasbourg, France

**Paula Miranda**, Polytechnic Institute of Setubal, Portugal

**Paul Sage**, Queen's University, Belfast, UK

**Pavel Brebera**, University of Pardubice, Czech Republic

**Pawel Pokutycki**, Royal Academy of Art (KABK), The Hague, The Netherlands

**Pawel Topol**, Adam Mickiewicz University in Poznań, Poland

**Pule Phindane**, Central University of Technology, South Africa

**Raluca Trifu**, UMF Iuliu Hatieganu from Cluj Napoca, Romania

**Rasa Nedzinskaitė-Mačiūnienė**, Vytautas Magnus University, Lithuania

**Remigijus Bubnys**, Kaunas University of Technology, Lithuania

**Richard C. Kalunga**, University of the District of Columbia, USA

**Rita Franceschini**, University Vita Salute San Raffaele, Italy

**Rosanna Tamaro**, University of Salerno, Italy

**Ryuichi Matsuba**, Tokyo University of Technology, Japan

**Sam Ramaila**, University of Johannesburg, South Africa

**Seppo Sirkemaa**, University of Turku, Finland

**Sheryl Williams**, Loughborough University, United Kingdom

**Silmar José Spinardi Franchi**, Federal University of Santa Catarina, Brazil

**Silvânia Alves de Carvalho**, Universidade Federal Fluminense, Brazil

**Simon Richir**, Arts et Metiers (ENSAM), France

**Simone Brasili**, University of Camerino, Italy

**Soane Joyce Mohapi**, University of South Africa, South Africa

**Stefania Pinnelli**, University of Salento, Italy

**Stephanie Linek**, ZBW - Leibniz Information Centre for Economics, Germany

**Susan Scott**, Lakehead University, Canada

**Susanne Schumacher**, Free University of Bozen, Italy

**Suzie Savvidou**, The University of Sheffield International Faculty, CITY College, Greece

**Syed Ziaur Rahman**, Majan University College, Oman

**Tatjana Portnova**, Russian Center of The University of Granada, Spain

**Temenujka Zafirova Malcheva**, Sofia University "St. Kliment Ohridski", Bulgaria

**Tena Velki**, Josip Juraj Strossmayer University of Osijek, Croatia

**Théodore Njingang Mbadjoin**, University Lumière Lyon 2, France

**Ulrike Stadler-Altman**, Free University of Bozen, Italy

**Valentina Vezzani**, University of Madeira, Portugal

**Vashti Singh**, University of Guyana, Guyana

**Vassilios Argyropoulos**, University of Thessaly, Greece

**Verónica Yanez-Monje**, University of Concepcion, Chile

**Vicente J. Llorent**, University of Cordoba, Spain

**Victor Fester**, University of Waikato, New Zealand

**Wendy Setlalto**, Central University of Technology, South Africa

**Wiktor Bolkunow**, Warsaw School of Economics, Poland

**Xénia Liashuk**, Trnava University, Slovakia

**Yelkin Diker Coşkun**, Yeditepe University,  
Türkiye

**Yevgeniya Daineko**, International IT  
University, Kazakhstan

**Yogesh Kumar Sharma**, Former Vice  
Chancellor Singhanian University, India

**Yonghuai Liu**, Edge Hill University, United  
Kingdom

**Youngsoon Kim**, Inha University, South Korea

**Zoltán Rónay**, Eötvös Loránd University,  
Hungary

## SPONSOR

---



<http://www.wiars.org>

## KEYNOTE LECTURE

---

### “TOWARDS TRANSFORMATION OF EDUCATION IN THE DIGITAL AGE”

**Dr. Omid Noroozi**

*Associate Professor of Educational Technology, Wageningen University and Research (WUR)  
(The Netherlands)*

#### Abstract

The COVID-19 pandemic has forced transformation in educational settings within a short period of time. Such transformation has led to significant changes in our educational settings not only for students and teachers but also for institutions as such. This implies the need for constant innovations within educational programs to prepare our society for dealing with complex and global issues. In such transformation, digital technologies play a key role in today’s classrooms and educational institutions are increasingly developing learning and teaching concepts that rely on the extensive use of such advanced digital technologies. This talk will focus on the key characteristics of transformation in our educational settings in the digital age. Then, the focus will shift towards how to integrate digital technologies in classrooms with particular emphasis on competencies that fit well with the digital age to enhance the process of teaching and learning. It will also focus on the key competencies that are crucial for students to acquire for dealing with complex issues and wicked problems in the digital age. This talk will also provide examples of active teaching methods and how they can be used in classrooms in line with the transformation of education in the digital age. Finally, the outlook of educational settings in the future will be discussed.

---

#### Biography

Dr. Omid Noroozi is an Associate Professor of educational technology at Wageningen University and Research, the Netherlands. He explores relations among educational technology, learning, and students’ transformative competence development. His Ph.D. (2013, Cum Laude) and research projects have been the subjects of various papers he has delivered at international conferences and various articles published in peer-reviewed journals. Omid has been a visiting scholar at the University of Michigan, USA, University of Oulu, Finland. He has received various research awards such as the most promising publication award at WUR, the best conference, and journal paper awards, nomination for Jan Hawkins award, and several junior research awards. Omid is now serving as an executive board member of the International Society for Technology, Education, and Science (ISTES), a committee member of the CSCL, Editor-in-Chief for the International Journal of Technology in Education (IJTE), and President and Scientific Chair of the International Conference on Studies in Education and Social Science (ICSSES). He has co-edited a couple of collected books, served as an editorial board member of several scientific peer-review journals, and also guest-edited a couple of special issues in top-rank journals in the field of educational research. Omid is an active member of scientific associations e.g. AERA, ISLS, ICO, EARLI, and serves as an active reviewer for international peer-reviewed journals and conferences.



## INDEX OF CONTENTS

---

### ORAL PRESENTATIONS

---

#### ***Teachers and Students***

<b>Arithmetic and algebraic knowledge in student learning of concepts</b> <i>Natalia Karlsson, &amp; Wiggo Kilborn</i>	<b>3</b>
<b>Teachers as students: Duality as perceived by teachers and aspects of self-efficacy in an online environment</b> <i>Michal Nachshon, &amp; Amira Rom</i>	<b>8</b>
<b>The nature of metacognitive language and networking: Development of the theory of metacognitive locale</b> <i>Divan Jagals</i>	<b>13</b>
<b>The effect of teacher's implemented strategies on students' text comprehension</b> <i>Krista Uibu, &amp; Triinu Kärbla</i>	<b>18</b>
<b>Bullying as driver of low mathematics achievement: South African no-fee-paying schools in a challenged context</b> <i>Marien Alet Graham</i>	<b>20</b>
<b>Adopting online learning approaches in professional music training – The TUT experience</b> <i>Hua Hui Tseng</i>	<b>25</b>
<b>Examining the mental health status of Hungarian teachers</b> <i>Mónika Veronika Szigeti</i>	<b>29</b>
<b>Tutored praxis-shock: Teacher candidates' opinion on the mental effects of school mentoring</b> <i>Magdolna Chrappán, &amp; Rita Bencze</i>	<b>34</b>
<b>An analysis of the use of simulation centers in the training of pre-service and novice English teachers in Israel. What makes them work well?</b> <i>Nicole Broder</i>	<b>39</b>
<b>Mentoring in teacher training practice: The interpretation of mentors' role in the triadic relationship</b> <i>Rita Bencze, &amp; Magdolna Chrappán</i>	<b>44</b>
<b>Who are you? Profile of early childhood caretakers and educators</b> <i>Aviva Dan, &amp; Eitan Simon</i>	<b>49</b>
<b>Student teachers' perception on the use of Mother Tongue as medium of instruction in foundation phase</b> <i>Pule Phindane</i>	<b>54</b>
<b>A meta-analysis: the association between relational parental involvement and student and parent outcome variables</b> <i>William Jeynes</i>	<b>59</b>
<b>Bridging the gap: From classroom to clinic</b> <i>Dinah Paritzky, Rachel Eichler, &amp; Ravid Rodan-Doron</i>	<b>62</b>



<b>University lecturers’ experiences with technology integration into teacher education post COVID-19 pandemic</b>	<b>66</b>
<i>Sithulisiwe Bhebhe, Luzaan Schlebusch, &amp; Gawie Schlebusch</i>	
<b>Preservice life sciences teachers’ conceptualisation of gender equality in the classrooms</b>	<b>71</b>
<i>Lydia Mavuru</i>	
<b>Moving high stakes assessments to digital platform in South Africa</b>	<b>76</b>
<i>Naziema Jappie, &amp; Ashley Niekerk</i>	
<b>Physical Education students’ intention of using the spectrum of teaching style in their future work</b>	<b>81</b>
<i>María Espada</i>	
<b>Developing preservice science teachers’ pedagogical content knowledge through reflection on lesson planning</b>	<b>86</b>
<i>Lydia Mavuru</i>	
<b>Exploring the influence of career awareness on the uptake of STEM subjects by rural girl learners</b>	<b>91</b>
<i>Magdeline Stephen, Nomfundo Radebe, Ngonidzashe Mushaikwa, &amp; Emmanuel Mushayikwa</i>	
<b>Capturing unique teaching experiences of first-year secondary mathematics teachers transitioning from virtual to in-person instruction</b>	<b>96</b>
<i>Amélie Schinck-Mikel, Katie Paulding, &amp; Elsa Medina</i>	
<b>Learning to teach: An evaluation of the preparation of doctoral students to lead their own teaching</b>	<b>101</b>
<i>Karel Němejc</i>	
<b>Cooperation between the university and the ombudsperson for children in the education of teacher’s faculty students for the protection of children’s rights</b>	<b>106</b>
<i>Ana Babić, &amp; Helenca Pirnat Dragičević</i>	
<b>Examining student teachers’ opportunities and barriers associated with formative online assessments at a university of technology</b>	<b>111</b>
<i>Paseka Patric Mollo</i>	
<b>“The Visual Code”: Educating in an age of visual culture</b>	<b>115</b>
<i>Noam Topelberg, &amp; Jonathan Ventura</i>	
<b>Lessons learned from teaching during the COVID-19 pandemic: Operationalizing the what if’s</b>	<b>120</b>
<i>Kathy R. Fox, Tracy Y. Hargrove, &amp; Kathleen Roney</i>	
<b>Towards future education: How do teachers and students perceive blended education?</b>	<b>125</b>
<i>Seyyed Kazem Banihashem, Perry den Brok, Omid Noroozi, &amp; Harm Biemans</i>	
<b>Pedagogical model for social transformation with a common good perspective</b>	<b>130</b>
<i>Mariano Sánchez Cuevas</i>	
<b>Challenges – Towards continuous peer assessment in undergraduate programming classes</b>	<b>134</b>
<i>Manfred Meyer</i>	
<b>Synergy between the lesson plan and lesson presentation: Practice what you plan!</b>	<b>139</b>
<i>Mokete Letuka, &amp; Paseka Mollo</i>	

<b>Assessment from within – Understanding the knock-on effect of teachers’ practices on classroom speaking assessments</b>	<b>144</b>
<i>Rúben Constantino Correia</i>	
<b>The effects of the middle layer on Chinese college teachers’ competence model: A meta-analysis</b>	<b>149</b>
<i>Lei You, Pei-Hua Tsai, &amp; Lung-Hsing Kuo</i>	
<b>What influence did a design thinking, creative problem-solving workshop have on beginner student teachers?</b>	<b>153</b>
<i>Karen McGivern</i>	
<b>TLM (Three Layers Methodology) model facing multidisciplinary education</b>	<b>158</b>
<i>Limor Sahar-Inbar, &amp; Nava Shaked</i>	
<b>Quality of online biodiversity summative assessments administered to student teachers at a South African university</b>	<b>163</b>
<i>Kholofelo Makgopa, &amp; Monde Kazeni</i>	
<b>Exploring the integration level of Information and Communication Technology (ICT) by Setswana student teachers at a university of technology in South Africa</b>	<b>168</b>
<i>Bridget Kesaobaka Mangwegape, &amp; Paseka Patric Mollo</i>	
<b>The decision tree analysis model on a remote popular science learning system for in-services education of teachers</b>	<b>172</b>
<i>Lung-Hsing Kuo, Pei-Hua Tsai, Tzuchau Yeh, Chenyu Chiang, &amp; Kuo-Ming Tu</i>	
<b>Innovative work-based learning and employability skills training for learners with special needs</b>	<b>177</b>
<i>Dalun Zhang</i>	
<b>Development of a new metacognitive self-regulated model of competency</b>	<b>181</b>
<i>Margarita Auli Giraldo, &amp; Jean-François Herold</i>	
<b>Stimulation of practices with emergent literacy with students in the initial years of literacy</b>	<b>186</b>
<i>Caroline Fernandes Brasil, Luana Baron Scollo, &amp; Simone Aparecida Capellini</i>	
<b>Teacher training on fundamental programming for mathematics and technology – What are the course takeaways?</b>	<b>191</b>
<i>Peter Mozelius</i>	
<b>Pre-service teachers’ knowledge of mathematics: A framework for sustainable development of student knowledge</b>	<b>196</b>
<i>Natalia Karlsson, &amp; Wiggo Kilborn</i>	
 <b><u>Teaching and Learning</u></b>	
<b>Rethinking learning potentials: The benefits of learning across the life span</b>	<b>201</b>
<i>Denise Calhoun, &amp; Reyna García Ramos</i>	
<b>Recomposition and photomontage as a stimulus for the development of creativity in teaching Visual Arts</b>	<b>206</b>
<i>Marija Brajčić, &amp; Dubravka Kušević</i>	
<b>How to be political? Exploring early childhood understanding of politics ecologically and philosophically</b>	<b>211</b>
<i>Gudrun Marci-Boehncke, Matthias Rath, &amp; Madeleine Rusch</i>	

<b>Doubt in religious fundamentalism: Education between authority and rational autonomy</b> <i>Rahel Kellich</i>	216
<b>Early identification of academic failure on higher education: Predicting students' performance using AI</b> <i>Fidel Cacheda, Manuel F. López-Vizcaíno, Diego Fernández, &amp; Víctor Carneiro</i>	221
<b>Exploring early childhood understanding of politics and the impact of (digital) media education</b> <i>Raphaëla Tkotzyk, Johanna Lategahn, &amp; Gudrun Marci-Boehncke</i>	226
<b>Demographic characteristics of teachers' perceptions towards the use of technology in early childhood education</b> <i>Baliqis Oladele Adeyinka, Adebunmi Yetunde Aina, &amp; Ayodele Abosede Ogebo</i>	231
<b>A multidisciplinary training program for Smart Cities technicians and engineers</b> <i>Vasileios Gkamas, &amp; Maria Rigou</i>	236
<b>Arts education in combined primary classes in the Republic of Croatia</b> <i>Jelena Blašković Glaleković, Svetlana Novaković, &amp; Zlata Tomljenović</i>	241
<b>Designing with multiple tools - Supporting young children agency in early childhood education</b> <i>Calkin Suero Montero, Kaisa Pihlainen, Niina Leppänen, Sanna Ikonen, &amp; Eija Kärnä</i>	246
<b>Using an interactive web-based tool to connect families, practitioners, and policy makers</b> <i>Dawn Thomas, Keith Hollenkamp, &amp; Catherine Corr</i>	251
<b>Standard of final year student teachers' main summative assessment papers at a university of technology</b> <i>Mokete Letuka</i>	253
<b>Meaningful teacher child dialogue - Responding to emotional needs of children in crisis situations</b> <i>Teresa Lewin, Samar Aldinah, &amp; Barbara Shapir</i>	258
<b>Online discussion forum tasks in ESP courses: Space for development of intralinguistic mediation skills</b> <i>Pavel Brebera, &amp; Zuzana Bezdickova</i>	262
<b>Can the analysis of the play <i>The Streetcar Named Desire</i> by Tennessee Williams through the social model of disability, encourage the development of critical thinking?</b> <i>Izabela Potnar Mijić</i>	267
<b>Research on foreign languages teaching in Mexico: A decade of work</b> <i>José Luis Ramírez-Romero, &amp; Fabiola Gómez-Baldenegro</i>	271
<b>Non-judgemental attention with intention: Mindfulness in the curriculum at home and abroad</b> <i>Ana Fonseca Conboy, &amp; Kevin Clancy</i>	275
<b>Analysis of theoretical and methodological aspects in research works with scientific dissemination</b> <i>Leticia Kurihara, &amp; Gildo Giroto Junior</i>	280

<b>A study regarding learning and innovation skills (4Cs) in a Portuguese higher education institution</b>	<b>285</b>
<i>Isabel Ribau</i>	
<b>Gauging anxiety and resilience in the mathematics classroom: Voices of grade 7 teachers and learners from South Africa</b>	<b>290</b>
<i>Jo Badenhorst, &amp; Dimakatso Rammile</i>	
<b>Coding for children – A way to fulfill the aims of the OECD Learning Compass 2030?</b>	<b>295</b>
<i>Olaf Herden</i>	
<b>Monitoring oral reading fluency in Elementary School I</b>	<b>300</b>
<i>Maira Anelli Martins, Noemi Del Bianco, Ilària D’Angelo, Catia Giaconi, &amp; Simone Aparecida Capellini</i>	
<b>Maximizing the efficiency of presence-distance education microcomputers systems</b>	<b>305</b>
<i>Robert Plšičik, Peter Klčo, &amp; Michal Praženica</i>	
<b>Practicing social-emotional and cognitive teaching strategies and STEAM activities in early childhood education</b>	<b>310</b>
<i>Ona Monkevičienė, Birutė Vitytė, &amp; Birutė Autukevičienė</i>	
<b>Playworlds: Imaginative adult-child joint play in early learning classrooms</b>	<b>315</b>
<i>Anna Pauliina Rainio</i>	
<b>Use of technology in supporting ECD centres’ pedagogy and management functions to provide quality education</b>	<b>320</b>
<i>Adebunmi Yetunde Aina</i>	
<b>Inspiration for preschool teachers: Content analysis of Czech Facebook group</b>	<b>325</b>
<i>Marie Dědičová</i>	
<b>Virtual reality in pre-service teacher education: Challenges of realization in music education</b>	<b>330</b>
<i>Ari Poutiainen, &amp; Heidi Krzywacki</i>	
<b>Education model for future</b>	<b>335</b>
<i>Marcin Fojcik, &amp; Martyna K. Fojcik</i>	
<b>Trends in learning group performance in problem-solving simulations</b>	<b>340</b>
<i>Alexander Pojarliev</i>	
<b>Developing young children’s text processing skills by using detective board games and RWCT techniques</b>	<b>345</b>
<i>Barbara Zsiray</i>	
<b>Immersive Virtual Reality and Artificial Intelligence for enhancing student preparedness for clinical exams</b>	<b>350</b>
<i>Brendan Concannon, &amp; Shaniff Esmail</i>	
<b>Students’ behavior on a “mathematical literacy” problem</b>	<b>355</b>
<i>Eleni Nolka, &amp; Chryssa Sofianopoulou</i>	
<b>Personality-sensitive pedagogies: A mixed methods analysis of small group interactions among 9-10 year olds</b>	<b>360</b>
<i>Marcus Witt, &amp; Ben Knight</i>	
<b>Sentence comprehension in children with developmental language disorders</b>	<b>365</b>
<i>Barbora Červenková, &amp; Gabriela Solná</i>	

<b>Co-creating an organization-wide pedagogical program in higher education</b> <i>Katri Ojasalo, &amp; Pauliina Nurkka</i>	<b>370</b>
<b>Developing an effective mobile app for improving English speaking skills</b> <i>Eun-Ok Baek, Qi Eyda Guo, Tong Feng, &amp; Lu Jia</i>	<b>375</b>
<b>Adapting architectural design education for the AI era: Preliminary findings and future directions</b> <i>Chih-Wen Lan</i>	<b>380</b>
<b>Hacking the children’s museum: Illuminating middle years social studies curriculum in permanent exhibitions</b> <i>Rafael Iwamoto Tosi, &amp; Bruno de Oliveira Jayme</i>	<b>385</b>

## POSTERS

---

### **Teachers and Students**

- Industry – University cooperation – A prerequisite for developing competencies 4.0** 393  
*Valentina Haralanova, Göran Fafner, & Samir Khoshaba*
- The preferences of students and their view on the education of economic and management subjects at a technically oriented university** 396  
*Ivan Katrencik, & Monika Zatrochova*
- The schoolification of computer gaming – Identifying the role of esport in school syllabi** 399  
*Björn Sjödén, & Kalle Jonasson*
- Teachers’ stress as a moderator of the impact of POMPedasens on preschool children’s social-emotional learning** 402  
*Maryam Zarra-Nezhad, Ali Moazami-Goodarzi, Joona Muotka, & Nina Sajaniemi*
- The development of formal thinking** 405  
*Ghada Wattad, & David Chen*
- Embedding trauma-informed care practices into special education personnel preparation programs** 408  
*Catherine Corr*
- Revolutionizing MSI to R1 graduate pathways through distributed teaching** 410  
*Dwayne C. Joseph*
- Exploration of the teaching method of the course “Circuit Analysis and Analog Circuits”** 413  
*Hua Fan, Tianchi Yang, Jianming Liu, Zonglin Li, Xinkai Guo, & Yan Sun*
- Measuring self-regulated learning in students with/without care-responsibilities to push gender equity** 416  
*Luzi M. Beyer, & Annina Böhm-Fischer*
- Generational intelligence as an integral aspect of pre-service teachers’ interpersonal communication competence** 419  
*Tai-Fen Chen, Daniel Chia-En Teng, & Ho-Yuan Chen*

### **Teaching and Learning**

- Entrepreneurship competencies in high school students: Effects of age and gender** 422  
*Eric Yergeau, & Marcelle Gingras*
- Design of power electronic system with variable topology of the main circuit for educational support of laboratory exercises of power semiconductor converters** 425  
*Michal Frivaldsky*
- Educational technology in problem-based learning** 428  
*Petra Pejić Papak, Jasminka Mezak, & Lidija Vujičić*
- The relation between parents’ characteristics/practices and children’s early literacy skills during the COVID-19 pandemics** 431  
*Jerusa Fumagalli de Salles, Gabriella Koltermann, & Érica Prates Krás Borges*

<b>Analysis, modeling and control of power electronic systems and their simulation as an educational support</b>	<b>434</b>
<i>Juraj Šimko, Michal Praženica, &amp; Roman Koňarik</i>	
<b>Motivation of second- and sixth-grade students regarding individual and collaborative writing</b>	<b>437</b>
<i>Joane Deneault, Jessy Marin, &amp; Natalie Lavoie</i>	
<b>Contribution of information design for the autonomy of the population in a health context</b>	<b>440</b>
<i>Mónica Santos, &amp; Suzana Dias</i>	
<b>Hieroglyph and the foundation of children's teaching - Cosmic language -- Cosmic language = World general type universal language, hieroglyph encoding language for spell characters</b>	<b>443</b>
<i>Ma Wen Bin, Ma Jin Sheng, Ma Ran, &amp; Dong Yu Ping</i>	
<b>Implementing collaborative and differentiated instruction in middle school</b>	<b>446</b>
<i>France Dubé, Maryse Gareau, &amp; Sophie Lanoix</i>	
<b>Courses in academic teaching - An example from Slovakia</b>	<b>449</b>
<i>Tímea Šeben Zai'ková</i>	
<b>Innovative teaching of philosophy through drama: Socrates</b>	<b>452</b>
<i>Anna Lazou, &amp; Giannis Spyridis</i>	

## VIRTUAL PRESENTATIONS

---

### Teachers and Students

- The effect of integrating GA's into the curriculum on the design of a new 3-year mechanical engineering degree at DUT** 457  
*Mark Walker, Bruce Graham, & Shoreek Sheoratan*
- Music teaching and learning community service program – Teaching music to elders** 462  
*Pui Kei Lau*
- Pre-service science teachers' emotional profile designing IBSE activities: The gender perspective** 467  
*Cristina García-Ruiz, Jorge Luque-Jiménez, Teresa Lupión-Cobos, & Ángel Blanco-López*
- Significance and attitude of teaching applied mechanics calculations in civil technology: Students analogy** 472  
*Khojane Geoffrey Mokhothu*
- Assessment of the sub-competences of entrepreneurial competence in the basic school** 475  
*Küllli Hiimäe-Metsar, Krista Uibu, & Mervi Raudsaar*
- Considering teachers' identity, well-being, and professional development in Croatian cultural context** 480  
*Sanja Tatalović Vorkapić, Dunja Anđić, Renata Čepić, Sanja Skočić Mihić, & Aleksandra Smolić Batelić*
- The amphibious life of South African schools departmental heads: A straddle between leading and teaching** 485  
*Tshepo T. Tapala*
- Primary school teachers' perceptions of their self-directed learning skills and use of practices that promote self-regulated learning** 489  
*Bernadette Geduld, & Lindie Ehlers*
- Mixed reality in secondary education** 494  
*Verónica Marín, Ignacio González, Belen Quintero, & Eloísa Reche*
- Response to Intervention (RTI) program for the development of executive functions in first-year elementary school** 499  
*Grazielle Kerges-Alcantara, & Simone Aparecida Capellini*
- An evaluation of flipped classroom pedagogy in natural sciences learning using mobile virtual reality** 504  
*Mafor Penn*
- Assumptions about learning that underpin teachers' feedback practices** 509  
*Verónica Yáñez-Monje*
- Performing small project assessment in civil technology through heutagogy approach teaching and learning process** 514  
*Khojane Geoffrey Mokhothu*
- A strength-based mentorship programme for novice teachers illuminated by acquired strengths** 518  
*Shaun Peens*



<b>Multilingual learners' perceptions of the role of English and scientific language on natural sciences learning</b>	<b>523</b>
<i>Nishana Wilson, &amp; Lydia Mavuru</i>	
<b>Factors influencing the comprehension of non-literary texts by Czech pupils of secondary technical schools</b>	<b>528</b>
<i>Dana Vicherková, &amp; Nela Nováková</i>	
<b>Investigating the implementation and administering of assessment policy at Technical Vocational Education and Training (TVET) college in the Free State</b>	<b>533</b>
<i>Paseka Ndleleni, Paseka Mollo, &amp; Khojane Mokhothu</i>	
<b>The ugly side of teaching practice: Teachers' perceptions of student teachers' immoral and unprofessional behaviour during teaching practice</b>	<b>538</b>
<i>Jaysveree M. Louw</i>	
<b>Emotions linked to certainty-based self-assessment: A multidiscipline experience</b>	<b>543</b>
<i>Ana Remesal, María José Corral, Iria SanMiguel, Patricio García-Minguez, Tomas Macsotay, &amp; Ernesto Suárez</i>	
<b>What we talk about when we talk about innovation and vocational education? A scientometric analysis of the research framework</b>	<b>548</b>
<i>Felipe Guevara-Pezoa</i>	
<b>Song-leading: An overview on contrasting didactics</b>	<b>553</b>
<i>Gabriella Cavasino</i>	
<b>Abeplana: As how TI teach with videogames in kindergarten class</b>	<b>558</b>
<i>Verónica Marín, Begoña E. Sampedro, Ana B. López, &amp; Esther Vega</i>	
<b>Covid-19: rethinking the skills required of 21st Century educators</b>	<b>563</b>
<i>Jan Pawlowski, Dimitra Pappa, Kati Clements, &amp; Sofoklis Sotiriou</i>	
 <b><u>Teaching and Learning</u></b>	
<b>Representations of consumption at the Chocolate Factory. A creative writing teaching proposal on positive consumerism</b>	<b>568</b>
<i>Christina Kalaitzi</i>	
<b>Digital creativity abilities for designing sustainable and fair futures. Reflecting on the results from the DM Learning Lab Madeira</b>	<b>573</b>
<i>Valentina Vezzani</i>	
<b>Life sciences teachers' planning of lessons for formative assessment in inquiry-based teaching</b>	<b>578</b>
<i>Thandiwe Dlamini, &amp; Umesh Ramnarain</i>	
<b>A proposal for teaching and learning in primary school post-COVID-19</b>	<b>583</b>
<i>Carlos Alberto Ferreira, &amp; Ana Maria Bastos</i>	
<b>Game for didactic innovation. <i>Classcraft</i> in Italian secondary school</b>	<b>588</b>
<i>Andrea Brambilla, Francesca Antonacci, &amp; Stephen E. Moore</i>	
<b>Between expectations and generative uncertainties: An action study in higher secondary school</b>	<b>593</b>
<i>Aet Raudsep</i>	

<b>Transitional objects in early childhood: What parents' think about their importance?</b> <i>Sanja Tatalović Vorkapić</i>	<b>598</b>
<b>Development of critical thinking - Wishful thinking or reality in elementary schools</b> <i>Dana Hanesová, &amp; Katarína Vančtková</i>	<b>603</b>
<b>English in Algerian primary schools: Prospects and realities</b> <i>Radia Guerza, &amp; Mohammed-Salah Nedjai</i>	<b>608</b>
<b>Language challenges grade 11 learners encounter in life sciences instructional materials and assessments</b> <i>Godfrey Zwane, &amp; Lydia Mavuru</i>	<b>613</b>
<b>The power of higher education curriculum in shaping character and perception: A social change dimension</b> <i>Pulane Adelaide Molomo</i>	<b>618</b>
<b>Uncovering a presumptive learning progression on electricity and magnetism: A case study of meaningful science teaching and learning in South African high schools</b> <i>Sakyiwaa Boateng</i>	<b>623</b>
<b>Reviewing the literature on the interplay of creativity and critical thinking in education</b> <i>Maria Gkouzioni, Eirini Kleidara, Zafiria-Sabrina Shehu, Panagiota Koulouri, &amp; Lefkothea-Vasiliki Andreou</i>	<b>628</b>
<b>“That’s just something I was playing with.” Math talk and avoidance in an art museum</b> <i>Nuria Jaumot-Pascual</i>	<b>633</b>
<b>Written reflection as a “movement” in a quality service-learning process</b> <i>Federica Martino</i>	<b>638</b>
<b>Dramatic play as a developmental means of preschool children's motor creativity</b> <i>Aspasia Panagiotaki, Kalliopi Trouli, &amp; Michalis Linardakis</i>	<b>642</b>
<b>Implementation of Matlab guide templates for chemical engineering students to solve complex material and energy balances</b> <i>Ivan Dominguez-Candela, Salvador Cayetano Cardona, Maria Fernanda López-Pérez, Jaime Lora, &amp; Vicent Fombuena</i>	<b>647</b>
<b>Measuring inquiry abilities of young learners using a performance-based assessment</b> <i>Cinthy Kayser, Mafor Penn, Umesh Ramnarain, &amp; Hsin Kai Wu</i>	<b>652</b>

## WORKSHOPS

---

### **Teachers and Students**

**Teaching and serving students of hidden and apparent diversity: Third Culture Kids and Cross Culture Kids** 659

*Patricia A. Stokke*

**GeoQuest TROPOMAG digital adventure path: When science is a game** 662

*Giovanna Lucia Piangiamore, Sabina Maraffi, Francesco Maria Sacerdoti, & TROPOMAG WP3 Team*

### **Teaching and Learning**

**The application of critical thinking in literature education** 665

*Geppo de Jong*

**Critical Reflexivity as a tool for addressing inequities in education and beyond** 668

*Eden Rivera, Langan Courtney, & Heidi Bloom*

---

### **AUTHOR INDEX**

671



# **ORAL PRESENTATIONS**



## ARITHMETIC AND ALGEBRAIC KNOWLEDGE IN STUDENT LEARNING OF CONCEPTS

**Natalia Karlsson<sup>1</sup>, & Wiggo Kilborn<sup>2</sup>**

<sup>1</sup>*Department of Pedagogy and Didactics, Södertörn University, Huddinge, Stockholm (Sweden)*

<sup>2</sup>*Faculty of Education, University of Gothenburg, Gothenburg (Sweden)*

### Abstract

Current research deals with students' arithmetical and algebraical knowledge, with a focus on a conceptual connection, and the relationship between two aspects of knowledge. The content in question is rational numbers, rational equations, and problem-solving in terms of proportion and ratio in grades 7, 8 and 9. The method contains three tests given to 400 students in grades 7–9. Tools for analysis were theories of generalizing arithmetic into algebra (Kieran, 2004), and the relationship between arithmetic and algebra in a conceptual context (Kaput, 2008).

Current research shows that student knowledge of algebra and arithmetic often has a limited conceptual connection, and a weak relationship. Their knowledge of arithmetic operations and solving rational equations used to be just procedural, and reliant on formulas learnt in a procedural way, and often mixed up. The study also shows that student procedural strategies for finding formulas suitable for solving the equations, as well as carrying out the corresponding calculations, were often insufficient.

The study investigates shortcomings in students' conceptualization of arithmetic operations with rational numbers, and how to apply them to solving rational equations. One reason for this, is lack of continuity in instruction and learning.

**Keywords:** *Rational numbers and algebra, conceptual knowledge, students' arithmetic and algebraic knowledge.*

---

### 1. Introduction

An important element of teacher training is that student teachers develop algebraic reasoning ability, based on generalizing mathematical ideas, and linked to algebraic concepts (Blanton & Kaput, 2005). This applies not least to the concepts constituting the basis of modern algebra and conceptual relationships between algebra, and the generalization of arithmetic, algebra and patterns, algebra and mathematical models, as well as the meaning of algebraic symbols (Kaput, 2008).

The generalization of algebraic concepts and the ability to create meaning from symbols is a long-term process, linked to the expansion of student arithmetic knowledge (Kieran, 2007). Algebraic reasoning is also important for conceptualizing algebra and using it to expand mathematical knowledge into abstract algebraic knowledge. According to Mason (2008), generalization of algebraic patterns calls for conceptual based knowledge, and the ability to analyze arithmetic situations. This means that student learning of algebra, related to earlier experience of learning and conceptual knowledge, plays a crucial role in operating with rational numbers and solving rational equations (Hackenberg & Lee, 2015). A prerequisite for this is that teachers can take a perspective on student learning, such that the continuity in, and expansion of, algebra in student learning includes conceptual relationships between different number areas from natural numbers to real numbers. This means, among other things, that the students understand conceptual relationships previously used for natural numbers, in a way that can be generalized to negative, rational and real numbers, even if the operations themselves must be modified. At the same time, it is important that students perceive subtraction as the inverse operation of addition, and division as the inverse operation of multiplication. To help students make such generalizations, the teacher is required to have sufficient knowledge of algebra, to understand how an extension of arithmetic works in a conceptual sense, before they start teaching that content (Kieran, 2004). It also involves how students can learn algebra by working informally with the four rules of arithmetic methods in grades 1-3 and 4-6, but in such a way that they will later be able to apply this to whole numbers, rational numbers and real numbers. To understand these generalization processes, students need pre-knowledge about characteristics of rational numbers before they apply rational numbers in problem solving.

## 2. Literature view

### 2.1. Student pre-knowledge

Arithmetics taught during early school years is often based on preliminary, more perceptible concepts, and it is important that these preliminary arithmetic concepts are gradually developable into correct mathematical concepts. This is often carried out with metaphors or by using different representations, for example, pictures. However, according to Kinard and Kozulin (2008), the aim of all representations is abstraction, student verbal understanding of arithmetical concepts and their crucial properties.

Learning of rational numbers is a matter of conceptual meaning (Ni & Zhou, 2005; Gözde & Dilek, 2017) from multiplication to fractions and more, a process that successively presupposes adequate prerequisite knowledge of algebra. According to Vygotsky (1986), mathematics is a social construct that implies an ability for abstract thinking. For that reason, students are not able to learn mathematics without support from their teacher.

Student understanding of rational numbers as arithmetical concepts assumes an ability to think in terms of algebraic abstracts. For students to assimilate the abstract concept of fractions, there is often a need for some kind of representation, a variation of tasks and problem-solving. Its aim is to facilitate a verbalization of crucial properties. However, as Ohlsson (1988) emphasizes, fraction is often a “bewildering array”, and it is important for a student to know which property of rational numbers is currently represented. For this reason, it is important for students to have suitable prerequisite arithmetic knowledge (Zazkis & Liljedahl, 2002; Kieran, 2018; Kieran & Martínez-Hernández, 2022). Moreover, when students are introduced to a new phenomenon, they are often more inclined to assimilate it according to their current understanding, than to accommodate and develop a new, deeper understanding.

### 2.2. Conceptual continuity in instruction and learning

Mathematics is abstract and has left the specific origin of the problems. This, in turn, is a condition for being general i.e., applicable in a variety of situations. An important follow-up question is what is meant by abstract and abstraction. Skemp (1987) explains the meaning of the terms, linked to school mathematics as follows:

Abstracting is an activity by which we become aware of similarities among our experiences.

Abstraction is some kind of lasting change, the result of abstracting, which enables us to recognize new experiences as having similarities of already formed classes. (p. 21).

That mathematics is abstract and general does not only apply to the academic subject of mathematics, but also to school mathematics.  $2+1=3$  is an abstraction that is general in the sense that it is applicable no matter what objects you add, and not only objects, but also minutes, ideas, age, etc. It is important to pay attention to this in student learning, as well in formal studies in mathematics, and continuous reflection on relationships between arithmetic and algebra, as how the complex nature of the content within arithmetic can be expressed as algebra. This will create conditions for continuity in student learning, and provide the pre-knowledge needed for understanding algebra (Carragher, Schliemann, Brizuela, & Earnest, 2006).

A central aspect of mathematics is the field of algebra. The common student perception of algebra is that it is about complicated “counting with letters”. In fact, basic algebra deals with the conditions for the arithmetic operations that students are already learning informally in the first years of school, and how later they can use it to derive and operate with negative numbers and numbers in fractional form. The “letters” are only used to describe the fact that something is general. To describe what is meant by an equation of the first degree does not require all such equations to be written down. Using symbols, this can be written as  $ax + b = 0$ , where  $a \neq 0$ . The conceptual relationship between rational numbers and equations is important in student learning of algebraic symbols and abstracting the ideas behind them (Kieran, 2013; Karlsson & Kilborn, 2014).

## 3. Theoretical framework

### 3.1. Generalizing arithmetic into algebra

An important feature of teacher training is that student teachers develop skills in algebraic reasoning based on generalizing mathematical ideas, linked to algebraic concepts (Blanton & Kaput, 2005). This applies not least, to concepts that constitute the basis of modern algebra, and conceptual relationships between algebra and the generalization of arithmetic, algebra and patterns, algebra and mathematical models and the meaning of algebraic symbols (Kaput, 2008). For students to understand symbols and

abstract algebra, they need to generalize algebraic concepts by reasoning with symbols (Kaput, 2008). Students' ability to express themselves using algebra and to make transformations from arithmetic concepts into algebraic concepts, depends on their conceptual knowledge of the relationship between arithmetic and algebraic concepts, and how numbers are transformed into algebraic symbols. For instance, students' conceptual knowledge of rational numbers is key to understanding equations, their construction and their conceptual meaning.

According to Kieran (2004) generalization of algebra requires algebraic activities with a focus on the ability of the student to explain and express their knowledge and understanding. Such activities include several main components: (1) generalization of arithmetic concept; (2) conceptual transformation from arithmetic into algebra; and (3) analyzing and applying in problem solving. Mastering algebra means not only knowing different algebraic expressions and equations, but also understanding conceptual connections between numbers and expressions, and between numbers and equations, as tools in problem solving. This means that mastering algebra not only includes a path from separate algebraic expressions and equations to their generalizations, but also the way back - from generalization to arithmetic.

The transformation of student knowledge from arithmetic to algebra presupposes a fundamental understanding of crucial properties and representations of numbers, and their connection to algebraic expressions and equations. Important in Kieran's view of this is that student mastery of algebra knowledge includes an ability to apply their conceptual knowledge to different problem-solving situations. Such a systematic pattern in student learning can effectively help them understand the conceptual relationship between arithmetic and algebra, and how to use it in problem solving. For example, students' conceptual understanding of rational numbers as equivalence classes. Such as  $\frac{1}{2} = \frac{2}{4} = \frac{2}{4}$  etc., is a conceptual pre-knowledge in understanding an operation such as extension of rational numbers, conceptual understanding of symbols, and the conceptual meaning of equations like  $\frac{x}{2} = \frac{2}{4}$ . This kind of knowledge also means that a student can comprehend and solve such equations using algebraic reasoning, and without using formulas (Carpenter, & Levi, 2000; Karlsson & Kilborn, 2015).

#### 4. The purpose

The purpose of the study was to examine student arithmetic and algebraic knowledge of rational numbers, and their ability to use this in problem solving. The research questions are: (RQ1) How do students interpret and represent rational numbers? (RQ2) How do students handle transitions from rational numbers to symbols and rational equations? and (RQ3) How do students apply this in a problem-solving situation?

#### 5. Methods

##### 5.1. Participants and procedure

The study was design to examine student arithmetic and algebraic knowledge in a conceptual context with especial focus on student perception of rational numbers and their properties, and how to handle this in solving rational equations and problems dealing with proportion and rate. Participants were 400 students in grades 7, 8 and 9, with three teachers A, B and C. In grade 7 two classes participated with teachers A and B, and one class with teacher C. In grade 8 one class participated with teacher A, two classes with teachers B and C. In grade 9 two classes participated with teachers A and C, and one class with teacher B.

The study included a quantitative and a qualitative approach. The instrument consists of three diagnostic tests: DT1, DT2 and DT3. Test DT1 focused on representations of rational numbers and operations with rational numbers, test DT2 focused on algebraic equations like  $\frac{3}{5} = \frac{x}{8}$ , and test DT3 focused on problem solving related to proportion and ratio. Each test consists of 7 tasks of increasing complexity. The tests were designed with two empty spaces, one for calculation and the other for written explanations. The quantitative approach concerned the frequency of correct answers and the qualitative approach concerned the quality of student answers, as well as a conceptions and misconceptions.

#### 6. Data analysis

The main purpose of the study was to answer research questions RQ1, RQ2 and RQ3 about student conceptual understanding of rational number and rational equations, and their ability to use this in problem solving. The theoretical model was based on Kaput (2008) and Kieran (2004), and was used to report the results of the diagnostic tests in a conceptual meaning. Moreover, the results were interpreted and explained in terms of written recommendation intended to develop the skills of the teachers involved and their colleagues.



## 7. Results and discussion

Conceptualization of arithmetic as rational numbers in student learning and its transformation into algebra has been recognized as a crucial and difficult issue in student mathematical learning. This study illustrates that students' arithmetic pre-knowledge (Zazkis & Liljedahl, 2002; Kieran & Martínez-Hernández, 2022), and their pre-knowledge of rational numbers (Ni & Zhou, 2005; Gözde & Dilek, 2017) play an important role for in student achievement of algebraic equations and problem solving, and more generally in student learning of the abstract nature of algebra, expressed in symbols (Carraher et al., 2006).

The test data shows a low development from grade 7 to 9 of student ability to handle fractions, rational equations, and algebraic reasoning. In grade 9, almost all students relied on formulas, for example, to solve simple tasks such as  $2 \cdot \frac{3}{7}$ . Moreover, 40% of the students in grade 9 failed. The low ability in terms of algebraic reasoning also became clear in problem solving. Most students just tried to apply a formula that they did not know how to handle. One example is: “Anna can cycle 80 kilometers in 3 hours. How long does it take Anna to cycle 50 kilometers at the same speed?” Only 26% of the students in grade 9 were able to solve it. Their solutions and comments on the tests show that most of the students were unable to reason, to choose a correct formula, or to carry out the calculation. When comparing the solutions from grade 7 to those of grade 9, it became obvious that there had been very little development of knowledge from grade 7 to 9. In grade 7, the students already used formulas like in grade 9, but most of them were unable to handle them. The problem is that such procedural knowledge is an insufficient ground for developing algebraic reasoning (Kieran, 2004).

One question in test DT2 was “For what values of  $x$  and  $y$  are  $\frac{5}{6} = \frac{x}{y}$ ”. The response rate was 2% in grade 7, 7% in grade 8, and 3% in grade 9, who answered  $x = 10$ , and  $y = 12$ . This confirms a lack of both reasoning ability and conceptual understanding of fractions (Kaput, 2008). It also shows student problems in understanding the important property of fractions as equivalence classes, a gateway to understanding and solving the current rational equations.

## 8. Conclusions

The study shows student conceptual knowledge of rational numbers, how they handled rational equations, and use of fractions and equations in problem-solving. One outcome is that the transition from arithmetic to algebra is a difficult process and impossible to carry through with only procedural knowledge. The theoretical frameworks of Kieran's (2004) and Kaput's (2008) visualize fundamental limitations in student solutions for equation solution, and their dependence on conceptual knowledge. More specifically, generalization of algebra cannot take place without generalization of arithmetical concepts (rational numbers). However, conceptual knowledge of rational numbers implies student ability to carry through solutions for equations through reflection and reasoning, even without the use of formulas.

## References

- Blanton, M., L., & Kaput, J. J. (2005). Characterizing a classroom practice that promotes algebraic reasoning. *Journal for Research in Mathematics Education*, 36(5), 412–446.
- Carraher, D. W., Schliemann, A. D., Brizuela, B. M., & Earnest, D. (2006). Arithmetic and algebra in early mathematics education. *Journal for Research in Mathematics Education*, 37(2), 87–115.
- Carpenter, T. P., & Levi, L. (2000). *Developing conceptions of algebraic reasoning in the primary grades. (Research Report 143)*. Wisconsin University: National Center for Improving Student Learning and Achievement in Mathematics and Science. Retrieved from <https://files.eric.ed.gov/fulltext/ED470471.pdf>
- Gözde, A., & Dilek, T. (2017). An analysis of middle school mathematics textbooks from the perspective of fostering algebraic thinking through generalization. *Educational Sciences: Theory & Practice*, 17(6), 2001–2030. <https://doi.org/10.12738/estp.2017.6.0506>
- Hackenberg, A. J. & Lee, M. E. (2015). Relationships between students' fractional knowledge and equation writing. *Journal for Research in Mathematics Education*, 46(2), 196–243.
- Kaput, J. J. (2008). What is algebra? What is algebraic reasoning? In J. J. Kaput, D. W. Carraher, & M. L., & Blanton, M.L. (Eds.), *Algebra in the Early Grades* (pp. 5–17). New York, NY: Lawrence Erlbaum Associates. <https://doi.org/10.4324/9781315097435-2>

- Karlsson, N., & Kilborn, W. (2014). *Grundläggande algebra, funktioner, sannolikhetslära och statistik*. Lund: Studentlitteratur, Sweden.
- Karlsson, N., & Kilborn, W. (2015). *Matematikdidaktik i praktiken: Att undervisa i årskurs 1–6*. Malmö: Gleerups AB, Sweden.
- Kieran, C. (2004). Algebraic thinking in the early years. What is it? *The Mathematics Educator*, 8(1), 139–151. Retrieved from <https://www.researchgate.net/publication/228526202>
- Kieran, C. (2007) Learning and teaching algebra at the middle school through college levels: Building meaning for symbols and their manipulation. In: F. K. Lester (Eds.), *Second Handbook of Research on Mathematics Teaching and Learning* (pp. 707–762). Greenwich, CT: Information Age Publishing.
- Kieran, C. (2013). The false dichotomy in mathematics education between conceptual understanding and procedural skills: An example from algebra. In K. Leatham (Eds.), *Vital directions in mathematics education research* (pp. 153–171). New York: Springer.
- Kieran, C. (2018). Seeking, using, and expressing structure in numbers and numerical operations: A fundamental path to developing early algebraic thinking. In C. Kieran (Eds.), *Teaching and learning algebraic thinking with 5- to 12-year-olds. The global evolution of an emerging field of research and practice* (pp. 79–105). New York, NY: Springer.
- Kieran, C., & Martínez-Hernández, C. (2022). Coordinating invisible and visible sameness within equivalence transformations of numerical equalities by 10- to 12-year-olds in their movement from computational to structural approaches. *ZDM Mathematics Education*. 54, 1215–1227. <https://doi.org/10.1007/s11858-022-01355-5>
- Kinard, J. & Kozulin, A. (2008). *Rigorous mathematical thinking. Conceptual formation in the mathematical classroom*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511814655>
- Mason, J. (2008). Making use of children’s power to produce algebraic thinking. In J. Kaput, D. Carraher, & M. Blanton (Eds.), *Algebra in the Early Grades* (pp. 57–94). New York, NY: Lawrence Erlbaum Associates. <https://doi.org/10.4324/9781315097435-4>
- Ni, Y., & Zhou, Y.-D. (2005). Teaching and learning fraction and rational Numbers: The origins and implications of whole number bias. *Educational Psychologist*, 40(1), 27–52. [https://doi.org/10.1207/s15326985ep4001\\_3](https://doi.org/10.1207/s15326985ep4001_3)
- Ohlsson, S., (1988). Mathematical Meaning and Application Meaning in the Semantics of Fractions and Related Concepts. In J. Hiebert and M. Behr (Eds.), *Research Agenda for Mathematics Education: Number Concepts and Operations in the Middle Grades* (pp. 55–92). Virginia: National Council of Teachers of Mathematics. Lawrence Erlbaum Associates.
- Skemp, R. (1987). *The Psychology of Learning Mathematics*. New York, NY: Routledge. <https://doi.org/10.4324/9780203396391>
- Ralston, N. C. (2013). *The development and validation of a diagnostic assessment of algebraic thinking skills for students in the elementary grades (UMI No. 3588844)* (Doctoral dissertation), University of Washington.
- van der Waerden, B.L. (1971). *Algebra*. New York: Springer Verlag.
- Vygotsky, L. S. (1986). *Thought and language*. Cambridge, MA: MIT Press.
- Watanabe, T. (2008). Algebra in elementary school: A Japanese perspective. In C. Greenes (Eds.), *Algebra and Algebraic Thinking in School Math: 70th Yearbook* (pp. 183–194). Reston, VA: NCTM
- Zazkis, R. & Liljedahl, P. (2002). Arithmetic sequence as a bridge among conceptual fields. *Canadian Journal of Science, Mathematics and Technology Education*, 2(1). 91–118.

## TEACHERS AS STUDENTS: DUALITY AS PERCEIVED BY TEACHERS AND ASPECTS OF SELF-EFFICACY IN AN ONLINE ENVIRONMENT

Michal Nachshon<sup>1</sup>, & Amira Rom<sup>2</sup>

<sup>1</sup>Center of Stem Education, Oranim, Academic College of Education (Israel)

<sup>2</sup>Education and Psychology Department, the Open University of Israel (Israel)

### Abstract

The success of online learning processes is linked to our ability to create strong motivation among teachers taking continuing education classes and teachers in their classrooms. Creating positive feelings and motivation to invest efforts in teaching and learning actions in teachers is depends on fostering teaching practices in areas related to the sense of belonging and feeling secure, self-efficacy and autonomy.

The aim of this study was to identify how teachers perceive their abilities in online environment in different roles: as teachers and as Students

The research was conducted among 48 teachers who participated in continuing education courses given online during the COVID-19 period. The research data were gathered by analyzing validated questionnaires. This research uses mixed methods. We conducted a quantitative analysis that included t-test. Distributions were checked and participants' answers as teachers and as students were compared.

The quantitative analysis shows that participants see themselves differently when answering as teachers and as students as far as related to the potential of an online environment and their ability to cope with it. By the qualitative findings we can see that personal experience positions participants' answers as teachers and as students in different places.

Some of the findings show that the ability to manage a class, promote students' involvement through the using of teaching practices in an online environment and with the appropriate pedagogy are the factors that reflect the degree of the teacher's self-efficacy and lead to constructive thinking that encourages teachers to develop understanding and performance promoting teaching practices.

**Keywords:** *Self-Efficacy, mixed methods, online environment, teacher functioning.*

---

### 1. Introduction

Teachers who have a strong sense of self-efficacy are open to experimenting, innovations and opportunities in nonformal teaching. As well, they are more likely to persevere longer when trying out new teaching methods in the classroom. In contrast, teachers with a low sense of self-efficacy will avoid adopting new ideas, new perceptions, and new ways of teaching. Self-efficacy influences the individual's considerations about how to behave, whether to handle a task facing them, how much effort to invest in it, and whether they believe they will succeed (Bandura,1997). Teachers who have a higher sense of self-efficacy are more prepared to adopt nonformal learning-related changes, innovations and opportunities in their work and they are more willing to try new work methods. They feel more confident about their teaching ability and perform more effectively in class. In contrast, teachers who have a low sense of self-efficacy will avoid adopting new ideas, viewpoints, and teaching methods (Kass,2012).

#### Characteristics of an online environment

According to the SAMR (substitution, augmentation, modification and redefinition) model (Puentedura, 2014), there are four levels of pedagogic change that result from the integration of digital technology in teaching:

- Substitution – the most basic level, in which technology does not give any added value and is used for performing a task that could have been performed without the technology.
- Augmentation – a higher level, yet the influence of technology on pedagogy is still not felt. The technology is used to broaden what exists, with the emphasis on functional improvement of a pedagogical task.

- Modification – a significant change. This level stresses the pedagogical change. The technology is not being used only as a tool that optimizes task functionality but also enables change and redesign of tasks and learning processes.
- Redefinition – the technology enables creation of new tasks, which previously could not have been performed as part of learning processes. Development of tasks in which pedagogy is redefined enables both the student and the teacher to experience a process of inquiry, given that the teacher who is also developing the task must take a great deal of factors into consideration when designing the learning process in terms of the level of change in online learning – in order to make it meet the learning objectives.

#### Teachers' perception

Teachers' internal beliefs play an important role in how they will use technology in their classrooms and guide their willingness to adopt changes in teaching methods.

Researchers believe that innovative technology may indeed improve teaching and learning processes, but only teachers who are “agents of change” can be the ones who realize their latent potential. To do so requires linking teachers' educational beliefs and perceptions and the way they use technology in teaching and learning (Ertmer & Ottenbreit-Leftwich, 2010).

Some studies looked at the link between teachers' technological pedagogical content knowledge (TPCK) and their view of school as a learning organization versus their opinion about the change process when assimilating new technology in school. Those studies found that the process of introducing changes in the teaching process and their implementation in school depends, to a very great degree, on the abilities and beliefs of the teacher operating as a professional pedagogical factor advancing the change in the educational system (Halverson & Smith, 2010). Three main changes in teacher functioning in an online environment were noted (Chief Scientist Office, 2020). The teacher has become a facilitator and an active partner, a designer of the digital learning environment and a digitally literate teacher. To fulfil these new functions, the teacher must promote and base their knowledge and positive attitudes on online learning during their training and professional development. Taking the relevant continuing education courses, through the learning process, the teachers identified the potential for implementation of the tools that emerged from their studies. The teachers' expectations from the professional development courses were that by taking them, they would get tools to implement what they were learning.

So, the aim of this study was to identify how teachers perceive their abilities in online environment in different roles: as teachers and as Students

## **2. Research question**

What are the participants' perceptions as teachers and as students vis-à-vis teaching- learning processes in an online environment?

## **3. Methodology**

This research uses mixed methods. We conducted a quantitative analysis that included t-test. Distributions were checked and participants' answers as teachers and as students were compared. The research was conducted among 48 Jewish and Arabic teachers who participated in two continuing education courses given online during the COVID-19 early period.

The research data were gathered by analyzing validated questionnaires distributed to participants at the end of the courses. The questionnaires included 11 statements, six statements relating to the perception of teaching-online processes and five statements relating to the perception of learning-online processes. Each participant was asked to express their agreement with 11 statements as both a teacher and a student, using a Likert-like scale with four levels. A reliability of the internal consistency (Cronbach's alpha) was conducted for the 11 statements. Focusing on participants' views as students,  $\alpha=0.706$  and as teachers,  $\alpha=0.673$ . A Pearson correlation was conducted between metrics to check the strength of the relationship and a clear moderate relationship was found between the metrics (0.463,  $p<0.001$ ).

## **4. Results**

According to Table 1, we can identify the findings related to participants' views on teaching processes on learning processes in an online environment.

When checking the finding using a t-test, it is clear that participants see themselves differently when answering as teachers and as students as far as related to the potential of an online environment and their ability to cope with it.

No significant differences were found between the Jewish and Arabic populations.

Table 1. *t*-test – comparison of the participants’ perceptions as teachers to their perceptions as students vis-à-vis the contribution of online learning.

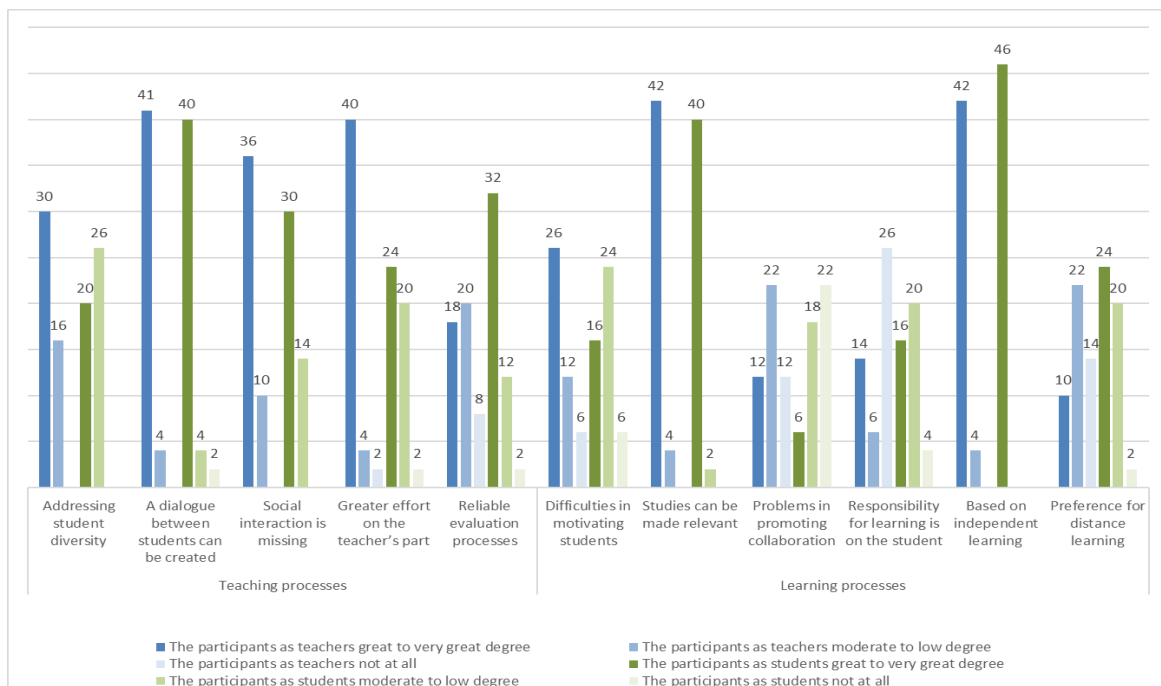
		Students (N=47)		Teachers (N=48)		t-test
		M	SD	M	SD	
<b>Teachers’ perceptions of the learning processes</b>						
1a.	Difficulty in motivating students	2.11	.849	2.54	.808	-3.078**
2a.	Can make the studies relevant for students	3.36	.673	3.15	.659	(1.945*)
3a.	Difficulties in promoting collaboration among students	1.64	.845	2.13	.924	-3.163**
4a.	Based on the student’s self-learning skills	3.34	.562	3.17	.601	2.069*
5a.	Responsibility for learning must be the student’s only	2.24	.857	2.00	.879	(1.914*)
6a.	Preference for online learning	3.06	.861	2.19	.924	6.423***
<b>Teachers’ perceptions of the teaching processes</b>						
1b.	The processes accommodate student diversity	2.70	.825	2.74	.642	.621
2b.	A dialogue among students can be created	3.47	.747	3.34	.731	1.353
3b.	Lack of social interaction among students	2.72	.902	3.15	.884	-2.656**
4b.	It requires more effort on the part of teachers	2.40	.970	3.40	.825	-6.2113***
5b.	Evaluation methods are reliable	2.85	.884	2.32	.862	3.314**

\*(p<0.06), \*p<0.05, \*\*p<0.05, \*\*\*p<0.001

A similar conclusion can be drawn from Figure 1, which presents an analysis of participants’ answers as teachers alongside their answers as students to the same statements regarding an online environment.

To summarize the comparison, we can see a gap between participants’ answers as teachers and as students. Personal experience positions participants’ answers as teachers and as students in different places.

Figure 1. Distribution of participants' perceptions of the online environment as teachers and as students (N=48).



## 5. Conclusions

The importance of familiarity and experience with assorted digital environments, is that the teacher can choose the appropriate technology for the planned pedagogy, developing the ability to transfer knowledge from one field to another, teamwork, and collaboration, encouraging the creation of shared knowledge bases, which can be used in practice and are appropriate for online learning.

Regarding the SAMR model (Puentedura, 2014), we see that most of the participants answering as teachers have not reached more than the second stage (augmentation). In other words, a significant change, as laid out in the model's third stage (modification), is required. The technology is not only a tool that optimizes the task functionality; it offers an opportunity for change and redesign of tasks and ways of learning. We also recognize the need to develop and promote the skills needed for online teaching and learning such as digital literacy and ICT literacy, acquaintance with and command of digital literacy skills that deal with cognitive and socioemotional processes for activities in a digital environment such as the ability to locate information, evaluate it and use it intelligently.

The gap between the participants' responses as teachers and as students indicates the disparity between their perceptions of their self-efficacy. As students, it is easier for them to work in an online environment. Accordingly, the more positive personal experience they gain with a range of online continuing education courses, the more their belief in their ability will increase, and the chances for developing feelings of self-efficacy and realizing their abilities in different teaching situations in the classroom will be higher, a process that will lead to significantly more academic application.

The fact that the teachers have undergone the process of online learning and even participated in it in the best possible way is still not enough to overcome the concerns about coping in the field. The good modeling that they had in the continuing education courses does not ensure their success in implementing it with their students. It may be that here too the lack of self-efficacy is being expressed.

Accordingly, it is important to find ways to empower social interaction in an online environment using the correct tools. Appropriate physical conditions such as a stable internet connection, readily available technical support, personal mentoring of teachers, and teachers' up-to-date knowledge about teaching in an online environment will enable fostering of collaboration, dialogue and social interaction among students that will nurture students' motivation.

Nonetheless, despite the possible enjoyment felt at times by teachers and students in online courses, many students report the lack of face-to-face encounters. An additional problem in online courses relates to the fact that some students do not feel comfortable in such courses in terms of participating in online discussions and creating relationships with the rest of the community (Stodel et al., 2006). The main conclusion from this is that self-efficacy for online learning must be created. Students must be prepared through preparatory workshops in advance of online learning, to help them adjust to participating in online discussions and online teamwork.

## References

- Bandura, A. (1997). *Self-efficacy: The exercise of control* (pp. 212–258; 422–425). New York: Freeman.
- Chief Scientist Office (2020). *Working group on pedagogic aspects of online learning*. Tel Aviv University. Jerusalem: Ministry of Education. (in Hebrew)
- Ertmer, P. A., & Ottenbreit-Leftwich, A. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, 42(3), 255–284. <https://doi.org/10.1080/15391523.2010.10782551>
- Halverson, R., & Smith, A. (2010). How new technologies have (and have not) changed teaching and learning in school. *Journal of Computing in Teacher Education*, 26(2), 16–49.
- Kass, E. (2012). *Don't be afraid of fear*- Development of a personal and professional sense of self-efficacy. Tel Aviv: MOFET Institute. (in Hebrew).
- Puentedura, R. (2014). *SAMR: A Contextualized Introduction*. Retrieved from <http://hippasus.com/rrpweblog/archives/2014/01/15/SAMRABriefContextualizedIntroduction.pdf>
- Stodel, E. J., Thompson, T. L., & MacDonald, C. J. (2006) Learners' perspectives on what is missing from online learning: Interpretations through the community of inquiry framework. *International Review of Research in Open and Distance Learning*, 7(3). <https://doi.org/10.19173/irrodl.v7i3.325>

# **THE NATURE OF METACOGNITIVE LANGUAGE AND NETWORKING: DEVELOPMENT OF THE THEORY OF METACOGNITIVE LOCALE**

**Divan Jagals**

*North-West University (South Africa)*

## **Abstract**

Theoretical developments in education research have established, almost parallel, two strands of theories: theories of networks (e.g., gestalt theory, social network analysis and micro-triad analysis) which explain social interaction among students and theories about meta-cognitive function (e.g. metamemory, metacognition and metarepresentational) which explain the inner workings of the mind. This split between theories (one form focusing on networks and the other on meta-cognition) leaves little room for advancing our understanding of metacognition as a social construct since no theory exists for explaining the relationship between networks and metacognition. In this paper, the author explore four propositions derived from metacognition research to propose a local theory. The four propositions are: (1) metacognitive knowledge, (2) regulation, (3) metacognitive language and (4) networking as constructs of this theory. In particular, the theory of metacognitive locale explains the nature of metacognitive language and metacognitive networks as contextualized in a mathematics education methodology course. Video recordings of lesson study experiences of two groups of final year students were analyzed through social network analysis to visualize their social interaction, and coded inductively to identify specific phrases through which they express their thinking. The results show constructs of metacognition, metacognitive language and metacognitive networking emerge on a social, interpersonal and social-metacognitive stratum which brings the two strands of theories together, thereby narrowing theoretical divide.

**Keywords:** *Metacognitive locale, metacognitive networks, metacognitive language, local theory, social-metacognition.*

---

## **1. Theoretical orientation**

A great deal of research has been done on metacognition (Lai, 2011), making a review of its literature subjective, however far less has been done on metacognitive language and even fewer (to my knowledge only Pasquali, Timmermans & Cleeremans, 2010) on metacognitive networks. For this reason, major sources of metacognition research were drawn on and conceptualised here in terms of four propositions about (1) metacognitive knowledge, (2) metacognitive regulation, (3) metacognitive language and (4) metacognitive networks. The purpose of the propositions is not only to reduce the amount of research on metacognition in thematic clusters but also to show propositions 3 and 4 are necessary to understand the social-network nature of metacognition.

## **2. Conceptualising metacognitive locale**

Clarity is needed as to how social network analysis serves as a form of network theory that emphasises the social interactions and communication between group members (represented by nodes) and their relationships (represented as links) with one another, to express their metacognition. Network theory often describes the patterns of these relationships through a network diagram which consists of nodes and links. Such a network view can also represent patterns of metacognitive thinking where the nodes are visualised as the metacognitive domain (e.g. metacognitive knowledge and regulation) and the metacognitive relationships formed between them, either interpersonal or social in nature.

## **3. Empirical investigation**

A qualitative design allowed insight into the nature of metacognitive language and networking, two novel concepts for understanding the social-network construct of metacognition. To do so, two lesson studies were conducted to explore these concepts and develop a local theory about students teachers' metacognitive locale, a conceptualised theoretical social-network dimension of metacognition. Data were



collected by means of audio-video recordings of a series of lesson study design sessions (for clarification regarding the lesson study sessions please refer to Jagals (2015)).

### 3.1. Sampling of the two lesson study groups

All fourth-year university students who registered for the intermediate and senior-phase mathematics methodology module were invited to take part in the research. Their curriculum content included lesson study as a developmental pedagogical tool through which teachers can collaborate and design lessons together (Rock & Wilson, 2005). The study began by purposively inviting two volunteering groups of students who were instructed to plan, design, present and refine a Mathematics lesson suitable for a Grade 6 class at a nearby primary school. Participants' involvement in the module made them particularly useful as key role players in this research because of their familiarity with lesson study's conduct, which has an underlying social and metacognitive nature. The ethnically diverse group of participants represented both male and female students who spoke Afrikaans, English and/or Setswana as home language.

### 3.2. Data collection and analysis

Participants were encouraged to think aloud and share ideas during a series of four design sessions, mimicking the lesson study phases of Rock and Wilson (2005). Both groups were expected to collaboratively (1) design, (2) present (3) refine and (4) re-present a lesson for Grade 6 Mathematics on the topic of Place Value. The idea of the design sessions was borrowed from the work of Cobb, Jackson, Smith, Sorum and Henrick (2013) and added validity and trustworthiness to the data as these sessions resembled multiple perspectives. The sessions' transcriptions were analysed by following a three-step set of data analysis procedures offered by Jagals and Van der Walt (2016b), and Jagals (2015). In doing so we coded the transcribed conversations of each design session in Atlas.ti, followed by the exporting of the coded data and preparation of the nodes and vertices' columns in Excel. The three set steps of qualitative data analysis procedures by Jagals and Van der Walt (2016b) were used. First, qualitative social network analysis were conducted to determine the nature of the social relationships between participants in the two groups. Second, the transcriptions were coded through in analysis based on a-priori coding for metacognitive networks by Jagals and Van der Walt (2016b). Third, through NodeXL's (a social network analysis add-on for Microsoft Excel) data were filtered to identify interpersonal and social metacognitive language statements (e.g. I think ... or: we feel ...).

## 4. Findings

Since the social-networking character of metacognition, and the metacognitive language used to express this character drives the argument to develop the theory of metacognitive locale, the propositions discussed above provide the structure in terms of which the findings are presented.

### 4.1. Proposition 1 – Metacognition is individually and socially mediated knowledge

Not being able to express their reasoning clearly, and lacking the vocabulary of their thinking about their thinking, participants explained that even though they worked together, they often became frustrated when their ideas were not understood or recognized:

*But we do not understand what each other means. I don't know what they don't know and what someone else is thinking about my idea...we had too many good activities and we do not know how to say that we do not want to use this or that idea...*

Discussing what their lesson plan's outcomes should be seemed to have presented them with a problem, not only for interpreting the curriculum documents, but also to put down in words a clear and explicit lesson plan and to communicate about what they expected from their learners at the end of the lesson:

*We have an outcome, we want them to be able to identify and apply...The outcomes must be smart. It must be specific, measurable, attainable, relevant and traceable...so we have to look at it again...*

The social construct of their metacognition also developed along with metacognitive language.

### 4.2. Proposition 2 - Metacognition is individually and socially regulated

**4.2.1. Metacognitive networks.** Group members later decided to work with each other's ideas, and not necessarily to come up with new ones all the time:

*We are all here, we know what to do. We have to take everyone's ideas into consideration...We started with an idea and talked about it and made a*

*combination of all the ideas. It helped us to understand the concept better... Lesson study is difficult if one student feels separated from another... When we get together we can say, this stuff works great and then we take other ideas and we build on that.*

Group members had realised what their strengths and weaknesses were, and that the nature of their networking was likely to be key to overcome the barriers group members had during the sessions.

#### **4.3. Proposition 3 - Metacognitive processes can be expressed verbally by means of a metacognitive language**

In Group A, one student urged the group in the beginning of the session to expand on their idea for a lesson. He did this by using a mental verb:

*I think we can perhaps begin by expanding what we know.*

This was followed by another student who talked about “we” and used this social language to highlight what they knew and do not know:

*We said in the introduction that we will test their prior knowledge. But how are we going to test their prior knowledge when we are there?*

Her question was almost immediately answered by another student who expressed her metacognitive knowledge through pedagogical language, hinting on her theory of mind:

*We have to look at what level they are on.*

#### **4.4. Proposition 4 - The epistemic context-specific metacognition is a local construct that can be represented as a metacognitive network**

The findings of the four propositions outlined above can be positioned on three cohesive theoretical networks, identified in this study as strata 1, 2 and 3 as an attempt to outline and construct a topology of metacognitive locale.

### **5. Discussion**

Some studies have shown that teachers’ metacognition is not adequate to model metacognitive thinking (Jagals & Van der Walt, 2016a), yet the way in which metacognition is expressed, observed and documented may be an underlying cause for this crisis.

First, metacognition can be regarded as individually and socially mediated knowledge, with the assumption that metacognition consists, in part, of a knowledge domain. Second, metacognition is individually and socially regulated, posing a second domain to its character as a regulation of the knowledge. Third, and this is a somewhat novel understanding, is the assumption that metacognitive processes can be expressed verbally by means of a metacognitive language. The fourth proposition assumes that metacognition is a local construct, meaning it contains context-specific epistemic metacognitive knowledge and regulatory components that can be expressed as a metacognitive network.

Barabasi (2011) explains further that networks exist because of the growth in knowledge, ideas and influence. It seems as if the result of such social interaction in a learning context can produce awareness of the metacognitive knowledge and regulatory domains, as the findings of proposition 1 and 2 show. This individual and socially mediated nature of knowledge and regulation can, however, be expressed through a metacognitive language as posed in proposition 3 and, as a result, shape the metacognitive networks formed in that context as implied in proposition 4. Together, the four propositions with their underlying assumptions suggest there is a typology involved in the architecture of metacognition’s social-network character. For the sake of reference, let’s call the collection of these networks *strata*. Based on the natural flow of information that is exhibited in social interactions, the first strata can represent, theoretically, an abstract view of the social network. Through social interaction participants in this study reflected on their own and each other’s comments during the lesson study design sessions and, in doing so, they expressed through a metacognitive language an individual (e.g. I am...) or social (we are...) metacognition as the findings of proposition 3 show.

Stratum 1 would involve the metacognitive domains of knowledge and regulation that are socially mediated through social interaction. It refers to the social sphere of metacognition and encapsulates propositions 1 and 2. Stratum 2 represents the interpersonal metacognitive networks, expressed through participants’ metacognitive knowledge as claimed in proposition 3. Stratum 3 shows how social interaction as well as impersonal metacognitive networks come together to form a social-network metacognitive dimension of the metacognitive locale.

The findings obtained from exploring these propositions reflect the social-network character of metacognition and are conceptualised in this paper as a theoretical dimension of metacognition. This theory of metacognitive locale explains the interrelated nature of the relationship between the constructs

of metacognitive language and metacognitive networks as represented in the topology of the metacognitive locale. To apply the theory of metacognitive locale across contexts, one should keep in mind that this dimension of metacognition is developed in and is thus suitable for use in the conditions where: theory is to be developed about metacognition, methodological contributions are desired to study metacognition's social-network construct and its development in social contexts.

The theory of the metacognitive locale is therefore contextual and limited by the didactical environment or the theoretical variables (e.g., instructional philosophies) in that environment.

## 6. The way forward and conclusion

To advance the applicability of the theory of metacognitive locale, the following recommendations are proposed for future research. Concept analysis of metacognitive language and metacognitive networks can inform the development and refinement of the theory, particularly in different contexts. The findings of this study can also be interpreted from a structuralist or post-structuralist perspective, focusing mainly on the taxonomy of different possible metacognitive network structures and the metacognitive language used to express them. This will enable teachers to implement a meta-curriculum that promotes the expression of metacognitive thinking as an individual, social and social-network construct. Educationists can also focus on the preparation and delivery of a curriculum that promotes social metacognition to instil a network view on learning. This study was an attempt to show how a social-network understanding of metacognition could develop a new theory that could lead to, at least, two results important for collaborative learning in group settings in general, and the preparation of teachers in particular. The use of metacognitive language in social settings can promote growth in metacognitive awareness of self and others and transcend to a higher level of socially shared metacognition. In doing so, and with some metacognitive reflexivity in mind, this higher-order thinking in social settings can be mapped as, perhaps, a new façade of learning in a cosmopolitan future.

## References

- Akyol, Z. & Garrison, D.R. (2011). Assessing metacognition in an online community of inquiry. *The Internet and Higher Education*, 14(3), 183-190.
- Atwater, M.M., Russell, M. & Butler, M. (2013). *Multicultural science education: Preparing teachers for equity and social justice*: Springer Science & Business Media.
- Ballarin, C. (2014). Locales: A module system for mathematical theories. *Journal of Automated Reasoning*, 52(2), 123-153.
- Barabasi, A. (2011). Introduction and keynote to a networked self. In C. Papacharissi (Ed.), *A networked self* (p 1-10). Routledge Publishers, New York.
- Barrett, L., Henzi, S.P. & Lusseau, D. (2012). Taking sociality seriously: The structure of multi-dimensional social networks as a source of information for individuals. *Philosophical Transactions of the Royal Society: Biological Sciences*, 367(1599), 2108-2118.
- Barzilai, S. & Zohar, A. (2014). Reconsidering personal epistemology as metacognition: A multifaceted approach to the analysis of epistemic thinking. *Educational Psychologist*, 49(1), 13-35.
- Cobb, P., Jackson, K., Smith, T., Sorum, M., & Henrick, E. (2013). Design research with educational systems: Investigating and supporting improvements in the quality of mathematics teaching and learning at scale. *National Society for the Study of Education Yearbook*, 112(2), 320-349.
- Coburn, C. E., Mata, W. S., & Choi, L. (2013). The embeddedness of teachers' social networks: Evidence from a study of mathematics reform. *Sociology of Education*, 86(4), 311-342.
- Curtin, M., & Fossey, E. (2007). Appraising the trustworthiness of qualitative studies: Guidelines for occupational therapists. *Australian Occupational Therapy Journal*, 54, 88-94.
- Dai, D. Y. (Ed.). (2012). *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning*. Routledge.
- Efklides, A. (2009). The role of metacognitive experiences in the learning process. *Psicothema*, 21(1), 76-82.
- Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist*, 46(1), 6-25.
- Flavell, J.H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10), 906-911.
- Frampton, K.L., Perlman, M. & Jenkins, J.M. (2009). Caregivers' use of metacognitive language in child care centres: Prevalence and predictors. *Early Childhood Research Quarterly*, 24(3), 248-262

- Halgin, D.S., Gopalakrishnan, G.M. & Borgatti, S.P. (2014). Structure and agency in networked, distributed work the role of work engagement. *American Behavioural Scientist*: 0002764214556807.
- Hurme, Tarja-Riitta., Tuire Palonen, and Sanna Jarvela. (2006). Metacognition in Joint Discussions: An Analysis of the Patterns of Interaction and the Metacognitive Content of the Networked Discussions in Mathematics. *Metacognition Learning 1*, 181-200.
- Isbell, J. (1981). Product spaces in locales. *Proceedings of the American Mathematical Society*, 81(1), 116-118.
- Islam, J., & Akatar, T. (2011). Metacognitive Language-Learning Strategies and Language-learning, Motivation: A study on Bangla-speaking Undergraduate EFL learners. Outlook: VUB.
- Jankowski, T., & Holas, P. (2014). Metacognitive model of mindfulness. *Consciousness and cognition*, 28, 64-80.
- Jagals, D. (2015). *Metacognitive locale: a design-based theory of students' metacognitive language and networking in Mathematics* (Doctoral dissertation, North-West University).
- Jagals, D., & Van der Walt, M.S. (2016a). Enabling metacognitive skills for mathematics problem solving: a collective case study of metacognitive reflection and awareness. *African Journal of research in Mathematics, Science and Technology Education*, 20 (1), 154-164.
- Jagals, D., & Van der Walt, M.S. (2016b). Exploiting metacognitive networks in narrative focus group interviews using NodeXL. *The Qualitative Report*, 21(10), 1868-1880.
- Kuhn, D. (2015). Thinking together and alone. *Educational Researcher*, 0013189X15569530.
- Lai, E. R. (2011). Metacognition: A literature review. Always learning: Pearson research report.
- Markova, G. & Legerstee, M. (2013). Implicit confusions in metacognition. *Infant and Child Development*, 22(1), 105-107.
- McKetcher, W.L., Gluesing, J.C. & Riopelle, K. (2009). From interviews to social network analysis: An approach for revealing social networks embedded in narrative data. *Field Methods*.
- Moos, D.C. (2014). Setting the stage for the metacognition during hypermedia learning: What motivation constructs matter? *Computers & Education*, 70, 128-137.
- Murphy, K. (2012). The social pillar of sustainable development: A literature review and framework for policy analysis. *Sustainability: Science, Practice, & Policy*, 8(1), 15-29.
- Nachlieli, T. & Tabach, M. (2012). Growing mathematical objects in the classroom—the case of function. *International Journal of Educational Research*, 51, 10-27.
- Odafe, V. U. (2007). Teaching and learning mathematics: Student reflection adds a new dimension. In *Proceedings from Ninth International Conference: The Mathematics Education into the* (Vol. 21).
- Onwuegbuzi, A.J., & Collins, K.M.T. (2012). A typology of mixed methods sampling designs in social science research. *The Qualitative Report*, 12(2), 286-316.
- Papaja, K.L. (2012). The impact of students' attitudes. *Latin American Journal of Content & Language Integrated Learning*, 5(2), 28-56.
- Papaleontiou-Louca, E. (2008). Metacognition and theory of mind.
- Paris, S.G. & Oka, E.R. (1986). Strategies for comprehending text and coping with reading difficulties. *Learning Disability Quarterly*, 12(1), 32-42.
- Pasquali, A., Timmermans, B. & Cleeremans, A. (2010). Know thyself: Metacognitive networks and measures of consciousness. *Cognition*, 117(2), 182-190.
- Proust, J. (2013). *The philosophy of metacognition: Mental agency and self-awareness*: Oxford University Press.
- Rodríguez, Esther., Marianna Bosch, and Joseph Gascón. (2008). A Networking Method to Compare Theories: Metacognition in Problem Solving Reformulated Within the Anthropological Theory of the Didactic. *ZDM Mathematics Education*, 40(2), 287-301.
- Rock, T. C., & Wilson, C. (2005). Improving teaching through lesson study. *Teacher Education Quarterly*, 32(1), 77-92.
- Rogan, M. & Mors, M.L. (2014). A network perspective on individual-level ambidexterity in organizations. *Organization Science*, 25(6), 1860-1877.
- Schraw, G. & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, 7(4), 351-371.
- Stack, S., & Bound, H. (2012). Tools for Learning Design Research Project Exploring new approaches to professional learning: Deepening pedagogical understanding of Singapore.
- Lier, L. V. (2000). From Input to Affordance: Social-interactive Learning from an Ecological Perspective'. In *Sociocultural Theory and Second Language Learning*. Edited by Lantolf, J. Oxford: Oxford University Press.
- Waters, H.S.E. & Schneider, W.E. (2010). *Metacognition, strategy use, and instruction*: Guilford Press.
- Zawojewski, J. S., Magiera, M. T., & Lesh, R. (2013). A proposal for a problem-driven mathematics curriculum framework. *The Mathematics Enthusiast*, 10(1/2), 469.

# THE EFFECT OF TEACHER'S IMPLEMENTED STRATEGIES ON STUDENTS' TEXT COMPREHENSION

**Krista Uibu, & Triinu Kärbla**  
*Institute of Education, University of Tartu (Estonia)*

## Abstract

Text comprehension is the key to successful participation in society, and it should be mastered at a sufficient level by the end of basic school. Various strategies should be used to support students' vocabulary and text comprehension at different cognitive levels. The teacher's role is crucial in this process. In order to identify how teachers' strategies affected students' vocabulary and text comprehension at different levels, basic school students were pre- and post-tested, and their language teachers were questioned. In the strategic intervention, the effects of six comprehension strategies were examined. Students' better comprehension was influenced by teaching them to form and answer questions. Comprehension was positively affected by the monitoring strategy. In contrast, the use of summarising the text and improving vocabulary negatively affected students' inferential comprehension. Teacher's proper usage of strategies is essential for promoting students' comprehension skills.

**Keywords:** *Text comprehension, teaching strategies, intervention effects, basic school.*

---

## 1. Introduction

Text comprehension is the key to successful participation in society, and it should be mastered at a sufficient level by the end of basic school. Various strategies should be used to support students' vocabulary and text comprehension. Empirical studies have identified multiple strategies to facilitate students' text comprehension (Duke & Pearson, 2009; NRP, 2000). However, the controversial effects of strategies on students' proficiency to understand text has found in previous studies (Duke & Pearson, 2009; Uibu & Männamaa, 2014). The reason might be that teachers cannot explicitly teach appropriate strategies to students (Duke & Pearson, 2009) and differentiate them for students developmental and school levels. Therefore, the effects of strategies on students' results might be lower than expected (Guthrie, Klauda, & Ho, 2013). Providing students with opportunities to gain mastery in using different strategies is crucial in explicit instruction. In strategic intervention the effects of different comprehension strategies on students' results might be lower than expected.

## 2. Design

Previous studies have suggested explicit teaching strategies as an effective approach to enhance students' comprehension and promote reading success (Archer & Hughes, 2011; NRP, 2000). The present study focuses on teachers' use of comprehension strategies to promote basic school students' vocabulary and text comprehension at different cognitive levels. Six strategies were chosen (Boulware-Gooden et al., 2007; Elleman, 2017; NRP, 2000; van Keer & Verhaeghe, 2005). In this regard, the study aimed to investigate the effects of comprehension strategies employed by the language teachers in the instruction on their students' vocabulary and text comprehension skills.

## 3. Objective and methods

The study conducted in Estonia, data set comprised students from 15 regular classes. In order to identify how teachers' strategies affected students' vocabulary and text comprehension at different levels, basic school students were pre- and post-tested, and their language teachers were questioned. In the strategic intervention, the effects of six comprehension strategies were examined. It was hypothesized that in intervention the effects of different comprehension strategies on students' results might be lower than expected. The test to measure students' vocabulary and text comprehension at different cognitive levels

and a questionnaire to assess teachers' comprehension strategies were compiled. The students were pre- and post-tested with the same tests and the teachers rated the use of six comprehension strategies in their instruction on the five-point Likert scale. The effects of teachers' implementation of strategies on their students' vocabulary and text comprehension at three levels were assessed by Structural Equation Modelling (SEM).

#### 4. Discussion and conclusions

When analysing the impact of various strategies on the students' post-test results, several significant effects were indicated. Firstly, students' better inferential and evaluative comprehension was influenced by teaching them to form and answer different kinds of questions. According to earlier studies, using different types of questions improves students' comprehension at each comprehension level (Eason et al., 2012; Graesser, McNamara, & VanLehn, 2005). By teaching these strategies, teachers enhance students to a higher level of comprehension. Secondly, comprehension at literal and inferential levels was affected by the monitoring strategy. Students with good monitoring skills are more conscious of how to adjust their reading according to the difficulty level of the text (Graesser et al., 2005) and become more skilled at reading. In contrast, various comprehension strategies had a greater impact on students' inferential comprehension and the use of summarising the text and improving vocabulary negatively affected students' inferential comprehension. Thus, teachers' use of comprehension strategies may foster, but also hinder students' text comprehension at different levels.

To conclude, teacher's proper usage of strategies is essential for promoting students' comprehension skills. Better results in students' higher-level text comprehension can be expected if teachers implement more elaborated strategies. Thus, the awareness gained from interventions should become a part of instruction and the teachers should continue the use of various text comprehension strategies after intervention – to ensure permanent results among students. It is also recommended for pre- and in-service training programmes and for systemic compliance in language lessons at schools.

#### References

- Archer, A. L., & Hughes, C. A. (2011). *Explicit instruction: Effective and efficient teaching*. New York: Guilford Press.
- Boulware-Gooden, R., Carreker, S., Thornhill, A., & Joshi, R. M. (2007). Instruction of metacognitive strategies enhances reading comprehension and vocabulary achievement of third-grade students. *The Reading Teacher, 61*(1), 70–77.
- Duke, N. K., & Pearson, P. D. (2009). Effective practices for developing reading comprehension. *Journal of Education, 189*(1–2), 107–122.
- Eason, S. H., Goldberg, L. F., Young, K. M., Geist, M. C., & Cutting, L. E. (2012). Reader-Text interactions: How differential text and question types influence cognitive skills needed for reading comprehension. *Journal of Educational Psychology, 104*(3), 515–528.
- Elleman, A. M. (2017). Examining the impact of inference instruction on the literal and inferential comprehension of skilled and less skilled readers: A meta-analytic review. *Journal of Educational Psychology, 109*(6), 761.
- Graesser, A. C., McNamara, D. S., & VanLehn, K. (2005). Scaffolding deep comprehension strategies through Point & Query, AutoTutor, and iSTART. *Educational Psychologist, 40*(4), 225–234.
- Guthrie, J. T., Klauda, S. L., & Ho. A. (2013). Modeling the relationships among reading instruction, motivation, engagement, and achievement for adolescents. *Reading Research Quarterly, 48*, 9–26. doi:10.1002/rrq.035
- National Reading Panel (NRP). (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Washington, DC: National Institute for Child Health and Human Development.
- Uibu, K., & Männamaa, M. (2014). Õpetamistegevused ja õpilaste tekstimõistmine üleminekul esimesest kooliastmest teise astmesse [Teaching practices and text comprehension in students during the transition from the first to second stage of school]. *Eesti Haridusteaduste Ajakiri, Estonian Journal of Education, 2*(1), 96–131.
- van Keer, H., & Verhaeghe, J. P. (2005). Effects of explicit reading strategies instruction and peer tutoring on second and fifth graders' reading comprehension and self-efficacy perceptions. *The Journal of Experimental Education, 73*(4), 291–329.

# **BULLYING AS DRIVER OF LOW MATHEMATICS ACHIEVEMENT: SOUTH AFRICAN NO-FEE-PAYING SCHOOLS IN A CHALLENGED CONTEXT**

**Marien Alet Graham**

*Department of Science, Mathematics and Technology Education, University of Pretoria (South Africa)*

## **Abstract**

Children in South Africa have the right to quality education free from harm. Still, incidents of school bullying continue to dominate South African news coverage. Creating a safe environment conducive to learning is vital to mathematics achievement (MA). We investigated the association between bullying and Grade 9 MA in South African public institutions that do not charge tuition. In South Africa, ordinary public schools are divided into five quintiles, with Quintiles 1 to 3 being in the most economically disadvantaged (poorest) geographic locations (no-fee-paying schools) and Quintiles 4 and 5 being in the wealthiest geographical areas (fee-paying schools). This study only considers schools in Quintiles 1 to 3 and uses Bronfenbrenner's ecological theory to investigate MA in a less-researched context (Global South) in schools in the most economically disadvantaged locations. We followed a quantitative design with a research paradigm of positivism and a secondary data analysis study design. We analysed Trends in International Mathematics and Science Studies (TIMSS) 2019 data, and, at Grade 9 level, South Africa was second to last in MA. We constructed a multi-level model containing 21 constructs; 20 independent variables (gender, socio-economic status (SES) and 18 bullying variables), with the dependent variable being MA. At learner-level, the unsurprising results were that learners who have been refused to talk to, their family insulted, made to do things they didn't want to do, sent nasty or hurtful messages online, shared nasty or hurtful things or embarrassing photos about them online and physically hurt, performed significantly worse than those where these occurrences happened less frequently. A surprising result is that learners who indicated they had been stolen from or had mean things said about their physical appearance outperformed learners where this was happening less frequently. For these results that seem counterintuitive, we give some suggestions on why this may be the case. At school-level, principals' beliefs concerning the level of severity of intimidation or verbal abuse amongst learners was a significant predictor. Learners must be reminded that there are clear policies that punish perpetrators of bullying. Since e-Learning has grown exponentially over the last two years due to COVID-19, we urge the inclusion of cyber-safety and cyber-protection strategies in all learner-teacher training. From the counterintuitive results, this study challenges deficit views by showing how learners living in disadvantaged areas and in a challenged context resile despite being bullied.

**Keywords:** *Bullying, mathematics achievement, TIMSS, socio-economic status, challenged context.*

---

## **1. Introduction and rationale**

Bullying during childhood and adolescence, whether as bullies, victims, or spectators, has damaging and long-term implications, including negative behavioural results, mental health disorders, financial concerns, low psychological well-being, low social adjustment, coping difficulties, psychological distress, risk of suicide and poor academic achievement (Huang, 2022; Murphy, Leonard, Taylor, & Santos, 2022; Xie & Cui, 2022). We link traditional and cyber bullying to mathematics achievement (MA), as the Trends in International Mathematics and Science Study (TIMSS) 2019 results indicated poor MA for South African learners; second to last of 39 countries (Reddy et al., 2021). Traditional and cyber bullying in South African schools is becoming a growing concern, and this is especially true for cyber bullying as the United Nations Children's Fund (UNICEF) reported that the findings of the "Disrupting Harm Study" (UNICEF, n.d., para. 1) released in 2022 indicated that 70% of South African children are involved in risky online behaviour, such as cyber bullying, without parental consent. Although research has been undertaken linking bullying to learner MA, very few of these studies have taken into account the various hierarchical levels often present in an educational setting, for instance, a learner-level/level-1 (L1) and a school-level/level-2 (L2) and, to the best of our knowledge, no such study has been conducted previously by considering South African learners in disadvantaged communities. Learners from low-SES schools were selected over learners from high-SES schools, as

literature on South African education has shown that learners from lower-SES schools reported being bullied more often than learners in higher-SES schools (Johansson, Myrberg, & Toropova, 2022). This article aims to identify bullying-related variables that are significantly associated with MA and SA to give recommendations to the appropriate stakeholders on how to potentially minimise bullying in these sorts of schools. If problem areas can be identified, specifically for South African no-fee paying schools in disadvantaged communities, then interventions can be tailored and directed to address those specific problem areas, as opposed to having general interventions or training sessions on bullying. Thus, the current study contributes not only to the literature on how to improve MA in low-SES South African schools but also to the literature on resilience and bullying, as well as the associated interventions conducted with underserved youth in school settings, by recommending what these interventions should focus on. The research hypothesis for this study is: It is hypothesised that South African learners in disadvantaged communities in less-research contexts (Global South) that are bullied via traditional or online methods perform significantly worse in MA than learners that are not bullied.

## 2. Literature review and theoretical framework

Huang (2022) conducted a secondary data analysis (SDA) of Programme for International Student Assessment (PISA) China 2015 data and found that bullying victimisation and bullying climate were significantly associated reading, maths and science achievement. In another study in China, Xie and Cui (2022) (1,747 learners in Grades 4-9) found a significant association between peer victimisation and academic performance. Miskimon, Jenkins and Kaminski (2022) conducted a study on 676 secondary schoolchildren in the USA and found significantly poorer academic performance due to traditional and cyber bullying for girls. Murphy et al. (2022) conducted studies on 22,308 learners from Ireland aged 9-15 years and found that bullying contributed to lower performance in maths and literacy. Many studies aim to eliminate school bullying, but many strategies are too expensive for economically disadvantaged schools to apply. It may be argued that the government can pay for these interventions; however, government funding is limited. Some interventions need printing of materials (e.g., Salimi et al., 2019) and the acquisition of specialised equipment such as karate clothes ( ), making it more complicated than simply reimbursing a specialist for conducting a workshop (e.g., karate clothes; Greco, Fischetti, Cataldi, & Latino, 2019). Resilience skills have been linked to bullying research as they enable learners to effectively cope with and adjust to social struggles (Rich et al., 2019), such as bullying. Rich et al. (2019), who conducted a resilience-based intervention with underserved children (67 children from schools serving primarily learners from low-SES households in the USA), stated that the research on “school-based group interventions administered to low-SES minority students is limited” (p. 33) and that “Resilience-focused interventions seem to exclude the very people who might need them the most” (p. 33) and recommended that more studies relating to resilience and bullying need to be conducted with underserved youth in school settings. As is clear from the discussion above, it is evident that bullying leads to poor academic achievement and that many of the interventions to reduce bullying are expensive and, accordingly, may not even be feasible for South African no-fee paying schools in disadvantaged areas as these schools don’t have the flexibility to collect fees or raise finances as fee-paying schools do (Maistry & Africa, 2020). Bronfenbrenner (1977)’s ecological theory involves five systems referred to as the “microsystem” (e.g., the learner themselves), “mesosystem” (the connection between the structures of the learner’s microsystem, e.g., the learner and their friends), “exosystem” (e.g., formal institutions, such as the parents’ work environment and school environment) and “macrosystem” (the overall societal culture in which the learners live, e.g., SES and ethnicity). Links between the theoretical framework and the current study are considered in the Discussion Section.

## 3. Methodology

A quantitative, SDA was used with a positivism research paradigm, as this “bias-neutral paradigm” is linked to the scientific method where it is believed that “the natural and social world can be understood and improved by employing deductive reasoning and precise empirical scrutiny” (Reed, 2022, p. 317). TIMSS 2019 non-fee-paying schools were used and, in South Africa, the school finance model consists of five kinds of schools, known as Quintiles (Q) 1 through 5. These quintiles determine how much financing each school receives from the government. The lowest quintiles (Q1 to Q3) are non-fee-paying schools, whereas the top quintiles (Q4 and Q5) charge tuition. Q1 schools are located in the most economically disadvantaged (poorest) geographic areas, whereas Q5 schools are located in the wealthiest geographic areas (fee-paying schools). No-fee-paying schools are schools that receive all of their funding from the government and are prohibited from charging user or school fees. On the other side, fee-paying schools are permitted to collect fees, raise finances, and have greater control over operational revenue generation (Maistry & Africa, 2020). Items from the TIMSS 2019 learner questionnaire, which learners answered, were used at L1 (12,491 learners from no-fee-paying schools), and items from the TIMSS 2019 school questionnaire, which principals answered, and from the TIMSS



2019 teacher questionnaire, which teachers answered, were used at L2 (280 no-fee paying schools participated in TIMSS 2019). South Africa's TIMSS 2019 data collection occurred in Sep 2018 (Cotter, Centurino, & Mullis, 2020), and we refer readers to Cotter et al. (2020) for information regarding the rigour of TIMSS 2019 study. HLM version 7 was used to perform the multi-level analysis, with the dependent variable being the TIMSS MA 5 plausible values. The predictors used at L1 were 14 bullying items "Said mean things about my physical appearance (e.g., my hair, my size)", "Spread lies about me", "Shared my secrets with others", "Refused to talk to me", "Insulted a member of my family", "Stole something from me", "Made me do things I didn't want to do", "Sent me nasty or hurtful messages online", "Shared nasty or hurtful things about me online", "Shared embarrassing photos of me online", "Threatened me", "Physically hurt me" and "Excluded me from their group", and "Damaged something of mine on purpose" (TIMSS, 2018a, p. 12). At L2, the principals had to answer the level to which they agree the following are a problem: "Intimidation or verbal abuse among students" and "Physical injury to other students" (TIMSS, 2018b, p. 7). Also, at L2, the teachers had to indicate their level of agreement with the questions "This school has clear rules about student conduct" and "This school's rules are enforced in a fair and consistent manner" (TIMSS, 2018c, p. 3). Gender and SES were included in the model at L1 to control for, as this is practice for many studies (e.g., Kotok & Knight, 2022; Murphy et al., 2022), with Murphy et al. (2022) pointing out that many studies fail to control for key covariates such as SES. SES was controlled for since, though the focus of this study is on schools in a challenged context, there are substantive financial differences between the Q1, Q2 and Q3 schools in terms of funding allocated by the government. Group centring and grand centring were used at L1 at L2, respectively (Raudenbush & Bryk, 2002), and the weighting was done as per the recommendations of Stancel-Piątak et al. (2013).

#### 4. Results and discussion

The null model without any variables was created to show the variance (*var*) between schools. The *var* at L1 and L2 are 3,061.58 and 733.83, representing 80.7% and 19.3% of the total *var*, respectively. The *var* at L2 is significantly different from zero ( $\chi^2=3,801.13$ ,  $p<0.001$ ), which means MA varied significantly across schools. The final (parsimonious) was created by adding all the predictors and control variables and then removing insignificant predictors one at a time until only significant variables remained. For the parsimonious model ( $\chi^2=4,201.35$ ,  $p<0.001$ ), the *var* at L1 is 2,770.60 and at L2 is 2,770.60, which signifies 79.4% and 20.6% of the total *var*, respectively. The average reliability estimate was 0.931, indicating that sample averages reflected the true school means. By comparing the *var* components of the parsimonious model to those of the null model, the percentage reduction in the *var* at L1 and L2 were 9.5% and 2.3%, respectively.

Table 1. Significant predictors of the parsimonious model.

Variable description	Coefficient	Standard Error	<i>t</i>	<i>p</i>
Intercept	357.70	2.41	148.62	<0.001*
L1: "Are you a girl or a boy?" <sup>i</sup>	1.38	1.32	1.03	0.312
L1: "Home educational resources" <sup>ii</sup>	0.34	0.44	0.78	0.444
L1: "Said mean things about my physical appearance (e.g., my hair, my size)" <sup>iii</sup>	-1.58	0.50	-3.16	0.003*
L1: "Refused to talk to me" <sup>iii</sup>	1.73	0.49	3.49	0.001*
L1: "Insulted a member of my family" <sup>iii</sup>	4.10	0.52	7.86	<0.001*
L1: "Stole something from me" <sup>iii</sup>	-7.01	0.51	-13.63	<0.001*
L1: L1: "Made me do things I didn't want to do" <sup>iii</sup>	2.67	0.76	3.49	0.004*
L1: "Sent me nasty or hurtful messages online" <sup>iii</sup>	1.61	0.65	2.52	0.014*
L1: "Shared nasty or hurtful things about me online" <sup>iii</sup>	4.53	0.75	6.04	<0.001*
L1: "Shared embarrassing photos of me online" <sup>iii</sup>	7.25	0.92	7.82	<0.001*
L1: "Physically hurt me" <sup>iii</sup>	3.59	0.78	4.62	0.001*
L2: "Intimidation or verbal abuse among students" <sup>iv</sup>	7.09	1.76	4.02	<0.001*

\*Significant at a 5% level of significance

<sup>i</sup>Response options: "1=Girl" and "2=Boy" TIMSS (2018a, p. 3)

<sup>ii</sup>Continuous: "<8.4 few", "8.4-12.2 some", ">12.2 many" Yin and Fishbein (2020, p. 16.168)

<sup>iii</sup>Response options: "1=At least once a week", "2=Once or twice a month", "3=A few times a year", "4=Never" TIMSS (2018a, p. 12)

<sup>iv</sup>Response options: "1=Not a problem", "2=Minor problem", "3=Moderate problem", "4=Serious problem" (TIMSS, 2018b, p. 7)

From Table 1, some unsurprising results at L1 were: For learners who “refused to talk to me” ( $\beta=1.73$ ,  $p=0.001$ ), “insulted a member of my family” ( $\beta=4.10$ ,  $p < 0.001$ ), “made me do things I didn’t want to do” ( $\beta=2.67$ ,  $p=0.004$ ), “sent me nasty or hurtful messages online” ( $\beta=1.61$ ,  $p=0.014$ ), “shared nasty or hurtful things about me online” ( $\beta=4.53$ ,  $p < 0.001$ ), “shared embarrassing photos of my online” ( $\beta=7.25$ ,  $p < 0.001$ ), and physically hurt me” ( $\beta=3.59$ ,  $p=0.001$ ) happened to less frequently achieved higher scores than learners where these things happen more frequently. A surprising result at L1: The relationship between “said mean things about my physical appearance (e.g., my hair, my size)” and MA was significant ( $\beta=-1.58$ ,  $p=0.003$ ), indicating for every unit increase in the predictor, with an increase indicating mean things being said happens less frequently, MA decreased on average by 1.58. This surprising result could be attributed to the normalisation of obesity in South African schools, especially in economically disadvantaged areas (Long et al., 2022; Verduci, Di Profio, Fiore & Zuccotti, 2022). Since this predictor is about physical appearance and particularly mentions size as an example, the exponential increase in South African children that are obese may have skewed the results. Another surprising result at L1 was: The relationship between “stole something from me” and MA was significant ( $\beta=-7.01$ ,  $p < 0.001$ ), indicating for every unit increase in this predictor, with an increase indicating it is happening less frequently, MA decreased on average by 7.01. This could be explained by the fact that “stole something from me” can be construed in numerous ways. Some learners may have believed that a missing pencil or eraser constitutes theft, while others may have considered it primarily referring to larger objects such as calculators or textbooks. In the following cycle of TIMSS, it is suggested that the question’s wording be changed to “stole anything of value from me”. A surprising result at L2 was: The relationship between “Intimidation or verbal abuse among students” and MA was significant ( $\beta=7.09$ ,  $p < 0.001$ ), indicating for every unit increase in this predictor, with an increase indicating the beliefs of the principals that the level of severity of the problem is a serious one, MA increased on average by 7.09. This could possibly be due to the resilient nature of South African learners in challenged contexts, as reported by Theron, Ungar and Höltge (2022). If we had used the bullying scale developed by TIMSS by averaging the individual bullying items, we would not have discovered these surprising results not would we have seen that some of the bullying items were not found to be significant predictors.

## 5. Conclusion and recommendations

The TIMSS team must consider rephrasing the item phrased “stole something from me” to “stole anything of value from me”, as the results showed unexpected results for this item. It is recommended that more research be conducted in South African schools regarding cyber bullying, since scoping reviews such as the one by Evangelio, Rodríguez-González, Fernández-Río and Gonzalez-Villora (2022), who identified 43 articles between the years 2016 to 2020 on children start using mobile phones and social media and cyberbullying, found only two were based on South African schoolchildren. Although more literature is available on traditional than cyber bullying in South African schools, more research on traditional bullying can be conducted on learners from low-SES schools, as literature on South African education has shown that learners from lower-SES schools reported being bullied more often than learners in higher-SES schools (Johansson et al., 2022). Regarding bullying interventions, we recommend that focussed interventions be used with a focus on the predictors significantly negatively associated with achievement. Learners must be reminded that there are clear policies that punish perpetrators of bullying. Since e-Learning has grown exponentially over the last two years due to COVID-19, we urge the inclusion of cyber-safety and cyber-protection strategies in all student-teacher training. The consequences of this study’s findings extend beyond South Africa’s academic system. If bullying victimisation has a major detrimental effect on learner academic performance, then pervasive bullying may impair not only individual learners but also South Africa’s long-term economic development by retarding human capital growth. This is why studies like these carry weight, and the recommendations should be taken seriously by the relevant stakeholders.

## References

- Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, 32(7), 513-531.
- Cotter, K. E., Centurino, V. A. S., & Mullis, I. V. S. (2020). Developing the TIMSS 2019 mathematics and science achievement instruments. In M. O. Martin, M. von Davier & I. V. S. Mullis (Eds.), *Methods and procedures: TIMSS 2019 Technical Report* (pp. 1.1-1.36). Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Evangelio, C., Rodríguez-González, P., Fernández-Río, J., & Gonzalez-Villora, S. (2022). Cyberbullying in elementary and middle school students: A systematic review. *Computers & Education*, 176, Article 104356, 1-18.

- Fishbein, B., Foy, P., & Yin, L. (2021). *TIMSS 2019 user guide for the international database*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Greco, G., Fischetti, F., Cataldi, S., & Latino, F. (2019). Effects of Shotokan Karate on resilience to bullying in adolescents. *Journal of Human Sport & Exercise*, 14(Proc 4), S896–S905.
- Huang, L. (2022). Exploring the relationship between school bullying and academic performance: The mediating role of students' sense of belonging at school. *Educational Studies*, 48(2), 216-232.
- Johansson, S., Myrberg, E., & Toropova, A. (2022). School bullying: Prevalence and variation in and between school systems in TIMSS 2015. *Studies in Educational Evaluation*, 74, Article 101178.
- Kotok, S., & Knight, D. S. (2022). Revolving doors: Cross-country comparisons of the relationship between math and science teacher staffing and student achievement. *Leadership and Policy in Schools*, 21(2), 345-360.
- Long, K. Z., Beckmann, J., Lang, C., Seelig, H., Nqweniso, S., Probst-Hensch, N., ... Gerber, M. (2022). Impact of a school-based health intervention program on body composition among South African primary schoolchildren: Results from the KaziAfya cluster-randomized controlled trial. *BMC Medicine*, 20(1), Article 27, 1-12.
- Maistry, S. M., & Africa, I. E. (2020). Neoliberal stratification: The confounding effect of the school poverty quintile ranking system in South Africa. *South African Journal of Education*, 40(4), Article 1872, 1-9.
- Miskimon, K., Jenkins, L. N., & Kaminski, S. (2022). Direct and indirect effects of bullying victimization on academic performance and mental health among secondary school students. *School Mental Health*. Advance online publication. 1-11.
- Murphy, D., Leonard, S. J., Taylor, L. K., & Santos, F. H. (2022). Educational achievement and bullying: The mediating role of psychological difficulties. *British Journal of Educational Psychology*, 92, 1487-1501.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: SAGE.
- Reed, J. (2022). The methodology wars and outdoor and environmental education: Feminism, positivism, and causation. *Journal of Outdoor and Environmental Education*, 25, 313-327.
- Reddy, V., Winnaar, L., Juan, A., Arends, F., Harvey, J., Hanna, S., ... Zulu, N. (2021). *TIMSS 2019: Highlights of South African Grade 9 results in mathematics and science*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Rich, B. A., Shiffirin, N. D., Cummings, C. M., Zarger, M. M., Berghorst, L., & Alvord, M. K. (2019). Resilience-based intervention with underserved children: Impact on self-regulation in a randomized clinical trial in schools. *International Journal of Group Psychotherapy*, 69, 30-53.
- Robitzsch, A. (2020). Why ordinal variables can (almost) always be treated as continuous variables: Clarifying assumptions of robust continuous and ordinal factor analysis estimation methods. *Frontiers in Education*, 5, Article 589965, 1-7.
- Salimi, N., Karimi-Shahanjarini, A., Rezapur-Shahkolai, F., Hamzeh, B., Roshanaei, G., & Babamiri, M. (2019). The effect of an anti-bullying intervention on male students' bullying-victimization behaviors and social competence: A randomized controlled trial in deprived urban areas. *Journal of Research in Health Sciences*, 19(4), Article e00461, 1-7.
- Stancel-Piątak, A., Neuschmidt, O., Aghakasiri, P., Meinck, S., Sandoval-Hernández, A., Jaschinski, K., . . . Karameta, J. (2013). *Hierarchical linear modelling with TIMSS and PIRLS data* [Workshop], 25-29 November 2013. Germany: IEA Data Processing Center.
- Theron, L., Ungar, M., & Hóltge, J. (2022). Pathways of resilience: Predicting school engagement trajectories for South African adolescents living in a stressed environment. *Contemporary Educational Psychology*, 69, Article 102062, 1-12.
- Trends in International Mathematics and Science Study. (2018a). *Student questionnaire: Grade 9*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Trends in International Mathematics and Science Study. (2018b). *School questionnaire: Grade 9*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Trends in International Mathematics and Science Study. (2018c). *Teacher questionnaire: Grade 9*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- United Nations Children's Fund. (n.d.). *What you're doing is wrong*. New York, NY: UNICEF.
- Verduci, E., Di Profio, E., Fiore, G., & Zuccotti, G. (2022). Integrated approaches to combatting childhood obesity. *Annals of Nutrition and Metabolism*, 78(Suppl 2), 8-19.
- Yin, L., & Fishbein, B. (2020). Creating and interpreting the TIMSS 2019 context questionnaire scales. In M. O. Martin, M. von Davier & I. V. S. Mullis (Eds.), *Methods and procedures: TIMSS 2019 Technical Report* (pp. 16.1-16.331). Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Xie, H., & Cui, K. (2022). Peer victimization, environmental and psychological distress, and academic performance among children in China: A serial mediation model moderated by migrant status. *Child Abuse & Neglect*, 133, Article 105850.

# ADOPTING ONLINE LEARNING APPROACHES IN PROFESSIONAL MUSIC TRAINING—THE TUT EXPERIENCE

**Hua Hui Tseng**

*Tainan University of Technology (Taiwan)*

## Abstract

Having been asked to respond to a question from the Ministry of Education, Taiwan, about whether educational technologies used during the COVID-19 pandemic can serve as a knowledge base and be incorporated as learning tools based on their impacts on music education curricula, what follows are some observations and reflections from the Tainan University of Technology (TUT), Taiwan, about its educators' experiences of teaching live lessons one-to-one and in groups online. The idea put forward is that technology applications reflect an emergent sensibility in music lessons, and this represents an opportunity for music educators to reconfigure and strengthen their pedagogical approaches. By recognizing the accessibility of new and varied forms of musicianship and acknowledging the ways in which course curricula continue to grow in their range of practices and necessary literacies, pedagogies can be developed in concert with digital technologies to support broader and more cohesive, inclusive, diverse, meaningful, and useful experiences for music students.

**Keywords:** *Curriculum, musician, online learning approaches.*

---

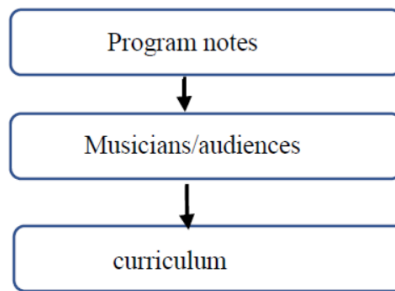
## 1. Introduction

Over the past decade, education, including music courses, have seen a consistent growth in the use of digital technologies, but in 2020, given the pandemic context generated by COVID-19, much of the world was forced to adopt online virtual working methods with immediate effect. As a result, important changes emerged in the way specific subjects in music education were taught, affecting not only the particularities of learning and teaching individual courses, but also group learning and the theoretical components of courses (Rucsanda et al., 2021).

A key challenge exposing music's limitation for shifting to online learning is its traditionally focused face-to-face teacher-apprenticeship teaching models. The background to adopting online music courses provide fascinating insights into the higher education scene where technology and the internet supplement face-to-face learning with respect to understanding engagement in practical hands-on activities such as learning how to play a musical instrument, singing, performing solo or in groups, and improvising and composing music.

The aim of this research is to explore the relationship between program notes and musicians /audiences (see Figure 1) and show how teaching students to write and understand program notes can be accommodated in a post-COVID-19 teaching milieu that includes online learning. To achieve this aim, the case of the TUT was examined. The main reason for focusing on the TUT is that the study of TUT's Music Department and its curriculum has been ongoing since 2009. TUT offers a seven-year program from high school directly to a bachelor's degree in vocational education and qualifying as a music artist first requires mastery of the general concert audience, an assumption that has ensured TUT as a leader in professional music training as artists shift from being amateur to professional musicians.

Figure 1. Relationships between teaching, learning, and curriculum.



## 2. Background

Like other educational programs, professional music training programs are challenged by major changes in the sociocultural and educational landscape and addressing pedagogical changes to ensure continued excellence in music teaching is both complex and stratified (Johnson, 2020). In response to Taiwan's societal challenges, such as current issues about music education policy, the Ministry of Education in Taiwan amended the Arts Education Act (AEA) in 1997 that outlined the curriculum for study in the performing arts. The AEA of 1997 was related directly to Taiwan's art education reform (Lau & Li, 2013). This new milestone provided a solid foundation in music education in Taiwan for all students (Ministry of Education, Taiwan, 1997). The TUT, Taiwan, Music Department's seven-year program from high school directly to a bachelor's degree in vocational education has served as an example for incorporating educational innovations and interventions based on Teachout's (1997) three categories of skills/knowledge components, namely, teaching skills, personal skills, and music skills and behaviors as core competencies. In the context of the COVID-19 and the associated lockdowns, further adaptations were necessary to achieve these formal educational goals.

## 3. Literature review

Research into teaching music online is not new (Keast, 2009); for example, Koutsoupidou (2013) noted that after the first online classes were launched in 1994 (Levy, 2003), rapid online courses in many disciplines at all levels of education proliferated. Much of the research about online learning is limited, however; it is focused mainly on the drawbacks of online distance learning. One drawback noted is that research is not focused on the actual teaching material and learning process and outcomes; the research is mainly related to psychological conditions involved in an online course both for the student and the instructor. For example, Nortvig and Balle (2018) noted that the transition to remote teaching led "to a loss of classroom awareness and social presence from both the instructor and student perspectives" (p. 53). Much of the research is therefore focused on how students' involvement in online social networks negatively affects their development of personal relationships with fellow students and tutors, and recommendations are focused on how to diminish those negative feelings and effects (Koutsoupidou, 2013).

Until the outbreak of the pandemic on 21 January 2020 in Taiwan, Taiwan universities' music courses took place face to face. However, studies show that music can be taught online in ways that further a student's musical understanding (Keast, 2009) as well as performance skills (Kruse et al., 2013), teaching internships (Pike, 2017), and music appreciation (Eakes, 2009).

In the following section, Schumann's Piano Piece Papillons, Op. 2 is used as an example to evaluate the merits of using video conference software, like Zoom video conferences, with students' performing during conferences to add to and foster increased interaction.

## 4. Schumann's Piano Piece Papillons, Op. 2 program notes for a classical western concert

As an aspect of the Research Methods and Thesis Writing class at graduate student level, student performers are expected to write program notes about their performance for a general concert audience, that is, an audience of non-musicians who are interested in music and fairly knowledgeable. The goal of teaching program notes is to increase the audience's understanding and enjoyment of the music performed (Blom et al., 2020).

As a knowledgeable musician, I still enjoy reading program notes and continue to learn through them because no one can know everything about a musician with a vast musical repertoire. It is assumed that program notes are naturally associated with knowing how to listen and think about the music performed at the strategic level and initiate the relationship between performers and their audiences. Students who are

presenting recitals are therefore encouraged to write notes for themselves and their audiences, and graduate students are often asked to relate interesting facts about the composer they are studying. Knowing the historical context of a piece makes for better interpretations and a better listening experience.

Prior to COVID-19, the teacher might have taken time in class to explain Schumann's Piano piece Papillons, Op. 2 as students rehearse the piece. For example, the teacher might have alerted students to what was going on in inventive and descriptive titles that come from Schumann's piano music at the time that he composed this piece and discuss how it is similar or different to anything that audiences had heard before. Much like a college music lecture-recitals, the teacher might have discussed with the students and raised awareness about how Schumann uses titles for his movements to reflect the tempo or speed at which he wants the music to be played. The teacher might also have focused on literature and reflected on including program notes to notify the audience of what was written before the piece. For example, it is the scene of the masked ball at the end of Richter's novel *Flegeljahre* (1804, as cited in Perahia, 2014) that provides the dramatic "setting" for the cycle, a scene in which two brothers, in love with the same woman, vie to win her heart amid the gaiety and varied musical offerings of a social evening with a dance orchestra. Program notes therefore inform the audience and facilitate a better listening experience by including what is interesting and relevant about the composer.

The purpose of learning this musical piece therefore reaches beyond just playing good music well. It incorporates an intentional introduction to new musical discourses as well as tools for students to add to their cognitive understanding of how music works (see Table 1) by helping both the student (and audience) understand that music is located within time and a culture.

During the Covid-19 pandemic, this class shifted to online classes. So, how did my teaching of writing program notes change due to the online educational context? In brief, I transitioned into connecting with my program notes' classroom community using Zoom video conferences and learned to create an engaging learning experience. The advantages of teaching the writing of program notes online is that a teacher has the means to access and foster interaction, for example, both the teacher and the student writing his or her program notes can produce, edit, and enrich videos of performances to create a better learning experience online. The disadvantages of teaching program notes online is that students have the ability to hide, but this risk can be met by administering online quizzes to ensure every student is engaged during the conference call.

The new online learning experience therefore changed the state of teaching and learning from "mono" and "teacher-centered" to "interactive" and "student-centered," thus making it necessary to create a hybrid model where the information technology and online activities became an integral component of the education process (Li, 2022). Zoom video conferences provided online classroom settings for music education and ways for musicians to collaborate virtually. I used those technologies to teach musical appreciation through the use of program notes. Tech brands such as Zoom, which ensured their product's relevance in the lockdown situation, therefore became one of the leading video call platforms that significantly enhanced the learning experiences of students. While the content conveyed during an online class remained much the same as the content conveyed in face-to-face classes, online music learning allowed teachers to assess how well students understood the different learning contexts (individual, group and theoretical) of the learning activities they were performing.

In addition, with the internet, it was so much easier for students to obtain information about a composer as compared to what was the case in the past, and it was exciting to see students think about music in new ways and begin to comprehend different musical styles as a result of their increased access to various musical genres. Many student musicians also discovered that online platforms such as Bandlab, Charanga, and Soundtrap (owned by Spotify USA) and their online cloud-based Digital Audio Workstations (DAWs) could enhance their reach to interested audiences.

## 5. Conclusion

Moving forward in a COVID-19 world has challenged the pedagogical approaches used by many face-to-face higher education music academics. However, in music training, technology, being a generic tool of both music and distance learning, can be valuable for teachers and raise their confidence by replacing and enhancing other forms of teaching that require a certain level of music skill and knowledge (Koutsoupidou, 2013). For example, prior to the COVID-19 pandemic, access to the internet provided students with knowledge about composers and genres, which supports the knowledge component. The shift to online learning then encouraged a more interactive and student-centered approach to learning. Students' learning was enhanced by learning how to use digital technologies to ensure their performances as accessible to wider audiences by virtue of making videos that showcased their musical performance skills. Instructors could also use video conference platforms like Zoom video conferences to teach students about

the merits of providing program notes to their audiences and use quizzes to ensure student engagement with the material and performance.

It is true that Zoom video conferences are limited with respect to providing the same quality of critique for performances as is face-to-face instruction, in the same way as watching a televised concert performance is an inferior experience as compared to watching a live performance. Moreover, online distance learning courses in music mean that those who are teaching music online require knowledge and skills in online design, assessment, and communication. At the same time, regardless of future lockdowns, teachers will be asked to make use of remote teaching methods in music education to ensure the sustainability and scalability of music education. The importance of adopting and adapting to online learning approaches for teaching music and musical appreciation should not be underestimated, therefore.

### References

- Blom, D., Bennett, D., & Stevenson, I. (2020). Developing a framework for the analysis of program notes written for contemporary Classical music concerts. *Directory of Open Access Journals*, 11, 1–13. <https://doi.org/10.3389/fpsyg.2020.00376>
- Eakes, K. (2009). *A comparison of a sociocultural and a chronological approach to music appreciation in face-to-face and online instructional formats* [Unpublished doctoral dissertation]. Degree of Doctor of Philosophy, Auburn University.
- Johnson, C. (2020, June 12). Moving towards adoption of online music pedagogy. *ASCILITE Technology Enhanced Learning Blog*. <https://blog.ascilite.org/moving-towards-adoption-of-online-music-pedagogy/>
- Keast, D. A. (2009). A constructivist application for online learning in music. *Research & Issues in Music Education*, 7(1), 8.
- Koutsoupidou, T. (2013). *Online distance learning and music training: Benefits, drawbacks and challenges*. 7th International Conference for Open and Distance Education. <https://doi.org/10.12681/icodl.536>
- Kruse, N. B., Harlos, S. C., Callahan, R. M., & Herring, M. L. (2013). Skype music lessons in the academy: Intersections of music education, applied music and technology. *Journal of Music, Technology & Education*, 6(1), 43–60. [https://doi.org/10.1386/jmte.6.1.43\\_1](https://doi.org/10.1386/jmte.6.1.43_1).
- Lau, H. F., & Li, C. (2013) (Eds.). *Curriculum innovations in changing societies: Chinese perspectives from Hong Kong, Taiwan and Mainland China*. United Kingdom: Sense.
- Levy, S. (2003). Six factors to consider when planning online distance learning programs in higher education. *Online Journal of Distance Learning Administration*, 6(1), 1–16.
- Li, D. (2022). The shift to online classes during the Covid-19 pandemic: benefits, challenges, and required improvements from the students' perspective. *The Electronic Journal of e-Learning*, 20(1), pp. 1-18. [www.ejel.org](http://www.ejel.org)
- Ministry of Education, Taiwan. (1997). Arts Education Act. <https://law.moj.gov.tw/ENG/LawClass/LawHistory.aspx?pcode=H0170037>
- Nortvig, A. M. A. K., & Balle, S. H. (2018). A literature review of the factors influencing e-learning and blended learning in relation to learning outcome, student satisfaction and engagement. *Electron. J. E-Learn*. 16, 46–55.
- Perahia, M. (2014). *Robert Schumann: Papillons, Op. 2*. <https://vanrecital.com/tag/papillons-op-2/>
- Pike, P. D. (2017). Improving music teaching and learning through online service: A case study of a synchronous online teaching internship. *International Journal of Music Education*, 35(1), 107–117. <https://doi.org/10.1177/0255761415613534>
- Rucsanda, M.D., Belabor, A., & Cazan, A. M. (2021). Students' attitudes toward online music education during the COVID19 lockdown. *Sec. Educational Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.753785>
- Teachout, D. J. (1997). Preservice and experienced teachers' opinions of skills and behaviors important to successful music teaching. *Journal of Research in Music Education*, 45, 41–50. <https://doi.org/10.1010.2307/3345464>

# EXAMINING THE MENTAL HEALTH STATUS OF HUNGARIAN TEACHERS

**Mónika Veronika Szigeti**

*“Education and Society” Doctoral School of Education, University of Pécs (Hungary)  
Institute of Education, Hungarian University of Agricultural and Life Sciences (Hungary)*

## Abstract

Research on burnout examines the phenomenon from an individual, interpersonal, and organizational perspective. The individual approach focuses on the examination of personality, with particular regard to personality traits predisposing to the burnout syndrome, as well as the symptoms of burnout appearing at the individual level. The interpersonal aspects refer to the social environment, the relationship between the helping professional and his client. Research on the organizational level emphasizes the particularities of the given workplace, job title, and the organization.

Examining the causes of the burnout syndrome, Pines, Aronson, Kafry (1990) revealed three reasons for burnout based on their research with 4,000 people: emotional overload, client-centered orientation and certain personality traits. As a result of these findings, in our research we investigated the psychological immune competence of teachers, because they can be regarded as a particularly vulnerable group, and psychological immune competence is a good coping resource (Vargay et al., 2019). We analyzed the mental health status of teachers (N: 301) from individual and interpersonal aspects in 2022, in Hungary. Based on our results, among the 16 factors of the Psychological Immune Competence Test (Oláh, 2005), they achieved the weakest result in the field of emotional control. We measured weaker results in the areas of challenge/flexibility, inhibition of irritability and social creativity, too. However, their results in the field of sense of coherence and endurance are better. In the mobilizing-creating-executive subsystem, they achieved a much higher value than the standardized average (for Hungarians). In the self-regulating and approach-monitoring subsystems, the results of teachers are similar to the standard average. 92% of the teachers have a positive mindset, but 40% achieved poor results in terms of challenge/flexibility. In the field of emotional control, 20% of them have below average results, which can lead to burnout later.

Our results show that among teachers, psychoeducational training can play an important role in preventing psychosomatic illnesses and burnout. Our long-term goal is to device targeted trainings for Hungarian teachers to prevent and alleviate burnout.

**Keywords:** *Teachers, mental health, psychological immune competence, burnout syndrome.*

---

## 1. Introduction

In our study, we present the examination of the psychological immune competence related to the mental health status of teachers on a Hungarian sample. In Hungary, it is extremely important to deal with the support of teachers these days, since the number of students applying for teacher training is decreasing every year, as a result, the teaching cohort is aging significantly, and the number of people dropping out has also increased. That is why it is important to find the points of intervention that can help make the teaching career attractive. With the help of our study, we would like to draw attention to the areas related to mental health in which it is necessary to provide support to teachers with state or institutional strategies, thus contributing to their psychological well-being and supporting their retention in the field.

### 1.1. Burnout

Burnout is a psychosocial corpus associated with helping people in welfare societies. There are three main symptoms of emotional exhaustion, depersonalization, and a loss of personal efficiency at work. In the experience of emotional exhaustion, a person cannot get emotionally involved in his work. Depersonalization means the development of negative attitudes and emotions about clients. In the sense of a loss of personal efficiency, assisting experts believe that their performance is not sufficient to carry out their duties properly and are dissatisfied with their results (Montero-Marín et al, 2009).



## **1.2. Health psychology**

Health psychology is one of the youngest fields of applied psychology, the American Psychiatric Association (APA) accepted it as an independent department in 1978 (Vargha & Szabó, 2015). According to Genrty (1984), the reasons for the development and prominence of the field include the fact that in recent decades the focus of medical treatment has shifted from infectious diseases to chronic diseases, that quality of life has become more prominent, the classic biomedical model is not very successful in health and in the interpretation of disease, and thanks to the behavioral sciences, learning theories helped to understand the behaviors associated with different diseases, as well as the etymology of the disease. The definition of the concept of health psychology is attributed to Matarazzo (1980). Health psychology includes "the combination of specific, educational, scientific and professional contributions of psychology to the support (health-promotion) and preservation of health, the prevention and treatment of diseases, the identification of the pathological and diagnostic correlates of health, disease and related disorders, and for the improvement of the health system and the development of an effective health policy" (Matarazzo, 1980, p.808).

## **1.3. Relationships between psychological immunocompetence, burnout and mental health**

By getting to know the concept of the psychological immune system - the components of which are all those personality resources that enable the individual to be able to endure various stress effects and to deal with them effectively, so that his development potential is not damaged in the meantime, and coping with stress is much more enriched with the internalization of his experience (Oláh, 1995) - it is clear that psychological immunocompetence is closely related to mental health status and burnout. The personality factors that create the coping resource capacity form an integrated system, the psychological immune system, within the personality as a whole. The different personality components performing those functions are grouped into three subsystems: the Approach-Monitoring, the Creative-Mobilizing-Executive and the Self-Regulating subsystems. The main groups of psychological immune competence are called coping potentials. Such coping potential is the ability to control, optimism, fitness, learned ingenuity, self-awareness and sense of coherence (Oláh, 1995). Through their mechanism of action, the person's position is strengthened in various interactions, from the beginning of the coping process to the selection of the appropriate behavior to the increase of resilience (Szicsek, 2004). At what level and with what result a person can cope with stress depends on several factors: their psychological immune competence, their ability to cope, and the invulnerability and unpredictability of the situation (Jaiswal et al, 2020). Positive coping strategies have a significant buffering effect in preventing the development of psychological illnesses (Takács et al., 2021). At the same time, we must also consider the results of Fináncz and Csima's (2019) study among workers in early childhood education, which found mild depression symptoms in 73% of those who completed it using Beck Depression Inventory – 9 Item Version.

Szicsek's (2004) study, in line with international examples, found that it is not work-related stress factors, but rather the workplace atmosphere that contributes to higher levels of burnout and lower values of psychological immune competence. That is why the strengthening of workplace mental health processes plays a particularly important role, not only in the health sector, but also in the field of education.

## **1.4. The state of wellbeing of teachers in Hungary today**

In recent years, the social perception and respect of teachers has gradually decreased in Hungary. Based on the results of the questionnaire research conducted by the education management among teachers in June and September 2022 - in which the participation rate was 24% - more than half of the respondents believe that with the current high class load, there is not enough time for proper preparation, the class sizes roughly correspond to what is considered ideal, however, it would be necessary to involve a pedagogical assistant in the daily work. The development of wages and the working environment, realistic performance evaluation and support for continuous professional development would also play a major role in making the teaching career attractive (Maruzsa & Kisfaludy, 2022).

## **2. Goals**

Based on the literature and our previous research results, we believe that burnout is related to psychological coping mechanisms and psychological immune competence in the case of teachers too. In our present study, we are looking for the answer to which factors in the study population, which of the 16 scales of Oláh's Psychological Immune System Inventory, help to cope with emotionally stressful situations, and which factors make it difficult. The obtained results can be incorporated into institutional and even governmental mental health strategies supporting Hungarian teachers.

### 3. Methods

#### 3.1. Study participants

A total of 301 people participated in the study. All of them work as teachers in Hungary. Of the 301 people, 281 are women and 20 are men. The age of the respondents was between 23 and 69 years old, they live in the capital, county seat, city, large village, or village. 285 people work in state and 16 private public education institutions. A significant part of the study population is represented by special education teachers, a total of 120 people. The number of primary school teachers (41 people), teachers (39 people) and psychologists working as teachers (29 people) is also high among those filling in, 72 people work in other pedagogical fields (e.g., development pedagogues, high school teachers, physical therapists, language teachers, vocational teachers, art subject teachers).

#### 3.2. Data collection

Our cross-sectional, quantitative, situational profile analysis took place from January to October 2022. Data collection was based on voluntary completion. The compiled questionnaire was shared electronically. The fill-in link reached the fill-ins using a snowball method, by sharing them online. In addition, thanks to the cooperation in the Cooperative Doctoral Program, the questionnaire was sent to all the maintained institutions of my employer, the Educational District Center in Kaposvár, which resulted in 107 out of 301 people completing it. The present study and the cooperation with the employer were based on the research presented at the 2021 International Conference on Education and New Developments, which is the study of teacher burnout in the Somogy County Pedagogical Service (Szigeti, 2021).

#### 3.3. Presentation of the test procedure

The Psychological Immune System Inventory (PISI) questionnaire, which was developed and standardized by Attila Oláh in 1997, was used to examine the immunocompetence of the teachers participating in the research. The questionnaire consists of 80 items. On a four-point Likert scale, the extent to which the respondent considers the given statement to be characteristic of him/herself must be indicated. 4 indicates "completely characteristic", 1 indicates "barely or not characteristic". The answers to the questionnaire are divided into 16 scales, which are as follows: positive thinking; ability to control; sense of coherence; self-respect; feeling of growth; flexibility, taking on challenges; empathy, social monitoring ability; ingenuity; sense of self-efficacy; capacity for social mobilization; social creativity; synchronicity; endurance; impulsivity control; emotional control; inhibition of irritability. The defined scale can be classified into the three subsystems of the self-regulatory system, such as the approach-monitoring, the creative-mobilizing-executive and the self-regulating subsystems, which provide the opportunity for further analysis of the data.

#### 3.4. Research questions

1. Is there a difference between the study population and the standard results in any scale of Oláh's Psychological Immunocompetence Questionnaire, and if so, what can be the reasons for this?
2. What are the areas of psychological immunocompetence in which the results of the study population are worse than the standard average? How can teachers be supported in these areas?

### 4. Results

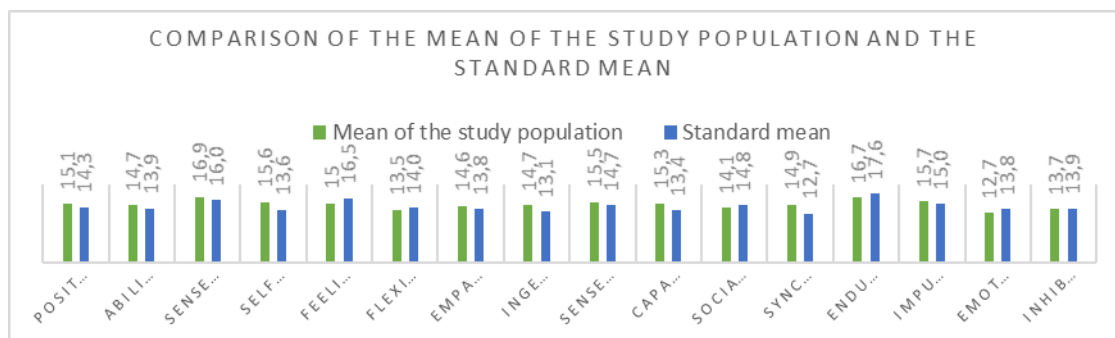
For the statistical analysis of our results, we used the SPSS V27 Statistical Program and MS Excel. Table No. 1 contains the averages and standard deviations for each scale determined based on the descriptive statistical analysis of the obtained results.

Table 1. Means and standard deviations in the scales of the PISI in study population (Oláh, 1997).

	Positive thinking	Ability to control	Sense of coherence	Self-respect	Feeling of growth	Acceptance on challenges,	Empathy, social monitoring ability	Ingenuity	Sense of self-efficacy	Capacity for social mobilization	Social creativity	Synchronicity	Endurance	Impulsivity control	Emotional control	Inhibition of irritability
Mean	15,1	14,7	16,9	15,6	15,0	13,5	14,6	14,7	15,5	15,3	14,1	14,9	16,7	15,7	12,7	13,7
SD	3,427	2,549	2,826	3,318	2,035	3,436	3,336	3,253	2,688	3,614	3,585	3,421	2,502	2,754	3,361	3,252

We compared our results obtained in the 16 scales of the Psychological Immune System Inventory with the standard values, using the ‘summary independent-samples t-test’ of SPSS. Based on this, it can be concluded that no significant differences were found between the standard group and our sample in the case of the Acceptance of challenges, flexibility and the Irritability-inhibition scale. In the case of three scales (Endurance, Social creativity and Emotional control) we found a significant negative difference, in all other cases we measured a significant positive difference ( $p=001$ ). A positive deviation indicates a higher psychological immunocompetence. 92% of the teachers participating in the study have a positive mindset, but 40% achieved poor results in terms of taking on challenges and flexibility. In the field of emotional control, 20% of them have below average results, which can lead to burnout later on. Lower average values were also obtained in the field of Irritability inhibition, but this is also lower in the case of standard values. In our previous study, which we conducted in a group of university students, the students achieved the best results in the Endurance scale of the PISI questionnaire, but in their case we also measured weaker results in the Emotional control and Social creativity scales (Di Blasio, Szigeti, 2022). A comparison of our obtained test results and the standard averages is presented in Figure 1.

Figure 1. Comparison of the average of the study population and the standard average in the 16 scales of the PISI (Oláh, 1997).



In the Mobilizing-creating-executive subsystem, they achieved a much higher value than the standardized average for Hungarians. In the self-regulation and approach monitoring subsystems, the results of teachers are similar to the standard average.

Based on the obtained results, we can give the following answers to our research questions:

1. With the exception of two scales (Challenge Acceptance, Flexibility and Irritability Inhibition), in all scales of Oláh's Psychological Immune Competence Questionnaire, we found a difference between the results of the study population and the standard values, mostly in a positive direction. In our opinion, teachers have better mentalization and empathy skills than the average population, and this helps them to cope better, and results in better psychological immunocompetence.

2. We experienced a negative deviation from the standard average on three scales: the Emotional control (controlling negative feelings in case of failures, Oláh, 2005), Perseverance and Social creativity (exploring the latent abilities in others, Oláh, 2005) scale. To support these areas, teaching relaxation methods, ensuring participation in supervisions, and practical knowledge of talent recognition and care can also be suitable strategies for teachers.

## 5. Conclusion

In our study, we presented a psychological immunocompetence test conducted among Hungarian teachers. Summarizing the results of the study, we can conclude that the psychological immunocompetence of the study population is better than that of the average Hungarian population, their sense of coherence, their self-respect, their sense of growth, their ingenuity, their self-efficacy, their ability to mobilize socially and their ability to synchronize are outstanding, but they have difficulties with emotional control, endurance and in the field of social creativity. Based on the investigation, we formulated recommendations regarding mental health support for teachers, e.g. providing the opportunity to learn relaxation techniques and participate in supervision. Our other plans include getting to know teachers' psychological coping strategies, which may be important in terms of both the prevention of burnout and the determination of our further focus points for mental health support.

### Acknowledgments

„Prepared with the professional support of the doctoral student scholarship program of the co-operative doctoral program of the ministry of innovation and technology financed from the national research, development and innovation fund.”

## References

- Di Blasio B. & Szigeti M. (2022). Student burnout in the post-COVID-19 period. (Hallgatói kiégés a poszt-covid időszakban). *Community Connections. 1.* pp. 5-17. Retrieved 01.03.2023., from: <https://ojs.bibl.u-szeged.hu/index.php/kapocs/article/view/43931/42924>
- Fináncz J. & Csima M. (2019). Indicators of the health status and health behavior of workers in early childhood education. (A kora gyermekkori nevelésben dolgozók egészségi állapotának és egészségmagatartásának mutatói). *Training and Practice. 1.* pp. 25-40. Retrieved 01.03.2023., from: <http://real.mtak.hu/95663/1/03-Financz-Csima-tanulmany-2019-01.pdf>
- Gentry, W. D. (Ed.) (1984). *The Handbook of Behavioral Medicine*. New York: Guilford. pp. 8-10.
- Jaiswal, A. & Singh, T. & Arya, Y. K. (2020). "Psychological Antibodies" to Safeguard Frontline Healthcare Warriors Mental Health Against COVID-19 Pandemic-Related Psychopathology. *Front. Psychiatry 11*:590160. doi: 10.3389/fpsy.2020.590160 Retrieved 12.28.2022. from: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.590160/full>
- Maruzsa Z., Kisfaludy L. (2022). The main experiences of questionnaire research conducted among teachers. (A pedagógusok körében végzett kérdőíves kutatások főbb tapasztalatai). *New Public Education. 78.(8)* pp. 8-11. Retrieved 12.29.2022., from: [https://folyoiratok.oh.gov.hu/sites/default/files/journals/uj\\_koznevelés\\_2022\\_08\\_online.pdf](https://folyoiratok.oh.gov.hu/sites/default/files/journals/uj_koznevelés_2022_08_online.pdf)
- Matarazzo, J. D. (1980). Behavioral health and behavioral medicine: Frontiers for a new health psychology. *American Psychologist, 35(9)*, 807–817. Retrieved 12.28.2022., from: <https://doi.org/10.1037/0003-066X.35.9.807>
- Montero-Marín J., García-Campayo J., Mosquera Mera D., López del Hoyo Y. (2009). A new definition of burnout syndrome based on Farber's proposal. *Journal of Occupational Medicine and Toxicology 4(31)*. Retrieved 12.29.2022., from: <https://occup-med.biomedcentral.com/articles/10.1186/1745-6673-4-31> 2022.12.29.
- Oláh A. (1995). *Anxiety, coping, and coping potential. (Szorongás, megküzdés, megküzdési potenciál)*. Candidate's thesis. Manuscript.
- Oláh A. (1997). Psychological Immune System Inventory. In: Forintos D. Perczel, Kiss Zs., Ajtay Gy. (ed.) (2005). *Questionnaires and rating scales in clinical psychology (Kérdőívek, becsülőkálák a klinikai pszichológiában)*. Budapest: National Institute of Psychiatry and Neurology. pp. 131-138.
- Oláh A. (2005.) *Emotions, coping and optimal experience. Methods of knowing our inner world. (Érzelmek, megküzdés és optimális élmény. Belső világunk megismerésének módszerei)*. Budapest: Trefort Publishing. Budapest. p. 224
- Pines A. M. & Aronson E. & Kafry D. (1990). *Burnt-out From Boredom to Self-development. (Ausgebrannt Vom Überdruß zur Selbstentfaltung.)* Klett-Cotta. Stuttgart. p.269
- Szicsek M. (2004). Correlations between burnout and psychological immunocompetence in nursing work. *Kharon. 8.(1-2.)* pp. 82-131. Retrieved 12.28.,2022., from: [http://epa.oszk.hu/02000/02002/00020/pdf/2004-1-2\\_szicsek-kieges.pdf](http://epa.oszk.hu/02000/02002/00020/pdf/2004-1-2_szicsek-kieges.pdf) 2022.12.28
- Szigeti M. V. (2021). Burnout prevention with psychoeducation in teachers. In Carmo M. (Ed.) *Education and New Developments*. Lisboa: inScience Press, pp. 205-209. Retrieved 01.03.2023, From: [http://end-educationconference.org/wp-content/uploads/2021/07/END-2021\\_Book-of-Proceedings.pdf](http://end-educationconference.org/wp-content/uploads/2021/07/END-2021_Book-of-Proceedings.pdf)
- Takács R. & Takács Sz. & T. Kárász J. & Horváth Z. & Oláh A. (2021). Exploring Coping Strategies of Different Generations of Students Starting University. *Front. Psychiatry 12*: 740569. Sec. Positive Psychology Retrieved 12.29.2022, From: <https://doi.org/10.3389/fpsyg.2021.740569>
- Vargay A. & Józsa E. & Pájer A.&Bányai É. (2019) The characteristics and changes of psychological immune competence of breast cancer patients receiving hypnosis, music or special attention. *Mental Hygiene and Psychosomatics, 20(2)*. pp. 139-158. Retrieved 12.29.2022, from: <http://real.mtak.hu/94753/1/0406.20.2019.009.pdf>
- Vargha J. L. & Szabó K. G. (2015). *Health psychology (Egészségpszichológia)*. Psychology Department. Cluj.

## TUTORED PRAXIS-SHOCK: TEACHER CANDIDATES' OPINION ON THE MENTAL EFFECTS OF SCHOOL MENTORING

**Magdolna Chrappán<sup>1</sup>, & Rita Bencze<sup>2</sup>**

<sup>1</sup>*Institute of Educational, University of Debrecen (Hungary)*

<sup>2</sup>*Doctoral School of Education, Eszterházy Károly Catholic University (Hungary)*

### Abstract

Teacher training is a key element of the quality of the education system. Staying in the teaching career is determined by many factors, however, overcoming the so-called praxis-shock means the first step for beginner teachers. For teacher students, mentoring during practical training is the main support, that is why it is important to know how the triadic relationship between the school mentor, the teacher and the university works. In our heuristic research, interactions between mentors, students and university actors, as elements of the mentoring process were examined (Sternberg, 2016, Ben-Harush & Orland-Barak, 2019).

During our research (2021-2022) we asked mentors working in Hungarian teacher training and student teachers who had just completed their coherent teacher training practice. Research was carried out with mixed methods, qualitative (scientific literature exploration, focus group interview in 4x8 groups) and quantitative (self-developed questionnaire based on the results of focus group interviews with 280 mentors and 351 students).

In the triadic relationship, the teacher candidate and his developmental process are in the focus. In our lecture we present a segment of the results of teacher candidates: how their professional development and self-efficacy are influenced by the activities of mentor, the organizational support of the school and the communication with the university.

The results show that teacher candidates are fundamentally uncertain in assessing the impact of school as a supportive environment (teacher colleagues, leaders), they are rather linked to the person of the mentor. It is surprising that almost exclusively the intensity of the personal relationship with the mentor influences self-efficiency and professional development.

The results are important primarily for mentors and schools, because it seems that it depends on them to what extent they can prepare candidates for the mental difficulties of the future career in a kind of "tutored reality shock".

**Keywords:** *Tutored praxis shock, triadic relationship, self-efficiency, teacher training practice, career change.*

---

### 1. Introduction

Staying in the teaching career is determined by many factors, however, overcoming the so-called praxis-shock means the first step for beginner teachers (Posny 2012; Ambrosetti, 2013). For teacher students, mentoring during the practical training is the main support (Williams, 2013; Landau Wright, 2015), that is why it is important to know how the triadic relationship between the school mentor, the teacher and the university works. In our heuristic research, interactions between mentors, students and university actors, the most important elements of the mentoring process as well as the influence of the school's organizational context were examined (Sternberg, 2016; Ben-Harush & Orland-Barak, 2019).

In addition to the most thorough theoretical preparation, the complex teacher role can be truly learned in a specific school context and through practical experience organized during teacher training. Numerous studies prove that these trainings also play an important role in forming teacher's habit and in reducing career leaving (Moir & Glass, 2001; Eby, Allen, Evans, & Dubois, 2008; Teacher Induction and Mentoring Brief, 2015). Reducing the so-called praxis shock seems to be one of the most crucial prerequisites for supporting students and beginner teachers to enter and remain in their career, which can be achieved mainly through the professional support of the pre-service period of the training and later on by the professional support provided by mentoring.

Becoming a teacher is a process in which it is important that the three phases, the pre-service, induction and the in-service phase should be built on each other and form an integral unity in course of a professional continuum (Knight, Turner & Dekkers 2013).

However, in this professional continuum considered as a lifelong professional development, the initial phase of the career (induction) is particularly important (Major, 2011). The first phase includes basic teacher education, where prospective teachers acquire basic skills competences. The second stage is characterized by the first independent steps of the beginner teacher, the first years of facing reality, that is what it really means to teach at a school.

Lortie describes the socialization process of novice teachers as a Robinson Crusoe effect. He also interprets the situation of the beginner teacher as being pushed into an extreme “sink or swim” situation when encountering reality. In these circumstances, the novice teacher, in the absence of professional communication, may interpret their initial failure as a lack of professional competence and weakness (Lortie, 1966, 1975). The terms of reality shock (Veenman, 1984) and transition shock (Corcoran, 1981) are also used to describe the impact on novice teachers. Reality shock refers to the personal emotional and professional uncertainty of starting the career, which comes from the contradictions between idealistic career formations and reality. Various researches indicate the lack of recognition, isolation, uncertain contact with colleagues and students, and professional idealism as parts of reality shock. (Hargreaves, 2000; Feiman-Nemser, 2001; Paul et al. 2001; Ballantyne, 2007; Kelly, 2008; Hourigan & Sheib, 2009; Servage & Beck, 2012; MacLeod & Walter, 2014).

In the first one or two years of teaching, the beginner teacher focuses on trying to bridge the gap between mastering the art of teaching (i.e. the knowledge gained during the teacher training program) and the daily experience gained at school. While trying to develop and integrate their own teacher identity within a given school culture, trying to solve daily teaching tasks (making lesson plans, dealing with classroom organization, keeping discipline, etc.), most of them are confronted with the fact that they do not yet have such a wide repertoire of skills as their more experienced colleagues. This gradually leads to frustration, isolation and finally practice shock (Stokking, Leenders, de Jong, & van Tartwijk, 2003; Chaplain, 2008; Miulescu, 2020)

Aarts, Kools, & Schildwacht (2020) created a synthesizing model of the difficulties of starting a teaching career. In this model, the individual, the students, the teaching-learning process, the school management and colleagues, the school organization, and the parents and society are the contexts in which novice teachers' problems can be interpreted. The development of reality shock is necessary to prevent as much as possible during teacher training, which can be solved by the practice orientation of the training. Practice orientation partly means early practical training (Gelfuso & Denis, 2014) and partly means an intensive school field training (Lawn-Furlong, 2009; Murray, 2016). During the practical training, the participants cooperate in a triadic relationship: the student, the school mentor and the university mentor (supervisor). The cooperation of the three actors determines the extent to which reality shock can be prevented or at least how prospective teachers can be prepared to handle it already during teacher training practice.

## **2. The context and methodology of the research**

Our research began in 2021 and has examined the impact system of the mentoring process. We have carried out a mixed method research, in accordance with the method of triangulation, the tools of literature processing, qualitative (interviews) and quantitative (self -developed student and mentoring questionnaires) were used. The sample was selected by expert sampling from the basic population of graduate students as well as the mentors of school practices, following the research ethics rules of the University of Debrecen. The student questionnaire consisted of 7 panels and 163 items, the average Cronbach's-alpha was 0.83 and the data processing was done with SPSS 29. The student sample consists of 351 students who are doing their complex school practice take place in the last year of the training. They spend their complex school practice in the final year of the training. 78.3 % of the sample are women (representative).

## **3. Data analysis and discussions**

One of the most severe public education problems in Hungary is the lack of teacher, it is especially true for beginner teachers, which is mainly due to low salary and low social prestige. Barely one -third of the students surveyed are confident that they want to work as a teacher.

Table 1. Are you planning to change your career?

		Gender		Total (N / %)
		Female (n / %)	Male (n / %)	
Are you planning to change your career?	Yes	126 / 46,5 %	43 / 56,6 %	<b>169 / 48,7 %</b>
	No	102 / 37,6 %	19 / 25,0 %	<b>121 / 34,9 %</b>
	Not sure	43 / 15,9 %	14 / 18,4 %	<b>57 / 16,4 %</b>

Source: own database, 2022

The data show that, although the correlation is not significant, the tendency is worrying, and one of the most important tasks of teacher training is to help teacher candidates enter and remain in teaching career. The retaining power of the profession is not dependent on the quality of training, but training content, especially practical training, can do a lot to make students more prepared for the challenges of the career. One method of this is the tutored practice mentioned in the title, the bottom line of which is that students gain their first experiences reality in a controlled, "incubated" environment with the help of a mentor. During the practice the university's expectations have to be fulfilled, but basically the practice place as an organization, mentor teachers and other members of the teaching staff are the sources of experience.

Therefore, in the questionnaire, we also asked about communication and cooperation with the mentor and other colleagues. The data show that mentors are particularly intense during practice, communicating with most candidates every day (19 %), or several times a day (50 %), but 30 % only talk to their mentor a few times a week.

The contents of the consultations with mentors move on a wide scale mentors (Table 2.)

Table 2. Topics of the communication between school mentor and student teacher (3 grade scale 1: few times per week... 3: many times every day N: 351).

	Mean		Std. Deviation
	Statistic	Std. Error	Statistic
scientific content of teaching	2,78	,02728	,50818
communication with learners	2,73	,02749	,51499
methodological ideas and solutions	2,66	,03156	,59120
we have discussion about each lesson held	2,41	,03578	,67033
learner-related tasks	2,36	,03640	,68195
extracurricular activities	2,25	,03386	,63082
we have discussion about each lesson plan	2,02	,04241	,78992
we mainly discuss deficiencies	1,98	,03859	,72295
we only agree on the basic principles regarding lessons	1,97	,04505	,83927
my actual emotional state of condition	1,93	,04284	,79801
cooperation with colleagues	1,83	,03810	,70977
keeping contact and communication with parents	1,74	,03618	,67391

Source: own database, 2022

The topic of consultations with the mentor (in what area the candidate receives direct support) does not affect teacher candidates' intention to leave their career. However, two factors correlate with the intention of leaving the profession, one is the frequency of communication (Pearson Corr.: -0,248, Sig.: 0.006), and the other is whether the mentor regularly evaluates the candidate's work (Pearson Corr.: -0.251, Sig.: 0.005). The judgement the school and the management's support is favorable, but the actual cooperative activities are at the end of the frequency rank. Two of these are worth mentioning: 1. involving the candidate in extracurricular activities, 2. visiting the candidate's lessons (by management or non -mentor teachers). Both, and only these two influence the candidate's intention to leave the career (1. Pearson Corr.: -0,221, sig. <0.001; 2. Pearson Corr.: -0,264, Sig. 0.002).

Only one element of the university relationship has an impact on the intention of leaving the career is: if the student feels he gets maximum help from the university (Pearson Corr.: -0.192, Sig. <0.001). However, knowing university expectations and administrative tasks has a positive effect on students' confidence. Confidence is an eight-element aggregate indicator based on research data (including steadiness related to teacher activities, criticism, openness, self-reflectivity and longer-term goals). The results show that the intention to leave the career correlates with this confidence indicator (Pearson corr.: -0,226, sig. <0.001). The intention to leave the profession is also correlated with two other aggregate indicators mostly: one is a career commitment indicator (enthusiasm, acquiring the love of

disciples, emotional burden of teacher work, perception of difficulty in teacher work), which shows a moderately strong correlation (Pearson Corr.: -0,499 . <0.001). Another aggregate indicator is the career prestige indicator (career opportunities, benefits, prestige, administrative tasks), with a moderate correlation as well. (Pearson Corr.: -0,429, sig. <0.001).

#### 4. Conclusions

The data show that the intention to leave the career also depends on factors that can be changed during teacher training exercises, so mentors and school as a whole can help with the by decreasing the initial praxis shock and mainly by supporting emotional and mental characteristics. Many elements of career commitment are a deeply rooted personality trait, but the presentation of coping techniques with difficulties can help a lot. At the same time, the intention to leave the profession also depends on several factors which the university or school practice have no impact on, only the public education system and the education policy interventions may change it. Career prestige in Hungary is a critical indicator that can fundamentally shake the earlier operation of the public education system. Further processing of our data may point out even deeper relationship, which may transform not only the tutoring system of practical training, but also the internal contents of the training (personalized development of socio-emotional competences).

#### References

- Aarts, R., Kools, Q., & Schildwacht, R. (2020). Providing a good start. Concerns of beginning secondary school teachers and support provided. *European Journal of Teacher Education*, 43(2), 277-295. doi: 10.1080/02619768.2019.1693992
- Ambrosetti, A., Knight, B., & Dekkers, J. (2013) A New Vision of Mentoring in Teacher Education. In: D. E. Lynch & T. Yeigh (Eds.), *Teacher Education in Australia: Investigations into Programming, Practicum and Partnership* (pp. 77-90). Oxford Global Press.
- American Institute for Research (2015). *Teacher Induction and Mentoring Brief*. Retrieved June 2021, from <https://lincs.ed.gov/publications/te/mentoring.pdf>
- Ballantyne, J. (2007). Documenting praxis shock in early-career Australian music teachers: The impact of preservice teacher education. *International Journal of Music Education: Practice*, 25(3), 181-191. doi: 10.1177/0255761407083573
- Ben-Harush, A. & Orland-Barak, L. (2019). Triadic Mentoring in Early Childhood Teacher Education: The Role of Relational Agency. *International Journal of Mentoring and Coaching in Education*, 8(3), 182–196. doi: 10.1108/IJMCE-10-2018-0055
- Chaplain, R. P. (2008). Stress and psychological distress among trainee secondary teachers in England. *Educational Psychology*, 28(2), 195-209. doi: 10.1080/01443410701491858
- Corcoran, Ellen (1981). Transition Shock: The Beginning Teacher's Paradox. *Journal of Teacher Education*, 32(3), 19-23.
- Eby, L. T., Allen, T. D., Evans, S. C., Ng, T., & DuBois, D. L. (2008). Does mentoring matter? A multidisciplinary meta-analysis comparing mentored and non-mentored individuals. *Journal of Vocational Behavior*, 72(2), 254–267. doi: 10.1016/j.jvb.2007.04.005
- Feiman-Nemser, S. (2001). From preparation to practice: designing a continuum to strengthen and sustain teaching. *Teachers College Record*, 103, 1013–1055. doi: 10.1111/0161-4681.00141
- Gelfuso, A. & Dennis, D. V. (2014). Getting Reflection off the Page: The Challenges of Developing Support Structures for Pre-service Teacher Reflection. *Teaching and Teacher Education*, 38, 1–11. doi: 10.1016/j.tate.2013.10.012
- Hargreaves, D. (2000, May). *How to design and implement a revolution in teacher education and training: Some lessons from England*. Keynote speech at the Conference on Teacher Education Policies in the European Union, Loulé, Portugal
- Hourigan, R. M., & Scheib, J. W. (2009). Inside and outside the undergraduate music education curriculum: Student teacher perceptions of the value of skills, abilities, and understandings. *Journal of Music Teacher Education*, 18(2), 48-61. doi: 10.1177/1057083708327871
- Kelly, S. N. (2008). High school instrumental students' perceptions of effective music student teacher traits. *Journal of Music Teacher Education*, 17(2), 83-91. doi: 10.1177/1057083708317648.
- Knight, B., Turner, D., & Dekkers, J. (2013). The Future of the Practicum: Addressing the knowing-doing gap. In: D. E. Lynch & T. Yeigh (Eds.), *Teacher Education in Australia: Investigations into Programming, Practicum and Partnership* (pp 63-74). Oxford Global Press.



- Landau Wright, K., Hodges, T. S., Franks, A. D., McTigue, E., & Douglass, A.G. (2015). Minding the Gap: Mentoring Undergraduate Preservice Teachers in Educational Research. In: Li, Y. & Hammer, J. (Eds.), *Teaching at work*. (pp. 171-192). Sense Publishers.
- Lawn, M. & Furlong, J. (2009). The Disciplines of Education in the UK: Between the Ghost and the Shadow. *Oxford Review of Education*, 35(5), 541–552. doi: 10.1080/03054980903216283
- Lortie, Dan C. (1966). The Robinson Crusoe model. In: *The real world of beginning teacher. Report of NCTEPS Conference, June 22-25, 1965, New York City*. 54-67. Retrieved February 14, 2021, from: <http://files.eric.ed.gov/fulltext/ED030616.pdf>
- Lortie, Dan C. (1975). *Schoolteacher: A sociological study*. Chicago, University of Chicago Press.
- MacLeod, R. B. & Walter, J. S. (2014). A descriptive study of cooperative teachers' perceptions regarding student teacher preparation. *Bulletin of the Council for Research in Music Education*, 190, 21-34.
- Major É. (2011). A mentor mint szaktanár [The mentor as a teacher]. In: Baumstark B., Gombocz O. & Hunyady Gy. (Eds.) *A tanárképzés 2010-2011 fordulóján: A piliscsabai regionális tanácskozás. Közép-magyarországi pedagógusképzési hálózat tanárképzési nap* (pp 192-196).
- Miulescu, Miruna Luana (2020). Walking the tightrope: challenges encountered in novice teachers' practice. *Journal of Pedagogy*, 1, 115-136. doi: 10.26755/RevPed/2020.1/115
- Moir, E., & Gless, J. (2001). Quality induction: An investment in teachers. *Teacher Education Quarterly*, 28(1), 109–114.
- Murray, J. (2016). Trends in Teacher Education across Europe: An Initial Analysis. In: Falus I. & Orgoványi-Gajdos J. (Eds.): *New Aspects in European Teacher Education* (pp. 6-17). Eger, Líceum Kiadó
- Paul, S. J., Teachout, D. J., Sullivan, J. M., Kelly, S. N., Bauer, W. I. & Raiber, M. A. (2001). Authentic-context learning activities in instrumental music teacher education. *Journal of Research in Music Education*, 49(2), 136-145. doi: 10.2307/3345865.
- Posny, A (2012). The Federal Department of Education Looks Ahead. Retrieved May 2, 2015 from [http://images.pearsonassessments.com/images/NES\\_Publications/2012\\_03Posny.pdf](http://images.pearsonassessments.com/images/NES_Publications/2012_03Posny.pdf)
- Servage, L., & Beck, J. (2012). *Teaching in the early years of practice: Fourth year report*. The Alberta Teachers' Association. Retrieved May 20, 2021, from [https://legacy.teachers.ab.ca/SiteCollectionDocuments/ATA/Publications/Research/Teaching%20in%20the%20Early%20Years%20of%20Practice%20\(PD-86-19a\).pdf](https://legacy.teachers.ab.ca/SiteCollectionDocuments/ATA/Publications/Research/Teaching%20in%20the%20Early%20Years%20of%20Practice%20(PD-86-19a).pdf)
- Stenberg, K., Rajala, A. & Hilppo, J. (2016). Fostering Theory–Practice Reflection in Teaching Practicums. *Asia-Pacific Journal of Teacher Education*, 44(5), 470–485. doi: 10.1080/1359866X.2015.1136406
- Stokking, K., Leenders, F., de Jong, J. & van Tartwijk, J. (2003) 'From student to teacher: reducing practice shock and early dropout in teaching the profession.' *European Journal of Teacher Education* 26(3), 329-350. doi: 10.1080/0261976032000128175
- Veenman, S. (1984). Perceived Problems of Beginning Teachers. *Review of Educational Research*, 54(2), 143–178.
- Williams, J. (2013). *Constructing New Professional Identities. Career Changers in Teacher Education*. Sense Publishers, Rotterdam.

# AN ANALYSIS OF THE USE OF SIMULATION CENTERS IN THE TRAINING OF PRE-SERVICE AND NOVICE ENGLISH TEACHERS IN ISRAEL. WHAT MAKES THEM WORK WELL?

**Nicole Broder**

*David Yellin Academic College (Israel)*

## Abstract

Escalating rates of teacher attrition require teacher training programs to consider more contemporary training methods. Adapted from the medical and aviation fields, the concept of simulations is currently making an entry into the world of education. An international pioneer in this venture, Israel already has twenty simulation centers at its universities and teacher training colleges and has more in the planning stages. Through qualitative research methods, this study analyses the factors contributing to their success. It highlights benefits derived by teachers from experiences at simulation centers including, inter alia, heightened self-awareness leading to more successful interactions in the workplace. Numerous benefits, particularly for graduates entering the teaching profession, suggest that simulation center experiences should be necessary inclusions of teacher training programs around the world.

**Keywords:** *Simulation centers, teacher training programs.*

---

## 1. Introduction

Teachers are responsible for shaping the minds of future generations. It is for this reason that the training of future teachers is of fundamental importance. The conception of simulation centers for educators seeks to enhance this training period. The opportunity for pre-service and in-service educators to experiment with interpersonal skills - whether real or in the form of simulated role play - promises improved performance inside and outside the classroom. While practice at real schools, in real classrooms is necessary, mistakes often occur at the cost of the children and the teachers themselves. Simulations are dynamic experiences, occurring in safe, artificial environments, away from the real world. Simulation centers attempt to serve as places that contribute to the vital training of teachers.

In 2023 Israel, there are twenty simulation centers for specifically built for educators, all of which are located on the campuses of universities or teaching colleges. These centers welcome all types of stakeholders in the field of education, including pre-service and in-service teachers, principals, inspectors, pedagogical advisors and college lecturers. Thousands of educators and future educators experience simulations each year as an integral part of their professional development. The needs of the target audience are ascertained ahead of time by the staff at the center so that relevant, genuine scenarios that reflect actual practice, can be tailor made for them by scenario writers. Professional actors and debriefing facilitators are prepared to be immersed into the complex, and often conflict-filled world of education.

Simulations are traditionally used in the training of air force and health care professionals (Rutherford-Hemming, 2012). In fact, Dr. Sarah Zilberstrom together with Dr. Meira Eizenhamer, leading educators of newly qualified teachers at Bar Ilan University in Israel, carried out three years of research and study at the M.S.R. Simulation Center for Health Care professionals - adjacent to Tel Hashomer Hospital in Tel Aviv - before developing their own program for educators at Bar Ilan University between the years 2009-2011. In 2013, after two years of pilot studies, mainly for the benefit of the members of their own teacher internship program, the center obtained approval and funding from the Ministry of Education to provide simulations for educators from all sectors and at all levels of their professional development. HaLev, the National Center for Simulation in Education, is part of the School of Education at Bar Ilan University and was the first center of its kind in the world. Since then, an additional nineteen simulation centers for educators have sprung up all over the country, aiming at educators at all levels.

This study will focus on the organizational aspect of simulation centers. The relatively new simulation center at David Yellin Teachers' College in Jerusalem is the center at which I carried out my

research. This center has been successfully providing simulations in conflict management - in Hebrew, Arabic and English - for educators, since 2016. In particular, I focused on the experiences of EFL (English as a Foreign Language) student teachers and novice teachers.

## 2. Literature review

At simulation centers, teachers can experiment with a variety of strategies, unpack them in a group forum and then attempt to improve them based on the lessons they have learnt (Kaufman and Ireland, 2016). The emergence of simulation centers, founded in recent years for the purpose of both pre and in service educators, attempts to upgrade the future practice of teachers. The simulation center experience for educators is, in fact, a modern concept in education. Traditionally, simulations are standard, conventional learning tools in the medical and aviation professions (Keskitalo, 2014), and studies from these disciplines point to them becoming recognized as potentially effective learning tools in teacher education too (Kaufman and Ireland, 2016). Simulations have the ability to hold slices of reality under the magnifying glass with a view to reap better understandings and use of inter-personal skills (Cruz and Patterson, 2005) in the workplace.

In fact, the main objective of simulation centers is to enhance and improve social interactions between educators, as well as between educators and students, teachers and parents (Eizenhamer, 2014). At simulation sessions, educators are required to display behavior based on respect and trust in a safe environment, in groups no larger than fifteen participants, although this number varies from center to center. The simulation sessions are led by facilitators who are skilled in creating this environment. In an introductory session, they explain the process of the simulation experience and following the scenario, they lead a debriefing session aided by screenings of recorded clips from the scenarios themselves. During debriefings, participants are encouraged to reflect on both their choice of both verbal and non-verbal methods of communication in order to raise their awareness of the ways in which they are able to manage conflict situations and thereby explore alternative routes to successful results in real-life interactions in the future (Eizenhamer, n.d.).

Participants in simulation scenarios are encouraged to engage in realistic situations, and to attempt, in the best way possible, to manage them and later, to reflect on the results. Based on the conclusions of these reflections, they are expected to find parallels between the scenes enacted in these pre-written scenarios and their own practice, with the intent of rethinking their actions and words in future similar real-life situations (Zigmont et al., 2011b).

As with all types of learning, reflection and repeated practice are key factors in the change process (Girod and Girod, 2006). Therefore, simulations may be seen as tools of professional development adopted to encourage and support change in teaching strategies, decision making, classroom management abilities, and other inter-personal interactions, innate in the daily lives of educators (Kaufman and Ireland, 2016).

Situational simulations are role-plays based on conflict or emergency situations during which the teacher or trainee teacher is required to behave as though in a real-life situation, using strategies in order to resolve them in an optimal manner. Participants usually react to the actors in the scenarios as a result of their individual characters, cultures, backgrounds and life or work experience (Cruz and Patterson, 2005). A sense of urgency is provided by the limited amount of time allotted for the scenario to take place and the particular inter-personal strategies chosen to deal with the situation, making it meaningful and practical (Alessi and Trollip, 2001).

Simulation based training encourages active involvement, collaboration and reflective practice, which are all necessary elements on the road to meaningful learning. By experiencing a vast range of individual emotions and reactions during the simulation experience, participants are driven to reflect on their own real-life situations and possibly change their practice (Paskins and Peile, 2010) or at least, consider other possible courses of action in order to achieve more desirable results.

The facilitator then sets the stage for the scenario, and in doing so, provides an introduction to the program so as to avoid any uncertainty about the length and shape of the debriefing process (Rall et al., 2000). Scenarios range between issues of classroom management, interactions between teachers and students, teachers and parents and others. One of the participants volunteers to participate in the scenario, usually in the role of the teacher. Additionally, a professional actor will play the part of the student, principal or a parent. The remaining participants are encouraged to take notes of interesting observations, thoughts, or feelings they experience during the scenario.

The scenario plays out for between five to seven minutes and is filmed. Clips chosen by the facilitator for group discussion will be screened later on in the debriefing session and essentially a platform for reflective group discussion. Taking an active part in a simulation scenario or being an observer of one is not sufficient for the simulation experience to be complete. Following the scenario, the

participant returns to the circle where his colleagues await him following the observation of the scenario. Led skillfully by a trained facilitator, the debriefing process begins. This process is commonly thought of as the most important factor in the simulation experience (Issenberg, 2005; Zigmont et al., 2011a). Indeed, of what value is observation if not to spur reflection?

Towards the end of the debriefing session, the facilitator sums up the session, providing the participants with tangible points to take away with them. It makes no difference if they are written in point form on the board or provided digitally. Educators are adult learners. Andragogy, or the teaching of adults, understands that adults are self-motivated to learn; their learning is based on life experience; adults learn what they want to learn when they want to learn it, usually because they are interested in improving their performance (Deci, 1985). Adult learners need to feel that they have not wasted their time discussing intangible topics, but instead come away feeling that the experience has succeeded in granting them with useful, practical tools (Jobe et al., 1997).

Often, videos are shown during pedagogy courses at pre-service teachers' colleges or at in-service programs in order to activate productive reflection and professional discussion in a collaborative setting (Alsawaie and Alghazo, 2010). There is much value for a student teacher who provides a video clip of himself teaching during the practicum for class discussion, for he gains valuable critical feedback on his teaching from his lecturer and peers. Observers of video clips are permitted to take an impartial stance and an objective view of authentic classroom scenarios. Repeated viewings of these clips constantly provide new angles, detached reflection, and hopefully, change in practice (Amador, 2018).

At simulation centers, however, the use of video has a twin purpose. Not only does it allow scenario observers access to a scenario taking place in a different room perhaps, but later on in the debriefing session, it provides participant who volunteered to take part in the scenario to actually see themselves in action as well.

### 3. Empirical illustration

I investigated the experiences of student teachers and intern teachers at the Simulation Center at David Yellin Teaching College. In order to discover which factors contribute to the success of simulation experiences for student teachers as well as novice teachers, I chose to interview three participants who volunteered to act in the simulation scenarios, both before and immediately after the simulation sessions.

### 4. Discussion

It is interesting that the facilitator, attributes the success of the scenarios to her communication with the group's pedagogical advisor prior to the date of the session (Cherrington and Loveridge, 2014). Not only does this ensure that the scenario is relevant and practical for the participants' needs, but it also creates a relationship between the facilitator and the pedagogical advisor, which becomes a key factor during the debriefing session. When students witness agreement between the two during the debriefing, the messages being relayed to them, bear more weight. Preparatory work involving the coordination of the pedagogical advisor, facilitator and actor is vital. The scenario must be relevant and appear realistic for the participants, the actor must be provided with the scenario ahead of time in order to immerse herself into her role and attempt to predict the participants' reactions, and, as previously stated, the relationship between the pedagogical advisor and the facilitator must be established.

A revelation by a student teacher regarding her childhood speech impediment and the traumatic effect of the cameras on her performance admittedly surprised me. Until now, I had only seen the positive benefits of the use of filming the scenarios (Cherrington and Loveridge, 2014). Although the cameras didn't bother the other two students interviewed, they certainly had a profound effect on this student. The actress too, suggests that in order to improve the simulation experience, the scenarios should take place in a separate room, away from the glare of cameras and fellow participants alike. On the other hand, a novice teacher reported that although, at first, she felt that the scenario was staged, in a matter of minutes, she found herself immersed in her interaction with the actress, and perceived the scenario as real.

In general, unless they are entertainers, people tend to shy away from cameras. It is for this reason that the cameras in simulation centers should be hidden as well as possible. If participants are to behave and respond to stimuli in an authentic manner, they need to suspend the feeling of disbelief. Cameras prevent this from occurring. This said, the value of filming the scenarios for later use in the debriefing period, is overwhelming. Without this tool, facilitators would need to describe the participants' body language and other forms of unspoken communication to them and conversely, participants would have to accept their perceptions. However, due to the filmed clips, participants are provided with hard evidence of this communication which, although perhaps painful, they must acknowledge. It is

fascinating to witness the power of a slight glance at one's cellphone or an unintended yawn on people with whom we are interacting.

Two student teachers admitted to gaining a boost in confidence when receiving compliments from their peers during the debriefing. Workshop participants agreed that teachers are often isolated in their classrooms. They are rarely observed by others. In fact, many teachers claim that they feel lonely in the workplace (Flinders, 1988). To prevent feelings of loneliness from developing, there need to be strong communication networks in place for teachers (Dodor, 2010).

The simulation experience provides not only a place for reflection, but also for observation by others, which can lead to an increase in confidence, an opportunity to engage in collaborative discussion and a sense of comradery. For novice teachers, feelings of isolation can often lead to attrition, whereas a sense of belonging has the potential to keep them in the teaching profession. Interviewees acknowledged a need for future simulations dealing with classroom management issues and dilemmas.

It is unlikely that the participants will be faced with a similar set of circumstances for some time, and since, according to Jobe et al. (1997), following the discussion in the debriefing session, it is advisable to reenact the scenario. In my experience, all too often, time runs out too quickly, and the opportunity to repeat scenarios is lost. It is my belief that, already in the preliminary planning stages, time for this must be factored into the timetabling of the simulation experience.

## 5. Conclusion

As the existence of simulations for educators is relatively recent, there is sparse literature on this topic. My research attempts to fill a void in knowledge, which is the fundamental strength of my study. On the whole, there are many benefits for participants at the simulation center (Cherrington and Loveridge, 2014). This study aims to provide a glance into the many advantages of such experiences at simulation center for educators in general, but specifically for both student teachers and novice teachers. There are currently twenty simulation centers in Israel, each unique in its own way, and my study focused on just one of them. Additionally, I interviewed only five key players, i.e. two student teachers, one intern teacher, a facilitator and an actor. Surely, if my study would have included more people, the results would have differed. For these reasons, I acknowledge that although some general conclusions may be drawn, there is no sense in which conclusions will be seen to be more widely applicable; my intention however, is that they will serve as a base line for future, broader studies.

## 6. Concluding comments

In this study, I have focused on the experiences of pre-service teachers and novice teachers of EFL, who are literally balancing on the threshold into the world of education. At this initial, embryonic stage of their careers, they are most open to the establishment of good practice, most willing to accept sound advice and to learn about and adopt successful habits. For this reason, I regard simulations as an essential ingredient of teacher training programs.

Interviews with various key players at the center, including the simulation facilitator, an actress, two student teachers and one newly qualified teacher, provided me with valuable, in-depth qualitative data based on personal experiences and observations. I extracted recurring themes that I discovered from the data and my conclusions are as follows.

I believe that the repetition of scenarios following debriefing sessions is absolutely necessary, for fear of losing opportunities for participants to act in the near future based on decisions made at the sessions. Effective planning by the center ahead of the simulation experience is also essential so that a partnership between the facilitator and pedagogical advisor is created and that relevant and meaningful scenarios for the participants are ensured.

The gift of being able to see oneself through multiple lenses is extraordinary. It brings to mind the experience of riding in an elevator whose four walls are mirrored. When looking straight ahead, one sees a one-dimensional image, but a glance to the side shows a different angle and a glance to the corner provides a look at oneself in 3D. This is the beauty of the debriefing session; it magically provides multiple perspectives of our behavior, body language and linguistic expression from many points of view. The skills required to orchestrate this very unique experience belong mainly to the facilitator. It is for this very reason that I would like to suggest that, at the very minimum, both actors and facilitators, are required to attend occasional training sessions, or become members in specialized learning communities, at which they can learn from both professionals and each other.

This study has exposed the potentially sensitive nature of simulations and the deeply seated reactions they can arouse. On the one hand, they can serve as springboards for the elevation of teachers' confidence while simultaneously, awakening an awareness to the fact that there are a bounty of

alternative ways to deal with relationships and interactions. Conversely, when simulations are not handled in a sensitive manner, deep offense can be taken or unwanted memories may surface, unintentionally barring participants from the ability to learn from their experiences. In order to accommodate for people who are generally camera-shy, scenarios should be enacted in a room far away from stares of other participants and obtrusive cameras.

In conclusion, it appears that simulation centers for educators have much to offer in terms of spurring reflection, leading to an improvement in the future performance of teachers. When paying careful consideration to the suggestions that have emerged from the data provided in this study, and ensuring their implementation, stakeholders in simulation centers will have the ability of providing an even more valuable experience to all those who pass through their gates.

## References

- Alessi, S., & Trollip, S. 2001. *Multimedia for learning: methods and development* (3<sup>rd</sup> ed.). Boston, MA.
- Alsawaie, O., and I. Alghazo, 2010, The effect of video-based approach on prospective teachers' ability to analyze mathematics teaching: *Journal of Mathematics Teacher Education*, v. 13, p. 223-241.
- Amador, J. M., 2018, Video simulations to develop preservice mathematics teachers' discourse practices: *Technology, Pedagogy & Education*, v. 27, p. 1-15.
- Cherrington, S., and J. Loveridge, 2014, Using video to promote early childhood teachers' thinking and reflection: *Teaching and Teacher Education*, v. 41, p. 42-51.
- Cruz, B. C., and J. Patterson, 2005, Cross-Cultural Simulations in Teacher Education: Developing Empathy and Understanding: *Multicultural Perspectives*, v. 7, p. 40-47.
- Deci, E. L., 1985, *Intrinsic Motivation and Self-Determination in Human Behavior*, Boston, MA: Springer US: Imprint: Springer.
- Eizenhamer, M., n.d. *Halev, the National Center for Simulation in Education* (online). Bar Ilan University, School of Education, Tel Aviv, Israel. Available from: [https://education.biu.ac.il/files/education/shared/plyyr\\_kns\\_shry\\_khynvk\\_2016.pdf](https://education.biu.ac.il/files/education/shared/plyyr_kns_shry_khynvk_2016.pdf) (Accessed 15 March 2019).
- Girod, M., and G. Girod, 2006, Exploring the Efficacy of the Cook School District Simulation: *Journal of Teacher Education*, v. 57, p. 481-497.
- Issenberg, S. B., 2005, Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review: *Medical Teacher*, v. 27, p. 10-29.
- Jobe, K. K., R. K. Dismukes, and L. K. McDonnell, 1997, *Facilitating LOS Debriefings: A Training Manual* - NASA-TM-112192, Sponsoring Organization: NASA Ames Research Center.
- Kaufman, D., and A. Ireland, 2016, Enhancing Teacher Education with Simulations: *TechTrends*, v. 60, p. 260-267.
- Keskitalo, T., 2014, Towards meaningful simulation-based learning with medical students and junior physicians: *Medical Teacher*, v. 36, p. 230-240.
- Paskins, Z., and E. Peile, 2010, Final year medical students views on simulation based teaching: A comparison with the Best Evidence Medical Education Systematic Review: *Medical Teacher*, 2010, Vol.32(7), p.569-577, v. 32, p. 569-577.
- Rall, M., T. Manser, and S. K. Howard, 2000, Key elements of debriefing for simulator training: *European Journal of Anaesthesiology*, v. 17, p. 516-517.
- Rutherford-Hemming, T., 2012, Simulation Methodology in Nursing Education and Adult Learning Theory: *Adult Learning*, v. 23, p. 129-137.
- Zigmont, J. J., L. J. Kappus, and S. N. Sudikoff, 2011a, *The 3D Model of Debriefing: Defusing, Discovering, and Deepening: Seminars in Perinatology*, v.35, p. 52-58.
- Zigmont, J. J., L. J. Kappus, and S. N. Sudikoff, 2011b, *Theoretical Foundations of Learning Through Simulation: Seminars in Perinatology*. V.35, p.47-51.

## **MENTORING IN TEACHER TRAINING PRACTICE: THE INTERPRETATION OF MENTORS' ROLE IN THE TRIADIC RELATIONSHIP**

**Rita Bencze<sup>1</sup>, & Magdolna Chrappán<sup>2</sup>**

<sup>1</sup>*Doctoral School of Education, Eszterházy Károly Catholic University (Hungary)*

<sup>2</sup>*Institute of Educational Studies and Cultural Management, University of Debrecen (Hungary)*

### **Abstract**

Teacher training is a key element of the quality of the education system. Staying in the teaching career is determined by many factors, however, overcoming the so-called praxis-shock means the first step for beginner teachers. For teacher students, mentoring during practical training is the main support, that is why it is important to know how the triadic relationship between the school mentor, the teacher and the university works. In our heuristic research, interactions between mentors, students and university actors, as elements of the mentoring process were examined.

During our research (2021-2022) we asked mentors working in Hungarian teacher training and student teachers who had just completed their coherent teacher training practice. Research was carried out with mixed methods, qualitative (scientific literature exploration, focus group interview in 4x8 groups) and quantitative (self-developed questionnaire based on the results of focus group interviews with 280 mentors and 351 students).

In our lecture we present one segment of mentors: how the role interpretation of mentors is influenced by organizational support, and also by the communication with the student teacher and the university (intensity, content).

For the role interpretation of the mentors, we made a scale based on different models, which refer to different elements of the pedagogical process and the relationship with the mentor.

Our correlation and cluster analysis also shows that the wide range of role interpretation is influenced by two factors: the intensity of supportive environment and communication with universities, as a result of which not only subject-matter knowledge, but also pedagogical content knowledge got in the focus of mentoring. The intensive communication with candidates results in the strengthening of their mental and emotional support, the strength of the correlation depends significantly on the mentor gender. Based on our results, recommendations may be articulated for each party regarding the triadic relationship: the more intense the communication between the actors and the more supportive the school environment is, the more effectively mentors and teacher candidates can participate in the mentoring progress.

**Keywords:** *Mentoring in teacher training, triadic relationship, school mentors' role, mixed method.*

---

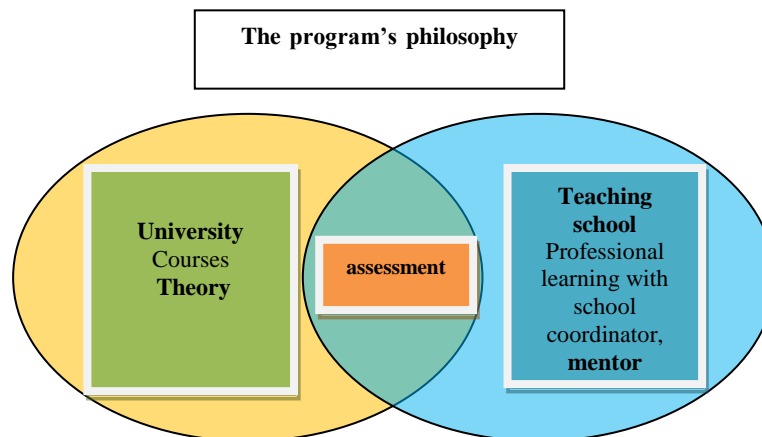
### **1. Introduction**

Text Nowadays, educational systems and its important pillars of teacher training are experiencing constant changes. In public education, quality and efficiency have become the key words of the last decade. In addition, it is also stated that the quality of education is basically determined by the quality of the teachers (Organisation for Economic Co-operation and Development, 2005, McKinsey, 2007). Mentoring as a program is a key element of effective teacher training, both for students and beginner teachers (Posny, 2012, Ambrosetti, 2013, Li & Hammer, 2015,). In the so-called induction phase (the first phase of the career), mentor as a colleague, consultant, trainer helps the teacher candidate and the new graduate teacher (novice teacher) understand that teaching is a continuous learning process, in which the pre-service period of teacher training was the very first step. With regard to the role of mentors, it is often pointed out that it falls on mentors and university supervisors cooperating with them to bridge the gap between the university and the school as theoretical and practical learning scenes (McLeskey & Waldron, 2004; Ritter, 2012; Landau Wright, 2015; Bruneel & Vanassche, 2021). Thus, the most important actors of teacher training are practical (tutoring) university lecturers and school mentors, senior teachers, and their cooperation is a key issue for the effectiveness of training.

Different models were created to interpret the university-school teacher candidate triad, and all the actors agree that communication between the parties is the basis of cooperation. Not only individuals (mentor, teacher candidate, university supervisor), but also organizations (school organization and university departments) are present in this communication and cooperative space. Lynch and Yeigh (2013) underline the problem that the relationship between teacher training institutions and schools is missing or very weak. One consequence of this is that some kind of gap is formed instead of cooperation. Universities also try to control teaching practice, questioning the ability of schools to do so in the right quality. As a result, the duality between "what we know" and "what we do" has become more and more determining, which has had an influence on the quality of teacher training, in terms of schools and universities. As a solution, in the Australian teacher training the so-called Teaching School Model was worked out, which strengthens the cooperation between the university and the school by giving the school a strong permission to organize teacher training. In the model mentor teachers have a significant role, who are important actors in the practice of graduate students, leading consultations, making lesson plans, being in charge of the teaching practice and evaluation. Meanwhile, the mentor also has the opportunity to enhance his own professional development, as by constant self-reflection he has to evaluate himself, so mentoring also develops a kind of practicing community (Lynch & Yeigh, 2013). The teaching school model represents a partnership between the university and the school where the school provides a real life environment under the guidance of senior educators.

The following figure shows how teacher training and practical training are interconnected, and their similar role in the process of teacher training.

Figure 1. Triadic relationship in Teaching School Model.



Source: Knight, Turner, & Dekkers (2013). 71.

The so-called "Third Space" model is recommended by many authors to enhance the productivity of cooperation and partnership (Ikpeze, Broikou, Hildenbrand & Gladstone-Brown, 2012; Arhar et al., 2013; Klein et al., 2013; Taylor, Klein & Abrams, 2014), which makes cooperation smooth among students, mentors and instructors. The "third space" is the venue where the culture of school practice is actually matched with the theoretical education system of the university.

However, the "third space" model does not count on the fact that students are very often forced into compliance with their mentor and their university instructor because of different expectations, which results in many conflicts in the cooperation (Chambers & Armour, 2011; Taylor et al. 2014).

As a solution, Lillejord and Børte (2016) shows a model that focuses on the student's learning activities, thus, through student activities, both mentors and university instructors should synchronize practice and theory. The solutions are important to build a less hierarchical, rather horizontal relationship (Ellis & McNicholl, 2015). This assumes that when the actors of the triad seek cooperation, they must keep in mind the different needs of participants in the partnership, namely the needs of the school, the university and the students (Lillejord & Børte, 2016).

## 2. The context and methodology of the research

Our research began in 2020 and has examined the effects of the mentoring process. We have applied mixed method research, in accordance with the method of triangulation, the tools of literature processing, qualitative (interviews) and quantitative (self-developed student and mentoring) were used.



The sample was selected by expert sampling from the basic population of graduate students and the mentors of school practices, following the research ethics rules of the University of Debrecen. The mentor questionnaire consisted of 6 panels and 143 items, the average Cronbach's alpha was 0.894 and the data processing was done with SPSS 29. The mentor sample contains 280 people and 74.9 % of the sample are women (representative). In our lecture, we present the results of the mentor's role based on the mentor questionnaire data and the results related to the mentor student, mentor-university relationship.

### 3. Data analysis and discussions

It is the task of mentors to perceive student needs, to judge and develop their teacher competences. It is therefore important how mentoring roles are interpreted and what activities they consider the most important ones. From our research data on students, we know that for students strengthening self-confidence and mental abilities are almost as important as the narrowly interpreted methodological help from the mentor.

The mentors interviewed apply the elements of the activity repertoire with different frequencies. (Table 1):

Table 1. The frequency of mentor's activity elements N:280, 5 grade Likert scale.

	Mean
giving feedback	4,81
providing personal assistance	4,81
efficient cooperation	4,79 (0,263**)
analysis and evaluation of observed lessons,	4,77
evaluation of candidate's work	4,71
providing methodological support	4,70
helping candidates handle students' behavioural issues	4,66
presenting good practices	4,57
developing candidate's reflectivity	4,54
developing candidate's competences	4,47
helping candidates gain experience (lesson observation, consultations, extracurricular events, etc.)	4,42
presenting the bright side of teaching profession	4,05 (0,239**)
rating evaluation of candidate's work	4,04
precise interpretation of teacher competences for candidate	3,97
providing professional support	3,96

Source: own database \*\*Pearson corr, sign.:<0,001 (a nőknél gyakoribb elemek)

Each of the activities listed is a regular element of mentoring activities, in case of two elements there is a significant difference in favour of women, in their case cooperation and the presentation of the bright side of teacher's career are more common. There are other differences between male and female mentors as well, although the correlations are in the low-moderately strong range, the difference is significant.

The basic medium of mentoring activity is communication with the student, which must reflect on the student's activities as well as his personal attitudes and emotions.

Table 2 shows what the common content elements of communication are and what their frequency is.

Table 2. Topics of mentor-student teacher discussions (3 grade scale, 1: almost never ...3: regularly, daily based).

	Mean
communication with children	2,9214 (0,208**)
methodological ideas and solutions	2,8607 (0,304**)
we have a consultation after each lesson held	2,7554 (0,148**)
children-related tasks	2,6786 (0,349**)
we discuss every lesson plan in details	2,6250 (0,148**)
professional contents of lessons	2,6232 (- 0,157**)
mentee's emotional state	2,4321 (0,278**)
extracurricular activities	2,1536 (0,276**)
cooperation with colleagues	2,1403
keeping contact and communication with parents	1,8214 (0,173**)
we only agree on basic principles related to lessons	1,7185 (-0,207**)
we mainly discuss deficiencies	1,6014 (-0,146**)

Source: own database, \*\*Pearson corr., sig.: <0,001, - sign: more frequent element with men

From the table it can be clearly read that basically there are two elements at the centre of the discussions: children and lesson-related tasks. Mentors discuss every lesson plan and each lesson held with the candidate on a daily basis. This is the basis for the development of reflectivity (this coincides with the data on the development of reflectivity in Table 1.).

The correlation values indicated in brackets in the Mean column show that there are elements more typical of male mentors. Male mentors are rather focused on the curriculum content and, in particular, they agree on the basic principles with the candidate, and provide less detailed methodological assistance. Frequency values do not show a significant difference broken down by genders (also due to the 3-point scale), and the correlation values, although in the weak-medium category, have a high significance value, so they are definitely suitable for trend formulation.

Female mentors are more likely to keep track of their mentees precisely and continuously, it is especially true for methodological solutions and child-related tasks. The role- interpretation of mentors is also influenced by the organizational context, which means the involvement of school management in the mentoring process. The data show that the participation of management reinforces certain mentoring activities. We have created a four -element aggregate management supporting indicator (the head of school visits, evaluates the student and helps the mentor and the student). This indicator correlates with presenting the beauties of the career (Pearson Corr.: 0.429, Sig.: <0.001) and interpreting teacher competences (Pearson Corr.: 0.295, Sig.: <0.001) in case of both genders. As this is exactly what we experience regarding women, too, we can assume with good reason that the involvement of the school management does not mean that mentors should be supervised. On the contrary, the school as an environment might become more supportive, which allows mentors a wider teacher role interpretation and this appears more frequently when presenting the beauty of the career and teacher competences. This conjecture must be confirmed with further data analysis.

#### 4. Conclusions

The role of mentors is the most important issue of practical teacher training because school practices have a strong socialization effect on teacher candidates. Hungarian mentors are characterized by the focus of direct classroom work (classroom management), and the contexts beyond that appear less, which pushes the mediated career in a more closed and subject-centric direction. It can help if the school management is present in the mentoring process more intensely, and presumably this is not a direct impact, but rather an impact deriving from organizational culture. According to our data so far, there seems to be typical, though not very strong differences between male and female mentors. These differences may be worth considering when assigning students to mentor. Our results can mainly be useful for organizational actors in the triadic relationship (university administration, preparing mentors and school management).

## References

- Ambrosetti, A., Knight, B., & Dekkers, J. (2013) A New Vision of Mentoring in Teacher Education. In: D. E. Lynch & T. Yeigh (Eds.), *Teacher Education in Australia: Investigations into Programming, Practicum and Partnership* (pp. 77-90). Oxford Global Press.
- Arhar, J., Niesz, T., Brossmann, J., Koebley, S., O'Brien, K., Loe, D., & Black, F. (2013). Creating a 'Third Space' in the Context of a University-School Partnership: Supporting Teacher Action Research and the Research Preparation of Doctoral Students. *Educational Action Research* 21(2), 218-236. doi: 10.1080/09650792.2013.789719
- Bruneel, S., & Vanassche, E. (2021). Conceptualising Triadic Mentoring as Discursive Practice: Positioning Theory and Frame Analysis. *European Journal of Teacher Education*, 44(4). doi: 10.1080/02619768.2021.1985456
- Chambers, F.C., & Armour, K. M. (2011). Do as we do and not as we say: teacher educators supporting student teachers to learn on teaching practice. *Sport, Education and Society*, 16(4), 527-544. doi:10.1080/13573322.2011.589648
- Ellis, V., & McNicholl, J. (2015). *Transforming Teacher Education: Reconfiguring the Academic Work*. London, Bloomsbury.
- Ikpeze, C. H., Broikou, K. A., Hildenbrand, S. & Gladstone-Brown, W. (2012). PDS Collaboration as Third Space: An Analysis of the quality of Learning Experiences in a PDS Partnership. *Studying Teacher Education* 8(3), 275-288. doi: 10.1080/17425964.2012.719125
- Klein, E., Taylor, M, Onore, C., Strom, K. & Abrams, L. (2013). Finding a Third Space in Teacher Education: Creating an Urban Teacher Residency. *Teaching Education* 24(1), 25-57. doi: 10.1080/10476210.2012.711305
- Knight, B., Turner, D., & Dekkers, J. (2013). The Future of the Practicum: Addressing the knowing-doing gap. In: D. E. Lynch & T. Yeigh (Eds.), *Teacher Education in Australia: Investigations into Programming, Practicum and Partnership* (pp 63-74). Oxford Global Press.
- Landau Wright, K., Hodges, T. S., Franks, A. D., McTigue, E., & Douglass, A.G. (2015). Minding the Gap: Mentoring Undergraduate Preservice Teachers in Educational Research. In: Li, Y. & Hammer, J. (Eds.), *Teaching at work*. (pp. 171-192). Sense Publishers.
- Li, Y., & Hammer, J. (Eds.) (2015). *Teaching at work*. Sense Publishers.
- Lillejord, S., & Børte, K. (2016). Partnership in Teacher Education - a research gapping. *European Journal of Teacher Education*, 39(5), 550-563. 10.1080/02619768.2016.1252911
- Lynch, D. E., & Yeigh, T. (Eds.) (2013). *Teacher Education in Australia: Investigations into Programming, Practicum and Partnership*. Oxford Global Press
- McKinsey & Company (2007). *How the World's Best Performing School Systems Have Come Out on Top*. Retrieved September 12, 2014 from <http://www.smhc-cpre.org/wp-content/uploads/2008/07/how-the-worlds-best-performing-school-systems-come-out-on-top-sept-072.pdf>
- McLeskey, J., & Waldron, N. L. (2004). Three conceptions of teacher learning: Exploring the relationship between knowledge and practice of teaching. *Teacher Education and Special*, 27(1), 3-14.
- Organisation for Economic Co-operation and Development (2005). *Teachers Matter. Attracting, developing and retaining effective teachers*. Retrieved January 29, 2015, from <https://www.oecd.org/education/school/34990905.pdf>
- Posny, A (2012). *The Federal Department of Education Looks Ahead*. Retrieved May 2, 2015 from [http://images.pearsonassessments.com/images/NES\\_Publications/2012\\_03Posny.pdf](http://images.pearsonassessments.com/images/NES_Publications/2012_03Posny.pdf)
- Ritter, J. K. (2012). Modelling powerful social studies: Bridging theory and practice with preservice elementary teachers. *The Social Studies*, 103(3), 117-124. doi: 10.1080/00377996.2011.596857
- Taylor, M., Klein, E. J., & Abrams, L. (2014). Tensions of Reimagining Our Roles as Teacher Educators in a Third Space: Revisiting a Co/autoethnography Through a Faculty Lens. *Studying Teacher Education* 10(1), 3-19. doi: 10.1080/17425964.2013.866549

# WHO ARE YOU? PROFILE OF EARLY CHILDHOOD CARETAKERS AND EDUCATORS

Aviva Dan<sup>1</sup>, & Eitan Simon<sup>2</sup>

<sup>1</sup>Dr., Head of Early Childhood Studies (Israel)

<sup>2</sup>Dr., Head of Advanced Degrees (Israel)

## Abstract

Quantitative research aimed to investigate the professional identity of Early Childhood Caretakers (ECC) enrolled in a professional training program through the Ministry of Education. The training program is an innovative program to increase the professional knowledge of Early Childhood Education staff who have no professional training and are working in the field. The results indicated that the participants had a strong feeling of professional identification based mostly on practical experience. The opportunity to gain theoretical knowledge through a professional training program such as the one in which they are currently enrolled, is expected to increase their feelings of teaching self-efficacy and confidence and consequently improve the quality of interpersonal interactions they provide, and as such to positively affect the development of the children in their care.

**Keywords:** *Early childhood caretakers, professional training for early childhood, teaching self-efficacy.*

---

## 1. Introduction

In 2021, the supervision of Early Childhood Education in Israel was transferred from the Ministry of Labor, Social Affairs and Social Services, which had been responsible from the beginning of the state of Israel for the establishment and supervision of early childhood services, to the Ministry of Education. Even so, there are still many private early childhood facilities for children under the age of three, that are not subject to any official framework or professional supervision to ensure the quality of the services.

As a result of the change in national policy concerning the supervision and standardization of early childhood facilities, and the transfer of early childhood education into an integral part of the national education ministry, one of the first major decisions that were initiated was that all members of staff had to have a professional early childhood certificate, authorized by the ministry of education. The course of training is funded by the government and each student who successfully finalizes their training is entitled to a grant from the government. The responsibility for training the untrained staff was delegated to academic teacher training colleges that are certified by the board of higher education to train kindergarten teachers. The Ministry of Education issued a protocol to invite academic colleges to take part in the professional training of untrained nursery staff who are currently employed from all areas in the country.

In contrast to early childhood educators that work in facilities for young children from three months old to three years old, kindergarten teachers of children from three years old to six, in Israel, by law, must have a first degree in early childhood studies from the academic colleges and a license to teach from the ministry of education. The research study examined the professional and personal profile of the ECCE workers who registered for the training course through one academic college in the North of Israel.

In training programs for students that desire to enhance their knowledge and gain a certificate for professional training, the term "caregiver" for young children is prevalent as the professional title and not teacher. The perception of most people regarding the contents of the profession for working with young children is a person, usually a woman that will provide nurturing and emotional aspects of care and individualized care rather than a planned curriculum or pedagogical interactions (Bergen et al., 2001). Seldom do people perceive the educational activities of infants and toddlers as sophisticated, learning experiences or even important to the child's future development (Jung, 2013). The professional work of staff that work with infant and toddlers entails complex and important reciprocal interactions in their daily practice (Rockel, 2009; Rogers, 1994).

## 2. Literature review

According to the statistics, 95 per cent of preschool kindergarten teachers in Israel have academic training that puts the country in a comparable place with other nations, such as Norway (95 per cent) and Chile (81 per cent) but the rest of the staff who are assistants, have a lower level of education, 69% have a high school education or less, 24% with post-secondary non-academic education and only 7% have an academic degree (Vakhnin, 2021). In the Arab speaking sectors of the Israeli society the statistics show an even lower percentage of preschool assistants with only high school education (74 per cent). The professional training for Early childhood educators who work in childcare services for children between three months until three years has been mandatory for those that work in supervised day care centers. Each class teacher was required to undergo a course organized by the ministry of Labor and Social Services, directors of childcare centers were required to undergo advanced training. Even though the training is mandatory not all educators enrolled in the training courses, and in private childcare centers that were not under the auspices of the Ministry of Labor and Social Services it was very difficult to enforce the mandatory training. As a result, thousands of early childhood educators without any professional knowledge were employed in various early childhood centers all over the country.

## 3. Professional identity

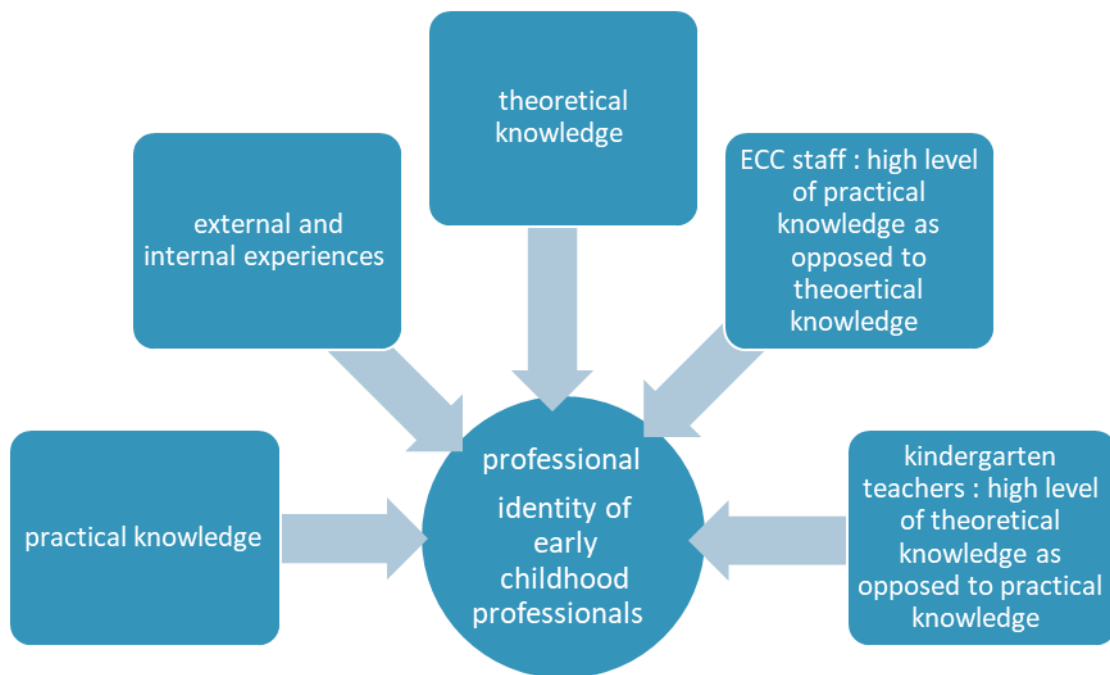
Professional identity is built on a combination of internal and external interactions, how one sees oneself and how one is perceived by outside factors. In a study by Doyle and Carter (1996) they stated that becoming a teacher means " a) transforming an identity b) adapting personal understandings and ideals to institutional realities and c) deciding how to express oneself in classroom activity" (p139). Research shows that high-quality early childhood settings have a direct influence on children's future academic success (Schütz, 2009; Bauchmüller et al., 2014; Dämmrich & Esping-Andersen, 2017), therefore it is mandatory that the staff working with young children have the necessary aptitudes, professional ability, and knowledge to be able to assist the young children in their developmental trajectory.

Professionalism is a set of behaviors that is required of a profession and a person working in that profession must exhibit these behaviors that are expected of him as a member of a profession (Freeny,2010). Frequently professionalism emphasizes the possession of specialized knowledge that has been acquired through years of academic studying. In the area of early childhood education, a large portion of professional knowledge is acquired through practicum, practical knowledge that is required through daily interactions with young children, year after year. (Kuisma & Sandberg 2008). The authors are convinced that the knowledge required through practical experience has an important contribution to the professionalism of early childhood educators as of course does the theoretical knowledge.

In addition to the professional core values and personal characteristics the quality of an educational setting is influenced by the effectiveness of the staff in their ability to engage children in meaningful activities and engage in meaningful educator -child interactions (Rimm-Kaufman & Hamre,2010). The level of teachers' effectiveness is influenced by the teacher's feeling of self- efficacy, which has been shown to effect student's academic achievement and motivation (Caprara,Barbranelli, et al., 2006). In preschool settings the feelings of high self -efficacy of educators has been found to influence three major areas, emotional support, classroom organization, and instructional support (Pianta, La Paro, & Hamre, 2008). Research has shown that teachers with higher self-efficacy have more confidence in supporting children's development through their interactions with children, leading them to engage in more positive, supportive, and sensitive interactions (Barni et al., 2019). Factors affecting the level of teacher self-efficacy are varied, teachers' characteristics and experience, though research has found that teacher's self-efficacy beliefs increased from early to mid-career but decreased after that (Klassen & Chiu 2010), classroom conditions and high levels of interpersonal collaboration between staff members (Guo et 2011).

There are no apparent studies that investigate the self-perception or professional identity of early childhood educators that are responsible for the safety, health and education of children under the age of three, a critical time in human development. Research that investigated the professional identity of kindergarten teachers that are responsible for the education of children between the ages of three years old to six found that a large percentage of the research population had a strong feeling of high professional ability and viewed their career choice very positively and 93% of the research population indicated that their career choice was made from a feeling of fulfilling a mission (Simon, Dan,2021).

Figure 1.



#### 4. Design

Participants in this study were 143 Israeli female ECC. They presented a wide age range: about 30% of them were up to 30 years old, another about 30% were in their thirties, about one fifth were in their forties, and the rest were mainly in their fifties (table 1). Most were married (about 61%), and others were single (about 22%) or divorced (about 17%). They had up to seven children, with a mean of about two children ( $SD = 1.50$ ). Most had a high school education (about 77%), and about 56% were working in rural areas.

#### 5. Research instruments

The Teacher's Professional Identity Questionnaire (Fisherman and Weiss, 2011).

This questionnaire depicts the professional identity of teachers as their thoughts and feelings about their professional choice, their professional conduct, their sense of mission and the general reputation they ascribe to the teaching profession. Phrasing of the items in the current study was adapted to the ECC staff.

The questionnaire includes 34 items, such as "I see the teaching profession as a mission", "I am sure I have the qualities to be a good teacher", "I have the right approach to students". Items are rated on a five-point scale from 'strongly disagree' (1) to 'strongly agree' (5). They are organized according to four sub-scales:

The questionnaire was distributed among the research population by digital means. As google docs at the beginning of the course. The questionnaire was anonymous and entailed the filling in of the form. The researchers were not present at the time and had no previous relationships with the research population. The population was recruited through local regional councils that are responsible for providing early childhood care for young parents.

#### 6. Results

Results show high means for the sub-scales of the teachers' professional identity. A repeated measures analysis of variance between them was significant ( $F(3, 426) = 9.42, p < .001, \eta^2 = .062$ ), and showed that the mean for 'Teaching self-efficacy' was highest, the means for 'Confidence in the professional choice' and 'Sense of mission' were next, and lowest was the mean for 'Teaching reputation'. This rank ordering of the means is significant, yet all mean is high. Correlations among the

scales were all significant and moderate to high, revealing that the higher was the professional identity on one dimension, the higher it was on the others.

Results show that the ECC staff were highly confident in their professional choice, although some had some doubts. Rather similarly, they reported high self-efficacy, and even the lowest items had rather high means. The ECC perceived education and teaching as a mission, and many (though not all) reported they had always perceived it as their mission. Many of them, yet not all, have corrected people who thought of them as working in another profession. They reported appreciating other kindergarten teachers, and believing that those who do not like to educate young children should not engage in teaching them. They partly agreed that only a few qualify for the definition of a professional in education and were not always personally negatively affected by the media.

## 7. Discussions and conclusions

The findings show that the EEC staff felt that their choice of profession was a decision made from a feeling of education being a mission, I always thought my mission was to be an ECC(3.64, 1.27)Early childhood teaching is a mission for me (4.62, 0.79) this feeling of ideology was expressed in research that investigated the professional identity of kindergarten teachers ,who also indicated that their professional choice was due to a feeling of fulfilling a mission (Simon, Dan 2021). This is a surprising in today's modern society and encouraging to see that educators of young children feel like their profession is a calling or a mission.

Teacher's self-efficacy has been shown to affect the quality of education (Barni et al., 2019). The results in this research show that the EEC staff had a high sense of self efficacy towards teaching. From the results it can be seen that the population that had a previous background of education above high school level indicated higher levels in all parameters of confidence in their professional choice, in feelings of teaching self-efficacy, that working in early childhood settings is fulfilling a mission and they had a higher evaluation of being an EEC. Therefore, it is imperative to implement a policy in the country that anyone who is to work with young children will have to have an education above high school level. This research shows the importance of ECC staff to have an opportunity to supplement their professional knowledge that is mostly practical knowledge with theoretical knowledge.

## References

- Barni, D., Danioni, F., & Benevene, P. (2019). Teachers' self-efficacy: The role of personal values and motivations for teaching. *Frontiers in Psychology, 10*, 1645. <https://doi.org/10.3389/fpsyg.2019.01645>
- Bauchmüller, R., Gørtz, M., & Rasmussen, A. W. (2014). Long-run benefits from universal high-quality preschooling. *Early Childhood Research Quarterly, 29*(4), 457–470. <https://doi.org/10.1016/j.ecresq.2014.05.009>
- Bergen, D., Reid, R., & Torelli, L. (2001). Educating and caring for very young children: The infant/toddler curriculum. New York, NY: Teacher College Press.
- Caprara, G. V., Barbaranelli, C., Steca, P., & Malone, P. S. (2006). Teachers' self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: A study at the school level. *Journal of School Psychology, 44*(6), 473-490. <https://doi.org/10.1016/j.jsp.2006.09.001>
- Dämmrich, J., & Esping-Andersen, G. (2017). Preschool and reading competencies — A cross-national analysis. In H. P.Blossfeld, N. Kulic, J. Skopek, & M.Triventi (Eds.) ,*Childcare, early education and social inequality: An international perspective* (pp.31–48). Cheltenham, UK: Edward Elgar Publishing
- Doyle, W., & Carter, K. (1996). Educational psychology and the education of teachers: A reaction. *Educational Psychologist, 31*(1), 23-28. [https://doi.org/10.1207/s15326985ep3101\\_3](https://doi.org/10.1207/s15326985ep3101_3)
- Guo, Y., Connor, C. M., Yang, Y., Roehrig, A. D., & Morrison, F. J. (2012). The effects of teacher qualification, teacher self-efficacy, and classroom practices on fifth graders' literacy outcomes. *The Elementary School Journal, 113*(1), 3-24. <https://doi.org/10.1086/665816>
- Jung, J. (2013). Teachers' roles in infants' play and its changing nature in a dynamic group care context. *Early Childhood Research Quarterly, 28*, 187–198. <https://doi:10.1016/j.ecresq.2012.05.001>
- Klassen, R. M., & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience, and job stress. *Journal of Educational Psychology, 102*(3), 741.
- Kuisma, M., & Sandberg, A. 2008. Preschool teachers' and student preschool teachers thoughts about professionalism in Sweden. *European Early Childhood Education Research, 16*(2): 186–195. <https://doi.org/10.1080/13502930802141618>

- Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2008). Classroom Assessment Scoring System™: Manual K-3. Paul H Brookes Publishing.
- Rimm-Kaufman, S. E., & Hamre, B. K. (2010). The role of psychological and developmental science in efforts to improve teacher quality. *Teachers College Record*, 112(12), 2988-3023. <https://doi.org/10.1177/016146811011201204>
- Rockel, J. (2009). A pedagogy of care: Moving beyond the margins of managing work and minding babies. *Australian Journal of Early Childhood*, 34(3), 1–8. <https://doi.org/10.1177/183693910903400302>
- Rogers, D. L. (1994). Conceptions of caring in a fourth-grade classroom. In A. R. Prillaman, D.J. Eaker, & D. M. Kendrick (Eds.), *The tapestry of caring: Education as nurturance* (pp. 33–47). Norwood, NJ: Ablex.
- Simon,E., & Dan,A. (2021) Who are you ? Profile of Early Childhood Caretakers(under review).
- Schütz, G. (2009). Does the quality of pre-primary education pay off in secondary school? An international comparison using PISA 2003. Ifo Working Paper Series, No.68. Ifo Institute - Leibniz Institute for Economic Research at the University of Munich.
- Vakhnin, Dana (Ed.) (2021). Early age group in Israel: Selected findings from research. Jerusalem: Taub Center. [Hebrew] <https://www.taubcenter.org.il/wp-content/uploads/2021/09/HE-ECEC-booklet-ONLINE.pdf>. Retrieved September 6, 2022. [Hebrew]



## STUDENT TEACHERS' PERCEPTION ON THE USE OF MOTHER TONGUE AS MEDIUM OF INSTRUCTION IN FOUNDATION PHASE

**Pule Phindane**

*Language and Social Sciences Education, Faculty of Humanities, Central University of Technology, Free State, Private bag X 20539, Bloemfontein 9300 (South Africa)*

### Abstract

The study investigated the perception of the student teachers in the use of Mother Tongue as a medium of instruction in Grades 1-3 and the perceived problems associated with its use. It also determined the relationship between attitude and age, sex, and place of origin (district). Guided by the Gardner's Socio-educational model (1985), the study collected data through a survey involving 150 student teachers enrolled in Bachelor of Education in Foundation Phase program at Central University of Technology and Free State University. Data were analysed using frequency, mean, mode, and standard deviation. The relationship between variables was determined through the Chi-Square test for independence using SPSS. The outcomes showed that most of the respondents agree that the use of home language as a medium of instruction is good in principle. They believe it would enable teachers to express themselves clearly, and it would also make the lessons interesting to learners. However, some problems associated with its use were also identified, such as: difficulty in translation, teacher's low proficiency in Mother Tongue, learners' low proficiency in Mother Tongue, degradation of English proficiency, and lack of teacher's training in teaching Mother Tongue. Findings further revealed that the place of origin, not age and gender, influences the respondents' perception. The study, therefore, proves that the student teachers, in general, have positive attitude towards the use of Mother Tongue as medium of instruction and are willing to undergo training to be able to teach using the mother tongue.

**Keywords:** *Perception, student teachers, Mother Tongue, language proficiency.*

---

### 1. Introduction

The apartheid era in South Africa was characterised by a language policy that did not officially recognise indigenous languages (L1) spoken by majority of the population. In 1994, the government recognised the significant role played by the mother tongue in learning, thus an educational language policy raised the status of indigenous languages (Phindane, 2017). According to the official language policy of the 1996 Education Act and Department of Education (2002), children in Grade 1 -3 are to be instructed in their home language and learn English (L2) as one of the subjects on curriculum. In South Africa, parents are permitted to choose the language in which their children are to be educated (Department of Education 2002); but most parents demand that their children are educated in English (Heugh 2010). This is partly due to global prestige of English as a medium of international communication, language of business, and pre-requisite for employment (Bhoi 2014). Many studies were conducted to find out the impacts of using mother tongue in teaching and learning English. They seemed to focus much on the positive effects rather than the negative ones. English skills can be improved better if they are taught in an only English environment (Nguyen, 2022). We listen and respond to what we hear around us and then we succeed in mastering our mother tongue. As a result, the proponents of monolingual approach, we believe that second language learning follows a process similar to first language learning, claim that exposure is essential in learning English (Coo, 2001, Kharma & Hajjaj, 1989). In other words, learners of English should be exposed to an English environment as much as possible to become master in English.

#### 1.1. Review of literature

The success of mother tongue instruction policy relied mostly on people's perception towards home language and English as First addition language. According to Khosa (2012), there are number of issues that play a significant role in influencing people's attitudes towards learning in mother tongue. The historical and political background was active in influencing mother tongue learning. The previous

apartheid language policies adopted the use of Afrikaans/English from the first grade or only encouraged the use of an African language as a medium of instruction in the lower grades in the primary school. This scenario can be regarded as the explanation behind the negative perception on mother tongue learning.

Studies have shown that instruction in the mother tongue is beneficial to language competence in the first language, achievement in other subject areas and training in a second language (UNESCO 2016). According to Phindane (2017:17) “instruction in the mother tongue helps in the search for self- affirmation, establishes group identity, satisfies the rational urge for cultural rootedness and avoids fanatics in concept formation, critical thinking, creativity and in important social values”. In other words, children who begin their education in mother tongue make a better start, demonstrate increased self- confidence and continue to perform better than those who start school in a foreign language. In their study on the effectiveness of teaching and learning mathematics using children’s home language and cultural tools, Hafiz and Farik (2016) observed that children who were taught without using their home language and materials from their cultural environment, did not perform well. They concluded by saying that the poor performance of learners in mathematics primary school is due to the negligence of incorporating children’s home language and material from children’s cultural environment.

In the context of education, studies of attitudes in the previous years have mostly dealt with the attitudes of students, teachers, and parents toward learning a second or foreign language (Baker, 1992; Gardner and Lambert, 1972). However, more recently, the focus of language attitude studies has shifted from L2 learning to L1 or mother tongue-based teaching in the hope of understanding more about the intended language innovation and in promoting greater success in education. Although studies in this field are of significance, research particularly on students’ attitude remains quite so few.

According to Tonio and Ella (2019), Chivhanga and Sylod (2014) compared the attitudes of student teachers toward the use of English and ChiShona as a medium of instruction in teaching Grade 4 Mathematics in Zimbabwe primary schools. The study revealed that parents, teachers/lecturers, and college/university learners preferred English over ChiShona as medium of instruction from primary to university level. Since Shona is prescribed to Grades 1 to 3 only, Webster, Mavies, Timothy, and Cordial (2012) investigated the influence of teachers and students’ language attitudes toward the use of Shona as medium of instruction if it will be adopted in secondary schools in Zimbabwe. Both the students and teachers manifested a negative attitude to Shona and opted for English as medium of instruction. Most of the students agreed that Shona has limited use in their lives and is presumed to be inadequate for the effective teaching of science and technology. Based on these results, Webster et al. (2012) concluded that the attitudes of the users toward the language innovation negatively affects the implementation of Shona.

In the meantime, studies dealing with the relationship between language attitude and age, gender, and place of origin have provided valuable insights in relation to the discussion of the shift from English to home language in the classroom. Ajepe (2014) revealed that age and gender influence students’ attitude toward the use of mother tongue. Students between 15 and 18 years old in his study were shown to be more interested in the use of home language. Additionally, female students have more positive attitude toward mother tongue use than male students. Nevertheless, in Alieto’s (2018) study, gender difference on language attitude was not evident. Apart from age and gender, Assefa (2002) reported that place of origin (district) is another significant factor that can affect language attitude.

## 1.2. Research questions

This study investigated the attitudes of the student teachers toward the use of home language as medium of instruction in Grades 1-3 and their willingness to teach in home language when they complete their studies. Explicitly, it sought to answer the following research questions:

1. What are the attitudes of student teachers towards home language-based teaching in Grades 1-3?
2. Is there a substantial relationship between the attitudes of student teachers towards home language-based teaching (i.e., age, gender and place of origin)?
3. What are the perceived challenges in the use of home language as medium of instruction in Grades 1 – 3?

## 1.3. The socio-educational model

This study is guided by the socio-educational model that was developed by Robert Gardner in 1985. The socio-educational model was created on the notion that language learning builds a learner’s identity that enables him/her to adapt and operate in a new environment. The model presents four interrelated variables, such as social setting (i.e., individual’s culture and environment), individual differences (i.e., intelligence, aptitude, motivation, and anxiety), second language acquisition context (i.e., formal and informal settings), and outcomes (i.e., linguistic skills and non-linguistic skills).

Furthermore, the model suggests the interdependent relationship between attitude and motivation as these two variables directly or indirectly influences successful language learning both in formal settings where language acquisition is the primary objective, and informal settings where language acquisition appears to be secondary and incidental (Gardner, 1985).

## 2. Methodology

This descriptive-quantitative study involved 150 student teachers enrolled in Bachelor of Education in Foundation Phase program at Central University of Technology and Free State University (Qwaqwa campus) through a survey. There were 30 respondents for each area. The respondents were composed of 39 (26%) males and 111 (74%) females. In terms of age, 75 (50%) of the respondents were between 18 to 19 years old; 54 (36%) of the respondents were 20 to 21 years old and lastly, 21 (14%) of the student teachers were 22 years old and above. There were 54 (36%) of the student teachers who reported that their L1 is different from the home language stated by Department of Education (DepEd), while 96 (64%) reported no difference as to their L1 and the home language identified by DepEd for their city or province.

The survey questionnaire was adapted from Ejieh (2004). Some modifications on the statements were made to fit the South African context. The modified questionnaire earned a reliability rating of 0.80 using Cronbach's Alpha. Also, the researchers opted for a 4-point Likert Scale that varied from strongly agree to strongly disagree instead of yes/no response. The survey questionnaire was divided into two parts. In Part 1, respondents were asked to provide pertinent personal information such as gender, age, district, first language, and whether their native language different from the home language identified/declared by Department of Education for their city or district. Meanwhile, the 10 statements included in Part II are made up of two levels; Level 1 includes items 1- 9 which seek the views of the student teachers on some issues and problems related to teaching and learning in home language such as the benefits of teaching and learning in home language to pupils, teachers and parents, as well as the limitations of instruction in home language. As for the second level, item 10 which is an open-ended question was included. The item requires the respondents to list down problems that they foresee in teaching home language in primary schools, specifically in Grades 1 to 3. Following the research ethics procedure, the researchers sought the approval of the designated deans and administrators of the institutions involved through a communication letter prior to the administration of the survey. Data were analysed using descriptive statistics, namely: frequency count, mean, mode and standard deviation. Furthermore, qualitative approach was employed to analyze the perceived problems in the use of home language.

## 3. Results and discussion

Table one below represents attitude of student teachers towards home-based teaching in Grades 1-3.

Table 1. Attitude of student teachers towards home language-based teaching in Grades 1-3.

Statement	SA	A	D	SD	Mean	DE
1. A policy on the use of home language in the South African primary schools (Grade 1-3) is good in principle.	56	85	9	0	1.69	A
2. It is possible to teach all primary school subjects from Grade 1-3 in the home language or language of the local community	43	82	24	1	1.89	A
3. It is possible to teach my own subjects completely in home language	16	75	53	6	2.33	D
4. Teaching in home language will enable teachers to express themselves clearly in class	52	88	10	0	1.72	A
5. Teaching in home language will enable pupils to understand easily.	60	80	8	2	1.69	A
6. It will make lessons interesting to pupils.	40	95	13	2	1.85	A
7. It will enable children to perform well in English language in the future.	14	83	47	6	2.31	D
8. It will enable parents to participate in the education of their children.	45	99	6	0	1.75	A
9. All technical terms and expressions in my subject area(s) can be easily translated into home language.	13	71	57	9	2.41	D

Legend: SA – strongly agree; A – agree; D – disagree; SD – strongly disagree; DE – descriptive equivalent

Table 1 shows that statements 1, 2, 4, 5, 6 and 8 generated a weighted mean of 1.69, 1.89, 1.72, 1.69, 1.85 and 1.75 respectively or a descriptive equivalent of “**AGREE.**” On the contrary, statements 3, 7 and 9 earned a weighted mean of 2.33, 2.31 and 2.41 and correspondingly or a descriptive equivalent of “**DISAGREE.**” Based on the above findings, it can be claimed that student teachers agree that the use of home language in Grades 1-3 is good in principle and that its use as a medium of instruction in Grades 1 to 3 would enable teachers to express themselves clearly and would make the lessons interesting to pupils, thus allowing pupils to understand the lessons easily. Similarly, student teachers view the use of home language to enable parents to take part in the learning of their children. Nevertheless, student teachers also realized that the use of home language as medium of instruction in teaching all the subjects in Grades 1 to 3 is not feasible since student teachers agree that it is impossible to translate in home language all the technical terms and expressions in their subjects.

### 3.1. Possible challenges associated with teaching Home Language

Table two summarizes the possible challenges that student teachers might encounter in home language in primary schools, specifically in Grades 1 to 3. As shown in the table, there are 10 challenges identified. The five most common problems identified by student teachers as ranked from highest to lowest are: first, difficulty in translation with 25.71%; second, teacher’s low proficiency in home language with 16.57%; third, pupil’s low proficiency in home language with 12.57%; fourth, degradation of English language proficiency with 11.43%; and fifth, lack of teacher’s training in teaching home language with 8%.

*Table 2. Challenges identified by student teachers with regards teaching home language.*

Challenges	f	%	Rank
Difficulty in translation	45	25.71	1
Degradation of English language proficiency	20	11.43	4
Lack of textbooks, references and instructional materials	13	7.43	6
Lack of teachers’ training in teaching home language	14	8	5
Low teachers’ proficiency in home language	29	16.57	2
Low pupils’ proficiency in home language	27	15.43	3
Incompatibility of HL used by pupils and of HL assigned by DepEd	12	6.86	7
Difficulty in teaching the different varieties of HL	6	3.43	8.5
Language barrier for transferees and pupils with different L1	6	3.43	8.5
Resistance of parents in using HL as medium of instruction	3	1.71	10
<b>TOTAL</b>	<b>175</b>	<b>100</b>	

According to the above findings, it appears that the primary challenge identified by the student teachers is the difficulty in translation of technical terms and concepts, specifically in the subjects like Mathematics and English. The following excerpts below provide source for the claim:

1. Difficulty in translating in Math.
2. Technical terms may be difficult to translate.
3. Translation may be hard.
4. Some English terms do not have exact translation in home language.
5. Using home language in Math is difficult.
6. Difficulty to translate Math concepts in home language.

## 4. Conclusion

Firstly, student teachers, in general, agree on the use of Home Language as a medium of instruction in Grades 1-3. This indicates that they have a positive attitude toward Home Language, which can be explained by the advantages that it can bring as it is popularly believed that it creates a positive impact on students and thus enhances students' learning experience and achievement. Their willingness to be trained

to teach using the Home Language implies that they support the implementation of the new language in education. Further, Alieto (2018) even noted that the training and discussions provided by their institutions could have conditioned the student teachers to accept the idea of teaching in home language, hence establishing a positive attitude towards its implementation.

Secondly, there is no relationship between age and attitude, and between gender and attitude. Attitude is not in any way dependent on age and gender. Regardless of age, both male and female respondents have positive attitude towards the use of Home Language as medium of instruction. Meanwhile, a significant relationship is found between place of origin (district) and attitude, implying that attitude is influenced by place of origin. Intervening factors like limited or varying levels of exposure of the students to multiple languages, diverse social and cultural settings, or ease of expressing themselves using the Home language in both formal and informal settings among others appear to be critical in this case. Nevertheless, these results cannot be generalized and should be considerably taken with caution as these can only be true in the current study.

Lastly, the many and different problems pertaining to translation of learning materials, teachers' and pupils' proficiency in Home Language and in English, trainings, and development of instructional materials as perceived by the student teachers imply that the implementation poses a great challenge to the educational system and to the student teachers who will be future teachers. The country's inadequate preparation for the shift to Home Language can directly affect the certainty of the full and successful implementation of the language program.

### References

- Ajepe, I. (2014). Investigating the attitude of undergraduate students towards the use of mother tongue. *International Journal on Studies in English Language and Literature*, 2(7), 122-130.
- Alieto, E. (2018). Language Shift from English to Mother Tongue: Exploring Language Attitude and Willingness to Teach among Pre-Service Teachers. *TESOL International Journal*, 13(3), 134-146.
- Bhoi C. 2014. Role of Mother Tongue in Teaching Learning English. *Journal of Research. PARIPEX*,3(10): 57-58.
- Ejeh, M.U.C. (2004). Attitudes of student teachers towards teaching in mother tongue in Nigerian primary schools: Implications for planning. *Language, Culture, and Curriculum*.73-81. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/07908310408666683>.
- Khosa M. 2012. Mother tongue education: A case study of Grade Three children. Unpublished MA Thesis. University of Johannesburg.
- Nguyen An Giang. The Disadvantages of Using Mother Tongue in Teaching English on Students' Speaking and Listening Skills at Universities in Vietnam. *International Journal of Applied Linguistics and Translation*, 8, No. 1, 2022, pp. 20-23.
- Phindane, P. (2017). Student teachers' approach on using indigenous language as LOLT in teaching science in primary schools. In International Conference on Education and New Development (END) by Carmo, M. W.I.A.R.S. Lisbon. Portugal.
- Tonio, Z, & Ella, J. (2019). Pre-service Teachers' Attitudes toward the Use of Mother Tongue as Medium of Instruction. *Asian EFL Journal Research Articles*. Vol. 21 Issue No. 2: 231 – 252.

# A META-ANALYSIS: THE ASSOCIATION BETWEEN RELATIONAL PARENTAL INVOLVEMENT AND STUDENT AND PARENT OUTCOME VARIABLES

**William Jeynes**

*Professor, Department of Teacher Education, California State University, Long Beach, CA (USA)*

*Senior Fellow, The Witherspoon Institute, Princeton, NJ (USA)*

## Abstract

This paper shares the results of a meta-analysis on the parental-relational component of parental-involvement and its association with the academic and behavioral outcomes of urban students. This meta-analysis includes 80 quantitative studies. The results indicated that statistically significant effects emerged across students of differences backgrounds, including difference by age groups, race, gender, and nationality. The results were also substantial in the highest quality studies. The significance of these results is discussed.

**Keywords:** *Parental involvement, parental engagement, relational parental involvement, parenting, academic achievement, academic outcomes, student behavior, family structure, relationships, education.*

---

## 1. Introduction

Parental involvement has become one of the most debated facets of education today (Ferrara, 2009; Gibson & Jefferson, 2006). Meta-analyses undertaken over the last twenty years have examined the relative contributions of different facets of parental involvement. A meta-analysis statistically combines all the relevant existing studies on a given subject, in order to determine the aggregated results of said research. A meta-analysis is among the most popular types of academic article, as measured by citations, because it enables people to grasp what the overall body of research on a given topic indicates (Cooper, Hedges, and Valentine, 2019).

As time has passed and more sophisticated quantitative studies, especially meta-analyses, have been done, it has become evident that the early parental involvement theorists examined parental involvement in too narrow a way, particularly in two respects: 1) they paid little attention to the number of dimensions of home-based parental involvement and 2) they overlook the place of relational parental involvement. Relational parental involvement considers the quality of the relationships between the parents and the child, the parents and the teacher, and the parents' relationship with each other, if applicable.

Increasingly, meta-analyses have revealed that the "how to" directives that the essence of myriad expressions of school-based family involvement yield not particularly large effect sizes, when it comes to raising academic achievement. In addition, over the years an increasing body of research suggests that the quality of parental *relationships* is important.

## 2. Design

This research paper includes a meta-analysis on the relational component of parental involvement and its relationship with the scholastic and behavioral outcomes of urban students. The meta-analysis includes eighty quantitative studies. The results indicated that statistically significant effects arose across students with difference in backgrounds, including differences by age groups, race, gender, and nationality. The results were also strong, when even only examining the highest quality studies.

### 3. Objectives

To determine: 1) The overall effects for *Relational Parental Involvement*, 2) the relationship between *Relational Parental Involvement* and academic achievement, 3) the relationship between *Relational Parental Involvement* and student behavior, 4) might the results differ by the nation in which the study was done, 5) might the results differ by the age (grade level) of the students, 6) The effects for *Relational Parental Involvement* for high quality studies, and 7) might the results differ by the whether the students were majority or minority students.

### 4. Methods

In this project, 60 major data bases were searched (Psych Info, ERIC, Sociological Abstracts, Wilson Periodicals, and so forth) to find studies examining the effects of relational parental involvement on the academic and behavioral outcomes of urban children from grades K-college freshmen. I also searched journal articles on relational parental involvement to find additional research articles that addressed this issue for urban students. Although this comprehensive search yielded hundreds of articles and papers on this topic, nearly all of these articles were not quantitative in nature. Ninety-five studies were found that quantitatively addressed the relationship under study and 80 studies of those that had a sufficient degree of quantitative data on urban students to include in this meta-analysis.

*Calculating average effect sizes.* A weighting procedure was used to calculate average effect sizes across all the comparisons. First, each independent effect size was first multiplied by the inverse of its variance. The sum of these products was then divided by the sum of the inverses. Then, 95% confidence intervals were calculated. As Hedges and Vevea (1998) recommend, all the analyses were conducted using fixed-error assumptions in one analysis and applied random-error assumptions in the other. Random-error assumptions were the ones presented in this paper, because this procedure yields more conservative effect sizes.

If there was more than one effect size presented in the results section, the effect size that was chosen was based on that which referred to: a) the overall sample and b) the purest measure of relational parental involvement, as explained in the section below on study quality. In the case of results that included clear statistical outliers, the presence of these outliers was acknowledged, and then supplemental analyses were run without such an outlier in order to estimate the degree to which the presence of an outlier might have affected the results.

Tests of homogeneity were completed on the relational parental involvement measures to gain a sense of the consistency of specific relational parental involvement scales across studies.

#### Defining of Variables

For the purposes of this study, parental involvement was defined as parental participation in the educational processes and experiences of their children. Relational parental involvement was defined as parents having strong and positive relationships with their child (student under study), the other parent of the child, and the teacher.

### 5. Discussion

There were several research questions addressed in the study. They included: 1) The overall effects for *Relational Parental Involvement*, 2) the relationship between *Relational Parental Involvement* and academic achievement, 3) the relationship between *Relational Parental Involvement* and student behavior, 4) might the results differ by the nation in which the study was done, 5) might the results differ by the age (grade level) of the students, 6) The effects for *Relational Parental Involvement* for high quality studies, and 7) might the results differ by the whether the students were majority or minority students.

### 6. Conclusion

Perhaps the most remarkable finding regarding the effects of the relational parental involvement is its consistency across almost all variables. The results are consistent across age, race, gender, academic measure, and scholastic subject. These findings are encouraging and suggest that relational parental involvement may be of help across population groups.

*References*

- Cooper, H. Hedges, L. V. & Valentine, J. C. (2019). *The handbook of research synthesis and meta-analysis*. New York Russell Sage Foundation.
- Ferrara, M. M. (2009). Broadening the myopic vision of parental involvement. *School Community Journal*, 19 (2), 123-142.
- Gibson, D. M. & Jefferson, R. N. (2006). The effect of perceived parental involvement and the use of growth-fostering relationships on self-concept in adolescents participating in gear up. *Adolescence*, 41 (161), 111-125.



## BRIDGING THE GAP: FROM CLASSROOM TO CLINIC

**Dinah Paritzky, Rachel Eichler, & Ravid Rodan-Doron**  
*Hadassah Academic College Jerusalem (Israel)*

### Abstract

**Introduction:** Students of clinical degrees such as medicine, dentistry, osteopathy, optometry etc. often find that the transition from theoretical lectures and technical practice to patient care in clinics is challenging. The Optometry Department at Hadassah Academic College Jerusalem designed a workshop called "Introduction to Patient Care" in order to bridge that gap. This workshop is given to second year students in the second semester, before they begin their clinical rotations at the start of their third year. The workshop has a maximum of 14 students who meet weekly for 13 weeks. The learning outcomes of the workshop are to develop communication skills, to implement self-reflection and critical thinking, to gain experience in analysing a clinical case, to formulate an evidence based (EBP) plan, and to advance the student's self confidence in a clinical scenario. The workshop uses the following active-learning pedagogical methods: Role play, Peer Assessment, Team Learning, Case Based Learning.

**Methods:** To test the learning outcome of self-reflection, the Groningen Reflection Ability Scale was administered before and after the workshop to evaluate the impact of the workshop on the student's ability to reflect. The anonymous questions explore the ability of self-reflection, empathic reflection, and reflective communication using 4-point Likert scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree). The overall range score is 18-72 points. The overall score as well as each reflection type's score were calculated. The Mann-Whitney test was used to compare the scores before and after the workshop. We added open questions that required the students to present their position in specific types of reflection that were thematically analysed.

**Results:** 104 students were recruited for the study. 97 students responded before the workshop and 101 at the end of the workshop. The overall score showed significant improvement before and after the workshop respectively ( $58.06 \pm 7.25$  and  $59.73 \pm 6.74$ ,  $p < 0.05$ ). In addition, a trend was seen in scores of self-reflection, empathetic and communication reflections but this did not reach a significant level. The open questions show that the workshop may trigger student's thinking about the importance of self-awareness, an empathetic approach and good communication skills.

**Recommendations/Conclusions:** We recommend the implementation of workshops of this kind in other clinical degrees. The workshop helps to develop self-reflection and interpersonal/communication skills of the student. Future plans include evaluation of the other learning outcomes.

**Keywords:** *Role Play, Reflection, Case Based Learning, Team Learning.*

---

## 1. Introduction

Students of clinical degrees such as medicine, dentistry, osteopathy, optometry etc. often find that the transition from theoretical lectures and technical practice to patient care in clinics is challenging (Flood & Robinia, 2014). The Optometry Department at Hadassah Academic College Jerusalem (HAC) designed a workshop called "Introduction to Patient Care" in order to bridge that gap. This workshop is given to second year students in the second semester, before they begin their clinical rotations at the start of their third year. The workshop has a maximum of 14 students who meet weekly for 13 weeks.

## 2. Objectives

The workshop uses the following active-learning pedagogical methods: Role play (Deepa & Ieva, 2012) (Rønning & Bjørkly, 2019) (Nestel & Tierney, 2007), Case Based Learning (Foutch, Awad-Amani & Belloli, 2020) (Thistlethwaite, 2012), Peer Assessment (Bostock, 2000) and Team Learning (Stanton, Sebesta & Dunlosky, 2021). The learning objectives of the workshop are: to develop communication skills (Lytton et al., 2019), to encourage self-reflection and critical thinking (Rønning & Bjørkly, 2019), to gain

experience in analysing an optometric case (Lytton et al., 2019), to formulate an evidence based (EBP) plan (Twa, 2019), and to advance the student's self confidence in a clinical scenario (Lytton et al., 2019).

### 3. Course structure

The students are divided into groups of 10-14. Each group has a facilitator. At the beginning of the semester the facilitator divides the students randomly into pairs. Before each weekly session a pair of students is given a case report of a virtual patient to prepare for the group. The case report consists of a short history describing the patient and their symptoms, and a record of the optometric examination. The pair of students prepares a role play in order to present the symptoms and history to the group. They also prepare a Power Point presentation (PPT) which includes: patient history (given as part of the case), clinical findings from the examination (given as part of the case), analysis of the clinical findings, treatment plan, Evidence Based Practice (EBP) to back up the chosen plan, and either a referral letter or a summary for the patient. The case reports are designed to cover a wide variety of patient types and optometric findings (Asokan et al., 2016). The pair also has to prepare an additional role play to present the findings and plan to the "patient" at the end of the session. Each student prepares and presents two cases during the semester.

### 4. Workshop structure

The workshop begins with the role play of the first part of the examination, whereby one student plays the optometrist who asks the patient for symptoms and history, and the other student plays the patient.

This role play is used to present to the group essential details about the patient, while at the same time it serves to develop the student's communication skills. After the role play, the group is encouraged to give feedback on the "optometrist's" communication skills and also regarding the content of the questions. The student playing the role of the optometrist is assessed on language, communication, manner and content.

The group is then divided into pairs. All pairs are given the examination results, and each pair has to upload to Padlet an Evidence Based analysis and plan for the patient. The facilitator grades the content of the Padlet. During this time the original pair of students who prepared the case present their "findings" and analysis and plan to the facilitator using professional language. The facilitator discusses their plan and asks questions, and reviews their PPT presentation. The students are graded on their presentation, and on their understanding of the examination, the findings, the analysis, the treatment plan, and the clinical research papers (EBP).

The group now comes together and each pair's analysis and treatment plan (on Padlet) are shown to the whole group. The clinical cases are carefully designed to allow for more than one option for treatment, and the group (helped by the facilitator) will have to discuss the different modalities and come to a consensus. The students need to use EBP to back up their arguments. The pair of students who prepared this case join in the discussion and will try to persuade the group to accept their suggested plan, but this does not always happen.

Once a treatment plan has been agreed on by the group, a second role play takes place. This time the facilitator plays the role of the patient while the student who originally played the patient plays the optometrist. The "optometrist" has to present the results of the examination along with the plan agreed upon in a clear, concise and empathetic manner to the patient. The "patient" will ask questions and often exhibit opposition. This gives the student experience in effective and empathetic communication.

After the second role play the group again gives peer assessment for the student who role played the optometrist. The student playing the optometrist is graded on his or her communications skills, including empathy towards the patient. Finally, the facilitator sums up the salient points from the workshop.

The pair who presented the case are graded on their role play, on their PPT presentation and on their understanding of the case. The rest of the group is graded weekly on their verbal input to the discussion and the analysis and plan from Padlet.

Overall grading for this course: 40% active participation (including Padlet, peer assessment, discussion), 10% for role play on first case, 10% first PPT presentation, 20% second role play, 20% second PPT.

### 5. Results

To test the learning outcome of self-reflection, the modified Groningen Reflection Ability Scale was administered before and after the workshop to evaluate the impact of the workshop on the student's ability to reflect. The anonymous questions explored the abilities of self-reflection, empathic reflection, and reflective communication using a 4-point Likert scale (1=strongly disagree, 2=disagree, 3=agree,

4=strongly agree). The overall range score was 18-72 points. The overall score as well as each reflection type's score were calculated. The Mann-Whitney test was used to compare the scores before and after the workshop. We added open questions that required the students to present their position in specific types of reflection that were thematically analyzed, 104 students were recruited for the study. 97 students responded before the workshop and 101 at the end of the workshop. Although we did not ask gender, the vast majority were female. The overall score showed significant improvement before and after the workshop respectively ( $58.06 \pm 7.25$  and  $59.73 \pm 6.74$ ,  $p < 0.05$ ). In addition, a trend was seen in scores of self-reflection, empathetic and communication reflections but this did not reach a significant level. The open questions show that the workshop may trigger student's thinking about the importance of self-awareness, an empathetic approach and good communication skills (Doron et al., 2022).

The students were also asked to complete two feedback forms on the workshop, one specifically designed for the course, and one general form administered by the college. Results are shown in tables 1, 2 and 3.

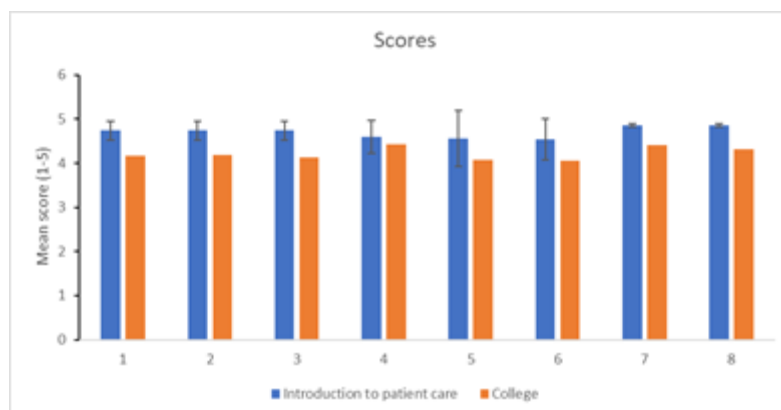
Table 1. Feedback from students using questionnaire designed specifically for course n=64.



Table 2. Questions from general feedback form from HAC.

The lessons were given in a clear and organized manner
The course resources helped to understand the material
The assignments contributed to understanding the course
The lecturer was available for help and questions
The teaching methods were appropriate for the course
The learning experience was positive
The course site is easy to navigate
The course materials were available, organized and suitable for study

Table 3. Feedback from students using general form from HAC n=65.



## 6. Discussion / conclusions

The feedback from the students shows a high level of satisfaction with the course, both with achieving the aims of this course and in comparison to other courses in the college. Towards the end of the semester students demonstrated a marked improvement in their communication and analysis skills during the workshop.

We recommend the implementation of workshops of this kind in other clinical degrees. The workshop helps to develop self-reflection and interpersonal/communication skills of the student. The course prepares students for patient interaction, increases the students' self-confidence, and enables them to integrate and apply their knowledge from different areas of the curriculum. In addition, the students learn the practical value of using EBP in clinical practice.

### References

- Asokan, Rashima & Ramani, Krishna Kumar. (2016). Innovations in Optometric Education. *Sci J Med & Vis Res Foun.* 2016. 11-14.
- Bostock, S. (2000). Student peer assessment. *Learning Technology*, 5(1), 245-249.
- Deepa R & Ieva S (2012) Exploring the potential of role play in higher education: development of a typology and teacher guidelines, *Innovations in Education and Teaching International*, 49:4, 427-436.
- Doron, R., Eichler, R., & Rajhans, V. (2022). Effectiveness of online learning in improving optometry student's reflective abilities. *Journal of Optometry*. 2022 Nov 15:S1888-4296(22)00066-8
- Flood LS, Robinia K. (2014) Bridging the gap: strategies to integrate classroom and clinical learning. *Nurse Educ Pract.* Aug;14(4):329-32.
- Foutch, B K., Awad-Amani C, and Belloli Conner A. (2020) Case-Versus Lecture-Based Learning in a Public Health Course for Optometry Students: A Pretest-Posttest Design. *Pedagogy in Health Promotion*: 2022;8(1):41-48. doi:10.1177/2373379920944968
- Lytton, K., Woolley, T., Rasalam, R., Gorton, S., & Heggarty, P. (2019). Benefits of simulated General Practice clinics in the preparation of medical students for primary healthcare. *Education for Primary Care*, 30(5), 275-281.
- Nestel, D., Tierney, T. (2007) Role-play for medical students learning about communication: Guidelines for maximising benefits. *BMC Med Educ* 7, 3 <https://doi.org/10.1186/1472-6920-7-3>
- Rønning SB, Bjørkly S. (2019) The use of clinical role-play and reflection in learning therapeutic communication skills in mental health education: an integrative review. *Adv Med Educ Pract.* Jun 18; 10: 415-425.
- Stanton, J. D., Sebesta, A. J., & Dunlosky, J. (2021). Fostering metacognition to support student learning and performance. *CBE—Life Sciences Education*, 20(2):fe3. doi: 10.1187/cbe.20-12-0289
- Thistlethwaite, J, et al. (2012) The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23. *Medical teacher* 34.6: e421-e444.
- Twa, M. D. (2019). Implementing evidence-based clinical practice in optometry. *Optometry and Vision Science*, 96(8), 539-541.

# UNIVERSITY LECTURERS' EXPERIENCES WITH TECHNOLOGY INTEGRATION INTO TEACHER EDUCATION POST COVID-19 PANDEMIC

Sithulisiwe Bhebhe<sup>1</sup>, Luzaan Schlebusch<sup>2</sup>, & Gawie Schlebusch<sup>2</sup>

<sup>1</sup>Faculty of Education, University of Eswatini/Central University of Technology (Eswatini/South Africa)

<sup>2</sup>Faculty of Humanities, Central University of Technology (South Africa)

## Abstract

In this study, technology integration into teacher education post COVID-19 pandemic was explored from the perspectives of lecturers from selected Southern African universities. The study used a qualitative research approach and a multiple case study design. Two Southern African universities, in South Africa and Eswatini, the researchers' places of work, were conveniently chosen to be the research sites in this study. A purposeful sample of lecturers involved in teacher education participated in this study. Data were generated through, open-ended questionnaire completed by nine lecturers, and a focus group discussion with 12 participants, which included lecturers from both institutes. Thematic analysis was used to analyse the data collected from the study's participants. The study's conclusions show that lecturers from both universities experienced a change in instruction delivery compelled by the prevailing COVID-19 pandemic which made the physical environment in universities not suitable for face-to-face but online instruction where technology had to be integrated into teacher education. The study concludes that lecturers experienced a new norm as universities formed policies to ensure that technology is included in teacher education. The study also concluded that lecturers had limited knowledge, pointing to the need for training on the needed knowledge domains to integrate technology into teacher education. The study also concludes that the universities understudy offered some digital gadgets and internet connectivity for lecturers to using, especially while on campus. However, internet access would be limited when lecturers leave the campuses, with institution A failing to provide data for off-campus use while institute B did so, but load-shedding was one of the problems in the nation where institute B is located.

**Keywords:** Lecturer, technology integration, teacher education, university, COVID-19 pandemic.

---

## 1. Introduction

The COVID-19 pandemic stalled the globe, in the process forced educational systems to reevaluate the most beneficial pedagogies for instructing and learning in light of the problems with global health that were encountered (Cui, Ma, Wang, Yang, Liu, Kong & Wang, 2023). The COVID-19 pandemic prompted people to conduct more activities from home, including learning (Easterbrook, Doyle, Grozev Kosakowska-Berezecka, Harris & Phalet, 2023). As a result, education systems developed online learning guidelines that were implemented even in higher education institutions in teacher education programmes (Shahzad, Hassan, Aremu, Hussain & Lodhi, 2021). Globally, the educational system has shifted toward e-learning in an effort to mitigate the effects of the COVID-19 pandemic. Mahmood (2021), however, makes the point that universities have to put policies in place to guarantee a smooth transition from face-to-face to online teacher education.

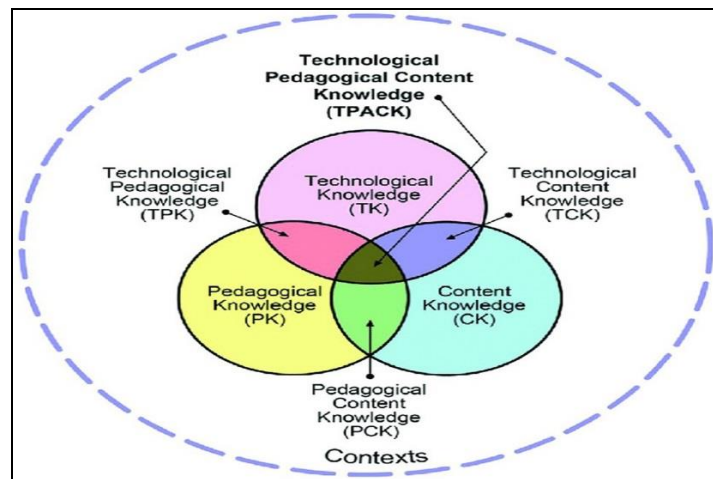
Technology knowledge and competence in its application are seen as two distinct forms of competencies (Instefjord & Munthe, 2017). lecturers in universities may be tech-literate, but, unable to effectively use technology in the classroom (Dinçer, 2018; Alanazy & Alrusaiyes, 2021). It shows that using technology in instructional practises and having technological understanding are two very distinct things. Lecturers must possess all of the knowledge domains for them to use technology in the lectureroom effectively (Ifinedo et al., 2020). Akram, Yingxiu, Al-Adwan and Alkhalifah (2021) point out that lecturers who are not proficient at using technology prefer to spend more time lecturing in lecture halls. The current environment advocates for technology integration into teacher education.

The problem identified was that despite receiving technology training, lecturers in the universities in South Africa and Eswatini often found it difficult to combine their expertise of pedagogy, content, and technology knowledge into teacher education (Siddiqui, Arif, & Hinduja, 2023). The only technological

experience lecturers had was preparing slides and using PowerPoint in lectures (Gunuç & Babacan, 2018). Universities in Southern Africa considered integrating technology into teacher education to be a feasible and perfect solution for continuing education physically away from the university throughout the COVID-19 pandemic (Roy, Babu, Abul Kalam, Yasmin, Zafar & Nath, 2023). Lecturers in the universities were using face-to-face instruction, meaning that for them to make a smooth shift to online instruction, they had to be trained on integrating technology to their instruction (Budianto, Arifani, Wardhono & Poedjiastutie, 2023). The move to a student-centred learning model, in which the student takes the lead in their own learning rather than the lecturer having complete control of the process, was made easier by integrating technology into the teacher education process (Keiler, 2018). In order to ensure that technology is integrated into teacher education even after the COVID-19 pandemic era, it is crucial for universities to provide university lecturers with the necessary knowledge and skills.

This study was informed by the Technological Pedagogical Content Knowledge (TPACK) theory, which describes the kinds of knowledge required for a systemic integration of technology into teacher education (Mishra, 2019). The TPACK theory emphasises the need for lecturers in universities to combine their subject-matter, pedagogical, and technological knowledge as shown in Figure 1 (Budianto, Arifani, Wardhono & Poedjiastutie, 2023).

Figure 1. The technological pedagogical content knowledge (TPACK) framework (Akram, Yingxiu, Al-Adwan & Alkhalifah, 2021).



Despite the fact that it was predicted that pedagogical content knowledge (PCK) would have the greatest impact on lecturers' activities in teacher education, effective teaching depends on well-integrated information from multiple knowledge domains (Şen, Demirdöğen & Öztekin, 2022). Another category of knowledge that has recently emerged and has to be addressed is technological knowledge (Choi, Lee & Yoon, 2023). Further, Eli-Chukwu, Igbokwe, Ifebude, Nmadu, Iguodala, Uma and Akudo (2023) alludes to the fact that it is vital that universities provide continuous training for lecturers in technology integration into teacher education.

## 2. Design

As part of an interpretive research paradigm, the study employed a qualitative research approach and a qualitative phenomenological research design (Hassan, 2023). The characteristics of the phenomenological research design make the design fit for this study. The Phenomenological research design is descriptive, hence it is fit for a study that is interpretive. The researcher aims to describe as accurately as possible the structure of a phenomenon in a phenomenological research design (Sheehan, 2014). Thus, in this study the integration of technology into teacher education in the studied universities was described as given by the research participants using direct quotations from the participants.

Qualitative phenomenological research design aims to uncover what a particular experience means to a group of people and how they experienced it (Zarestky, 2023). This study uncovered the university lecturers' experiences on technology integration into teacher education and described the experiences as given by the research participants. As the qualitative phenomenological research design focuses on the immediate experience, this study described the integration of technology into teacher education post COVID-19 pandemic era which is the current environment in Southern African universities.

The study was conducted in two Southern African universities that the researchers easily selected as their places of employment (Mudavanhu, 2017). The lecturers in the faculties of education were chosen as a purposeful sample for the reason that they are the instructors in teacher education (Tapala, Van Niekerk & Mentz, 2021). A total of 21 participants participated in the data collection process, a focus group discussion with 12 participants, an open-ended questionnaire completed by 9 lecturers who are involved in teacher education (Arving, Wadensten, & Johansson, 2014).

### 3. Objectives

- Determine the university lecturer's experiences with technology integration into teacher education post COVID-19 pandemic.
- Suggest what the universities in Southern Africa may do to sustain the integration of technology into teacher education after the COVID-19 pandemic era.

### 4. Methods

The research methods of this study were open-ended questionnaires, open-ended interviews and a focus group discussion. A well-designed questionnaire comprises questions that are pertinent to the subject matter of the study's research and may include lists, short responses, or in-depth narratives. All purposefully sampled lecturers were sent open-ended questionnaires to complete in order to provide the data necessary to address the research objectives. The individuals who responded favourably to the request to participate in the study were then encouraged to participate in a focus group discussion by the researchers. This worked really well because we were able to get the data we required from the study participants.

In this study, the lecturers who were unable to complete the questionnaire were invited to take part in a focus group discussion with lecturers from the two higher education institutions that were the subject of the study. Six participants from institute A fully participated in the focus group discussion. Focus groups helped us triangulate the data gathering techniques utilised in the study, including virtual interviews, questionnaires, and document analysis. Focus group interviews are conducted to gather data for a study in order for the researcher to more fully comprehend the issue, (Nyumba, Wilson, Derrick & Mukherjee, 2018). In order to get information from the study participants about how they integrate technology pedagogies in teacher education, document analysis was used in this study along with open-ended interviews and open-ended questionnaires.

### 5. Discussion

The results of the study reveal that with the integration of technology into teacher education in both the studied universities, lecturers experienced a shift from the traditional face-to-face teaching as COVID-19 heightened to the use of technology in teacher education. This finding is in line with the views from Shahzad, Hassan, Aremu, Hussain and Lodhi (2021) who reveal that the entire higher education system shifted to e-learning to mitigate the effects of the COVID-19 pandemic. Furthermore, Mahmood (2021) points out that policies were instituted in universities to ensure that technology is integrated into teacher education.

The findings of this study also reveal that the lecturers in the studied institutions through integrating technology in teacher education experienced a shift from an instructor centred to a student-centred type of learning style. This finding is consistent with views from Keiler (2018) who states that student-centred classes in universities have multi-benefits as they make the students active researchers and technology also assists them to connect with other students globally.

The results of this study also revealed that lecturers from both of the institutes under study were receiving training in integrating technology into teacher education. This finding is in line with the views from Budianto, Arifani, Wardhono and Poedjiastutie (2023) who point out that to integrate technology pedagogies in teaching and learning, lecturers have to be trained to develop innovative and imaginative solutions that highlight the three categories of knowledge, technology, content, and pedagogy in teaching as represented in TPACK.

The study also reveals that some lecturers still struggle with integrating technology into their lectures despite their training, to the point where they turn to their peers for help integrating technology into teacher education. This view is reflected by Eli-Chukwu, Igbokwe, Ifebude, Nmadu, Iguodala, Uma and Akudo (2023) who reveal that in training lecturers for effective technology integration, higher education institutions concentrate on professionally developing lecturers to independently apply TPK to their subject areas. Therefore, providing technical knowledge to lecturers in higher education institutes is

not enough as the issue is in having the four domains of knowledge in the TPACK complementing each other in successful integration of technology into teacher education in the studied higher education institutes in Southern Africa.

## 6. Conclusions

The problem is that, despite obtaining technological training, lecturers in South Africa and Eswatini still struggle to integrate their knowledge of pedagogy, content, and technology. Based on the findings of the study, this study concludes that lecturers from both universities experienced a change in instruction delivery compelled by the prevailing COVID-19 pandemic which made the physical environment in universities not suitable for face-to-face but, online instruction where technology had to be integrated into teacher education. The study concludes that lecturers experienced a new norm as universities formed policies to ensure that technology is included into teacher education. The study also concluded that lecturers had limited knowledge, pointing to the need for training on the needed TPACK knowledge domains to integrate technology into teacher education. The study also concludes that the universities understudy offered some digital gadgets and internet connectivity for lecturers to use, especially while on campus. However, internet access would be limited when lecturers leave the campuses, with institution A failing to provide data for off-campus use while institution B did so, but load-shedding was one of the problems in the nation where institution B is located.

## 7. Recommendations

Based on the findings of the study, it is recommended that universities studied in Southern Africa should give their lecturers continual training on how to integrate technology into teacher education. In addition, this study recommends that higher education institutions install enough internet across their buildings and install electrical generators to supply electricity during blackouts. Additionally, the study recommends that the training provided to the lecturers needs to take into account the application of all knowledge domains that would help with the integration of technology pedagogies in teacher education. Similar to this, the universities need to decentralize training to subject areas so that lecturers are knowledgeable about how to include technology pedagogies in their respective subjects.

## References

- Akram, H., Yingxiu, Y., Al-Adwan, A. S., & Alkhalifah, A. (2021). Technology integration in higher education during COVID-19: An assessment of online teaching competencies through technological pedagogical content knowledge model. *Frontiers in Psychology, 12*, 736522.
- Arving, C., Wadensten, B., & Johansson, B. (2014). Registered nurses' thoughts on blended learning in a postgraduate course in cancer care—content analyses of web surveys and a focus group interview. *Journal of Cancer Education, 29*, 278-283.
- Budianto, L., Arifani, Y., Wardhono, A., & Poedjiastutie, D. (2023). The TPACK level of in-service EFL teacher online professional training: The perspectives of teachers, students, and trainers. *Journal of Digital Learning in Teacher Education, 1-15*.
- Choi, J., Lee, C., & Yoon, J. (2023). Exploring a technology ecology for technology opportunity discovery: A link prediction approach using heterogeneous knowledge graphs. *Technological Forecasting and Social Change, 186*, 122161.
- Cui, Y., Ma, Z., Wang, L., Yang, A., Liu, Q., Kong, S., & Wang, H. (2023). A survey on big data-enabled innovative online education systems during the COVID-19 pandemic. *Journal of Innovation & Knowledge, 8*(1), 100295.
- Dinçer, S. (2018). Are pre-service teachers really literate enough to integrate technology in their classroom practice? Determining the technology literacy level of pre-service teachers. *Education and Information Technologies, 23*, 2699–2718. doi: 10.1007/s10639-018-9737-z
- Easterbrook, M. J., Doyle, L., Grozev, V. H., Kosakowska-Berezecka, N., Harris, P. R., & Phalet, K. (2023). Socioeconomic and gender inequalities in home learning during the COVID-19 pandemic: examining the roles of the home environment, parent supervision, and educational provisions. *Educational and Developmental Psychologist, 40*(1), 27-39.
- Eli-Chukwu, N. C., Igbokwe, I. C., Ifebude, B., Nmadu, D., Iguodala, W., Uma, U., ... & Akudo, F. U. (2023). Challenges confronting e-learning in higher education institutions in Nigeria amid Covid-19. *Journal of Applied Research in Higher Education, 15*(1), 238-253.



- Gunuç, S., & Babacan, N. (2018). Technology integration in English language teaching and learning. *Positioning English for Specific Purposes in an English Language Teaching Context*, 1.
- Hassan, M. (2023). The use of Husserl's phenomenology in nursing research: A discussion paper. *Journal of Advanced Nursing*.
- Ifinedo, E., Rikala, J., and Hämäläinen, T. (2020). Factors affecting Nigerian teacher educators' technology integration: considering characteristics, knowledge constructs, ICT practices and beliefs. *Computers & Education*, 146:103760. doi: 10.1016/j.compedu.2019.103760
- Keiler, L. S. (2018). Teachers' roles and identities in student-centered classrooms. *International journal of STEM Education*, 5, 1-20.
- Mahmood, S. (2021). Instructional strategies for online teaching in COVID-19 pandemic. *Human behavior and emerging technologies*, 3(1), 199-203.
- Mishra, P. (2019). Considering contextual knowledge: The TPACK diagram gets an upgrade. *Journal of Digital Learning in Teacher Education*, 35(2), 76-78.
- Mudavanhu, Y. (2017). Quality of literature review and discussion of findings in selected papers on integration of ICT in teaching, role of mentors, and teaching science through science, technology, engineering, and mathematics (STEM). *Educational Research and Reviews*, 12(4), 189-201.
- Nyumba, O. T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, 9(1), 20-32.
- Roy, G., Babu, R., Abul Kalam, M., Yasmin, N., Zafar, T., & Nath, S. R. (2023). Response, readiness and challenges of online teaching amid COVID-19 pandemic: the case of higher education in Bangladesh. *Educational and Developmental Psychologist*, 40(1), 40-50.
- Şen, M., Demirdöğen, B., & Öztekin, C. (2022). Interactions among topic-specific pedagogical content knowledge components for science teachers: The impact of content knowledge. *Journal of Science Teacher Education*, 33(8), 860-887.
- Shahzad, A., Hassan, R., Aremu, A. Y., Hussain, A., & Lodhi, R. N. (2021). Effects of COVID-19 in E-learning on higher education institution students: the group comparison between male and female. *Quality & Quantity*, 55, 805-826.
- Sheehan, S. (2014). A Conceptual Framework for Understanding Transcendental Phenomenology Through the Lived Experiences of Biblical Leaders (2023). *Journal: Emerging Leadership Journeys*, 7(1).
- Siddiqui, S., Arif, I., & Hinduja, P. (2023). Technostress: A catalyst to leave the teaching profession-A survey designed to measure technostress among teachers in Pakistan during COVID-19 pandemic. *E-Learning and Digital Media*, 20(1), 53-79.
- Tapala, T. T., Van Niekerk, M. P., & Mentz, K. (2021). Curriculum leadership barriers experienced by heads of department: a look at South African secondary schools. *International Journal of Leadership in Education*, 24(6), 771-788.
- Zarestky, J. (2023). Navigating Multiple Approaches to Qualitative Research in HRD. *Human Resource Development Review*, 22(1), 126-138.

# PRESERVICE LIFE SCIENCES TEACHERS' CONCEPTUALISATION OF GENDER EQUALITY IN THE CLASSROOMS

**Lydia Mavuru**

*Department of Science and Technology Education, University of Johannesburg (South Africa)*

## Abstract

Gender equality has become a rhetorical phrase in today's modern societies where women are challenging the societal gender stereotypical practices particularly in the African context. Such vibrancy however is not evident in research to provide empirical evidence of how issues of gender equality can be promoted in different fora. The school context is an ignored stakeholder considering that schools are extensions of the lives in the homes and communities, yet this is where the future leaders are developed. In Life Sciences (Biology), there are topics which could be used as opportunities for teaching gender equality to the young learners. The current study sought to determine how preservice Life Sciences teachers conceptualised gender equality and the need for teachers to be gender sensitive. A questionnaire with only three open ended questions was administered to 90 pre-service teachers (50 enrolled for a Bachelor of Education and 40 enrolled for Postgraduate Certificate in Education) as a google form. The questionnaire sought participants' understanding of what gender equality in the science classrooms entails, topics that invoke gender issues, and reasons for the need for teachers to be gender sensitive when teaching such concepts. This information was pertinent as the lecturer (researcher) planned to introduce gender responsive pedagogy as a theme in the following year's module. Through deductive and thematic analysis of the data collected, three themes emerged: 1. Preservice teachers' understandings of what gender equality entails is based on their sociocultural practices and beliefs; 2. Gender equality issues arise from topics that evoke emotions in the Life Sciences classrooms; and 3. Teachers of Life Sciences have a duty to protect and embrace every learner despite their differences. The findings also revealed that there were preservice teachers who declined to give responses to the questions. When quizzed outside the lecture, two participants (separately) pointed out that such a topic is sensitive to them, and they declined to elaborate. Based on the findings, the researcher surmised that such a topic cannot be brought into the classroom without preparing the participants emotionally as previous experiences or encounters at home or in society may interfere with open mindedness to learn. The findings provided an important basis for further research and for teacher development.

**Keywords:** *Gender equality, Life Sciences, pre-service teachers, teachers' conceptualisations.*

---

## 1. Introduction

What happens in the classroom does not stay there but it permeates into the different societal platforms such as the family, the community, church, and relationships. As early as 2011, Aikman, Halai, and Rubagiza advocated for a deeper scrutiny of the gender biased nature of the school system. Their argument was that to improve the quality of education at classroom level, gender equality should not just focus on the fair distribution of resources but consideration of nature of educational experiences for both boys and girls is required. Quality of education requires that gender dynamics be analysed within the wider social context where boys and girls live (Aikman, Halai, & Rubagiz, 2011). A point to note is that the manifestation of gender discrimination can be obvious or subtle which Morley (2006) identified as occurring through "informal networks, coalitions, and exclusions, as well as by formal arrangements in classrooms and boardrooms" (p. 1).

Whilst teachers may seem to be aware of the existence of gender inequalities in society, previous studies have shown nonchalant behaviours and unwillingness to recognise such social ills in their classrooms (e.g. de Lange, Mitchell, & Bhana, 2012; Morrell et al., 2009). This is evident in the perpetual gender-based violence (GBV) in South African schools which sometimes go unnoticed nor challenged (de Lange, Mitchell, & Bhana, 2012) and teenage pregnancy (Panday et al., 2009). The authors argue that the source and foundation of GBV is gender inequality. Thus said the current study is premised on the

argument that the vibrancy displayed in social and human rights organisations in South Africa is not evident in schools and in the classrooms, yet schools are extensions of the lives in the homes and communities. The study therefore sought to determine how preservice Life Sciences teachers conceptualised gender equality and the need for teachers to be gender sensitive. The following research questions guided the study: 1. How do preservice Life Sciences teachers conceptualise gender equality in the classrooms? 2. What are their views about addressing gender inequalities through the teaching of some Life Sciences topics? Preservice teacher development provides for an opportunity to equip teachers with the knowledge and skills to address the pertinent issues in the contemporary science classrooms where learners are caught in the crossfire due to societal issues and injustices. Notably the preservice teachers are also students who may be subjected to the same gendered ill experiences.

## **2. Literature review**

In the context of higher education, an early study by Morsley (2006) revealed that females experience covert discriminatory practices. The discrimination ranges from exclusion from career developmental opportunities, gender-insensitive pedagogical processes, prejudice regarding the women's academic capabilities and intellectual authority, poor equality in implementing policy and unwarranted criticism and facing stigmatisation due to being recipients of affirmative action opportunities (Morsley, 2006). In other studies women reported being subtly treated differently or as 'second citizens' in some gendered corporate cultures even when they performed competitively with their male counterparts. In other words, their intellectual capital is undervalued. Such practices were well explained thirty years ago by Bourdieu and Wacquant (1992) who argued that power thrives when people recognise cultural privilege and power as ascribed rather than achieved.

Whilst such nasty experiences were reported in adult professional women, one can imagine how young females in universities and schools get disheartened on realisation of such marginalisation, injustices, and prejudices. In the classrooms gender inequality has been found to manifest through teacher implementation of gender-insensitive pedagogy, allowing males to dominate in terms of time, space and the content taught (Eliassona, Karlssona, & Sørensen, 2017). There is need to develop teachers as role models who can champion in mitigating gender inequalities. This is because schools are misrepresented as places where there is only rational teaching, learning, and engagement in meaningful activities, yet it is also a place where there is power struggle amongst various stakeholders (Morrell et al., 2009). Notably, a study by de Lange, Mitchell, and Bhana (2012) which investigated the voices of women teachers about gender inequalities and gender-based violence in rural South Africa revealed that the participants saw "the reciprocal influence of home, school, work and society on each other" (p. 504).

## **3. Methodology**

The study adopted an interpretive paradigm and employed a qualitative case study research design. The interpretive approach enabled the researcher to make sense of the preservice teachers' conceptualisation of gender equality in Life Sciences classrooms and their view of how certain topics can be used to address gender inequalities during the teaching and learning process. A qualitative case study (Creswell, 2014) enabled the participants to freely share their conceptions and views within their contexts.

### **3.1. Section of participants**

Using purposeful sampling technique (Patton, 2002), 90 preservice Life Sciences teachers were selected from a South African University to participate in the study. These participants were enrolled for a Bachelor of Education (50 participants) and for Postgraduate Certificate in Education (40 participants).

### **3.2. Data collection and analysis**

A questionnaire with only three open ended questions was designed by the researcher and piloted to fellow researchers in the department to check for plausibility and clarity of items. The questionnaire sought participants' understanding of what gender equality in the science classrooms entails, topics that invoke gender issues, and reasons for the need for teachers to be gender sensitive when teaching such concepts. It was administered to 90 pre-service teachers as a google form and a 100% response was attained considering that this was administered during the normal teaching and learning time where attendance was guaranteed. The purpose of such a study was made clear to the participants that the information was meant to assist the lecturer (researcher) in planning for the introduction of gender responsive pedagogy as a theme in the following year's module. Data was subjected to deductive and thematic analysis (Blum, Stenfors, & Palmgren, 2020).

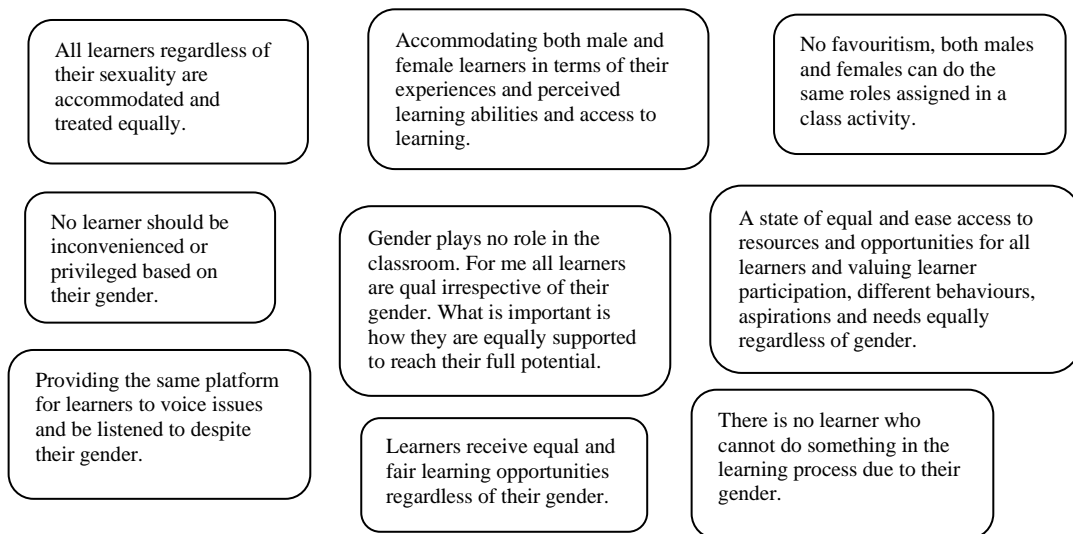
## 4. Findings

From the analysis of the data collected, three themes emerged: 1. Preservice teachers' understandings of what gender equality entails; 2. Gender equality issues arising from topics that evoke emotions in the Life Sciences classrooms; and 3. Life Sciences Teachers' duty to embrace every learner in their classrooms. Each of the themes is discussed below.

### 4.1. Preservice teachers' understandings of what gender equality entails

The participants had various conceptions about what gender equality entails in the Life Sciences classrooms. Figure 1 shows some of the direct quotes in response to the question: what is your understanding of gender equality in the Life Sciences classrooms?

Figure 1. Preservice teachers' conceptualisation of gender equality in Life Sciences classrooms.

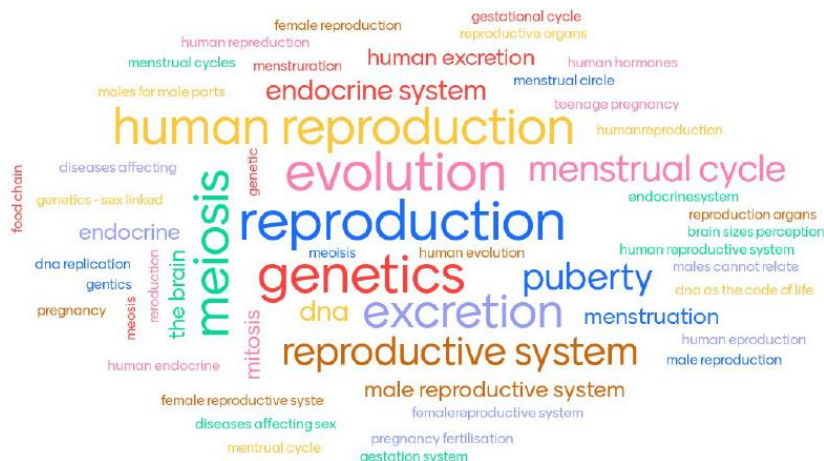


From the responses, it shows that preservice teachers' understandings of what gender equality entails is based on their sociocultural practices, experiences, and beliefs. There were some who felt that gender should not even be an issue in the classroom as all learners need equal support. Such a view evokes discussions and arguments on whether such teachers are genuine, or they are shying away from the existing issue of some learners being marginalised due to their gender. An important aspect on the sexuality of learners also arose from the responses which has been a prevalent issue in South African schools where homophobic teachers have been found to discriminate learners who did not conform to ascribed groups such as male or female. In terms of pedagogical aspects, the preservice teachers touched on fair distribution of resources, nurturing learners' aspirations, and providing opportunities for all learners to participate in class activities rather than the teacher assigning roles based on the learners' gender. They pointed out that where such gender inequality practices exist in the classrooms, some learners are left behind and fail to develop certain manipulative skills particularly in science practical work or investigations.

### 4.2. Gender equality issues arising from Life Sciences topics that evoke emotions

Figure 2 shows a word web showing some of the topics identified by preservice teachers in response to the question on Life Sciences topics that invoke gender issues when teaching such concepts.

Figure 2. shows the topics that preservice teachers identified.



Gender inequality issues arise from topics that evoke emotions in the Life Sciences classrooms. From the identified topics, it shows that concepts that deal with the human body and its systems were mostly identified as those suitable for teachers to address some of the gender inequalities pervasive in diverse communities. These topics have a bearing on reproductive systems such as puberty, menstruation, pregnancy, abortion, and contraception where there is a clear separation of males and females in terms of physical and physiological aspects. In some cultures reproductive health education is handled by the community elders who teach boys and girls separately about their sexuality. Topics such as meiosis and genetics require the teachers to be sensitive to the manner in which they tackle issues in class such as genetic diseases, sex determination, and paternity issues as some learners could be experiencing challenges associated with such issues in their families.

#### 4.3. Teachers’ duty to embrace every learner in their classrooms

When asked to give reasons why teachers should be gender sensitive when teaching the identified topics, the participants gave reasons based on their previous experiences as high school learners and also as university students. This was evident from the emotions ingrained in their responses. Some of the participants showed that the topic evoked emotions as they articulated how a school is a place fondly remembered by the majority of learners but despised by others depending on their experiences. An example of such a view comes from a participant who wrote, “The school should spark fond memories as learners remember their favourite mentors (teachers) whereas others view it as a place of discrimination which makes it hard for learners to pursue their dreams and attain growth.”

The participants indicated that teachers should understand that some learners are not comfortable to speak about issues that relate to sex, reproduction, and their bodies due to their sociocultural upbringing. When teaching puberty for instance teachers should show impartiality especially when discussing physical and physiological changes evident in their high school learners. The preservice teachers indicated that these sexual changes happen in everyone hence no learner should be made to feel disgraced or exposed. Pointing or emphasising on some obvious physical appearance for particular learners may make them uncomfortable and hence they become a subject of ridicule thereby impacting negatively on their self esteem and ultimately on their participation and performance in class.

The participants emphasised that male and female reproductive systems may be uncomfortable to learn for some learners hence teachers should be understanding. This can be sensitive and difficult for some learners who will take offence easily, for instance girls going through menstruation. They indicated that to help learners feel comfortable in the classrooms teachers should employ pedagogical strategies and employ a classroom environment which promotes learners to share ideas and experiences freely. The following are some of the excerpts from the participants’ responses.

Participant 1: It helps learners to be able to work on their own knowing that they can approach their teacher with every matter.

Participant 2: In a case where the teacher is a male and the concept is female reproductive system, it becomes more sensitive for the teacher to teach freely a class of both male and females, some learners may think that the teacher is verbally assaulting them. Reproduction mainly focus on the female and male sex organs and the learners might feel embarrassed or scrutinised as if their bodies are somehow exposed in the public because things like sex organs should be private.

Participant 3: To ensure gender inclusivity in the classrooms teachers should avoid harsh expressions.

Another topical issue raised by the participants was that gender inequality results in learners being prone to bullying and might lead to social ills such as suicide. One of the preservice teachers expressed how lack of gender sensitivity in the Life Sciences classroom when teaching issues about pregnancy, teenage pregnancy and abortion come in when she said, “Teachers should be sensitive because females are not the only ones responsible for causing or preventing pregnancy, yet teachers tend to be biased as they emphasise on girls being irresponsible.” In addition one participant indicated that the teacher should be careful not to share their views when teaching these sensitive topics as this may be misconstrued by learners as imposing or overreaching. The findings also revealed that there were preservice teachers who declined to give responses to the questions. When quizzed outside the lecture, two participants (separately) pointed out that such a topic is sensitive to them, and they declined to elaborate. An interpretation of such a behaviour could be that the participants in question could be witnessing or experiencing such gender injustices in their homes, communities or even institution.

## 5. Discussion, recommendations and conclusions

From the findings it shows that indeed gender inequality practices can happen in the Life Sciences classrooms without the perpetrators’ knowing or intention. This is supported by Morsley (2006) who pointed out that females in particular experience covert discriminatory practices. The current study hence shares the same views as Aikman, Halai, and Rubagiza (2011) who advocated for a deeper scrutiny of the gender biased nature of the school system. Based on the findings, the researcher surmised that such a topic cannot be brought into the classroom without preparing the participants emotionally as previous experiences or encounters at home or in society may interfere with open mindedness to learn. The findings provided an important basis for further research and for teacher development. Such development could be in terms of teachers recognizing gender stereotypical nuances during classroom interactions since learners can be perpetrators as well. Teachers need help in identifying suitable pedagogical strategies to address gender inequalities when teaching specific Life Sciences concepts.

## References

- Aikman, S., Halai, A., & Rubagiza, J. (2011). Conceptualising gender equality in research on education quality. *Comparative Education*, 47(1), 45-60. <https://doi.org/10.1080/03050068.2011.541675>
- Blum E. R., Stenfors, T., & Palmgren, P. J. (2020). Benefits of massive open online Course participation: Deductive thematic analysis. *Journal of Medical Internet Research*, 22(7): e17318.
- Bourdieu, P. & Wacquant, L.J.D (1992). *An invitation to reflexive sociology*. Chicago: The University of Chicago Press.
- Creswell, J. (2014). *Research design, qualitative, quantitative, and mixed method approach*, 4th ed. Thousand Oaks, California: Sage Publications.
- de Lange, N., Mitchell, C., & Bhana, D. (2012) Voices of women teachers about gender inequalities and gender-based violence in rural South Africa. *Gender and Education*, 24(5), 499-514. <http://dx.doi.org/10.1080/09540253.2011.645022>
- Eliassona, N., Karlssona, K. G., & Sørensen, H. (2017). The role of questions in the science classroom – how girls and boys respond to teachers’ questions. *International Journal of Science Education*, 39(4), 433–452. <http://dx.doi.org/10.1080/09500693.2017.1289420>
- Morley, L. (2006). Hidden transcripts: The micropolitics of gender in Commonwealth universities. *Women's Studies International Forum*, 29(6), 543-551. <https://doi.org/10.1016/j.wsif.2006.10.007>
- Morrell, R., Epstein, D., Unterhalter, E., Bhana, D., & Moletsane, R. (2010). *Towards gender equality. South African schools during the HIV and AIDS epidemic*. Pietermaritzburg: University of KwaZulu-Natal Press.
- Panday, S., Makiwane, M., Ranchod, C., & Letsoalo, T. (2009). *Teenage pregnancy in South Africa – with a focus on school-going learners*. Pretoria: Child, Youth, Family and Social Development, HSRC.

## MOVING HIGH STAKES ASSESSMENTS TO DIGITAL PLATFORM IN SOUTH AFRICA

**Naziema Jappie, & Ashley Niekerk**

*Centre for Educational Assessments (CEA) University of Cape Town (South Africa)*

### Abstract

Student success is critical in higher education. Measuring student success in higher education comprises of student support for retention, achievement and throughput, and to ensure employability of students. In addition, it can also be viewed through the important lens of transformation, equality and diversification. In South Africa the National Benchmark Test was developed to ensure that student was ready for university and through a diagnostic analysis it is able to provide an early warning system. The assessment has always been a pencil and paper format, however the sudden shift during the 2020 pandemic, from contact to remote digital learning platforms brought about unique challenges to the South African (SA) education landscape forcing learners into unfamiliar pathways. Similarly, the facilitation of assessments via online platforms presented new, uncharted challenges. The purpose of this technical research paper is to document the digitisation project from a paper-based test to an Online perspective and describe the @NBT Online system migration from a project and technical management perspective. Consultations were held with stakeholders to brainstorm possible solutions that would assist the Centre for Educational Assessments in responding to the global pandemic which led to a partnership with Territorium Life. Territorium had an online platform known as EdTest-AI, a software as a service (SaaS) solution, which combined proprietary software that uses Microsoft Azure Cognitive Services, Azure App Service, and Azure Database for My Standard Query Language (SQL) to deliver remote test proctoring, including verifying student identity and monitoring the room during an assessment. The digitisation of the NBT assessment was initiated on 1 June 2020 and completed by 12 July 2020, thus taking a total of 35 days to complete with the first pilot @NBT Online successfully administered on Saturday, 25 July 2020. The cost-effective and innovative SaaS approach implemented for this project is the first of its kind to be used in South Africa. Taking a high-stakes assessment digitally allowed the Centre for Educational Assessments' department to expand the types of services, reports, and products offered. Thus, this project is envisaged to support the departmental and institutional plans in highlighting the needs that require innovation, new approaches, new service models and the adoption of new and emerging technologies.

**Keywords:** *Assessments, digital platform, innovation, technical report.*

---

### 1. Introduction

The NBT was commissioned by the Higher Education of South Africa to assess the extent to which incoming students might be said to be ready to cope with the conventional demands of academic study (Cliff, 2014). Prince (2016) agrees and adds that the NBTs are based on academically researched test specifications which use modern test theories to evaluate scores of students and prospective students in the three domains of Academic Literacy (AL); Quantitative Literacy (QL) and Mathematics (MAT) in the language of instruction, namely English and Afrikaans. In 2020 Covid changed the way in which teaching, learning and assessments were conducted. Moving this high-stakes assessment online, meant that certain considerations had to be made to retain the credibility and security of the NBT tests, without compromising the validity and reliability of the scores. Digitizing the paper-based assessment(s) and adapting them for online delivery in the NBTs' context, meant that this implementation required an innovative, flexible, and robust solution to complement the paper-based implementation. Consultations were held with stakeholders to brainstorm possible solutions that would assist CEA in responding to the global pandemic which led to a partnership with Territorium Life (TL). TL had an online platform known as EdTest-AI combined proprietary software that uses Microsoft Azure Cognitive Services, Azure App Service, and Azure Database (DB) for MySQL to deliver remote test proctoring, including verifying student identity and monitoring the room during an assessment (Microsoft Inc, 2021). With a global

customer base, TL had developed a product that already had existing rules and business processes that were easily implemented, demystifying several concerns raised by CEA leading to the partnering with this strategic technology partner that specializes in secure, proctored online assessments. CEA was intended to not re-invent the wheel by partnering with this technology partner that specializes in secure, proctored online assessments, TL. This cloud-based digital assessment solution has a collection of features that were developed to service international institutions. These features and/or services are not restricted to, but comprise, artificial intelligence (AI), video and audio proctoring of writers, live chat support services, and multiple authentication layers to mention a few. However, the digitization of the NBT had a significant impact on the business workflow of the Research, Data Management, and Logistics team within CEA. In response to these challenges, CEA had to fast-track its plans for a secure, proctored online assessments with the pilot commencing on 25th July 2020. This project was initiated on 1 June 2020 and completed on 12th July 2020, would be the first of its kind with an assessment of this nature which uses technology-enhanced items (TEIs). Leonard (2021) explains that “TEIs are computer-delivered assessment items that involve higher-order thinking skills and leverage specialized interactions for capturing test-taker response data” (p. 01). An online survey was also conducted following the initial pilot of the NBT assessment, to gauge writer understanding as well as to adapt the platform to improve writer engagement and experience. While the writing experience is important to CEA, the team also needed to develop new terms and conditions regarding the new solution while remaining compliant with both Protection of Personal Information Act (POPIA) and general data protection regulations (GDPR). The digitization of this high-stakes assessment allows CEA the opportunity to offer the product via a hybrid model.

## 2. Advantages and disadvantages of SaaS

To most developers, SaaS is the sacred treasure of a recurrent revenue model which provides quicker deployment time than traditional on-premises software solutions. In keeping with other cloud service industries, TL’s EdTest-AI, SaaS offers small business units like CEA an opportunity to interrupt existing markets while taking advantage of their fair SaaS pricing model, thus lower costs. It also allows flexibility to scale SaaS use up and down based on specific need. It is easy to use and performs proof of concepts and test software functionality.

The advantage to using TL SaaS is also its number one challenge – demanding an internet connection. If writers have a solid, dependable connection, then it is a pro. Understandably, if writers do not have a reliable bandwidth connection, it is a con. However, with the progressively wide availability of high-speed broadband and networks, not unlike 5G, this is becoming less of a concern. However, there are a few other situations to consider before CEA agreed to go with the TLs SaaS solution. These concerns are loss of control because of geographical location of service provider. Limited customisation, TL’s EdTest-AI SaaS application offers little in the way of customization and clients are offered a standardised template and/or duplication of an already existing environment. Slower Speed: TL’s EdTest-AI SaaS solution can have more latency than client/server apps. With TL offices being located outside of SA this was a problem. However, this was mitigated by publishing the solution on Microsoft Azures server centres based in SA. Finally security risks.

## 3. CEA EdTest-AI platform design

On 1 June 2020, this phase started taking a total of three days and was concluded on 3 June 2020. TL during this time started the process of creating the development environment and setting up the platform. Figure 1 looks at the deployment of the SaaS solution and as displayed, the solution is hosted on the cloud (cloud computing).

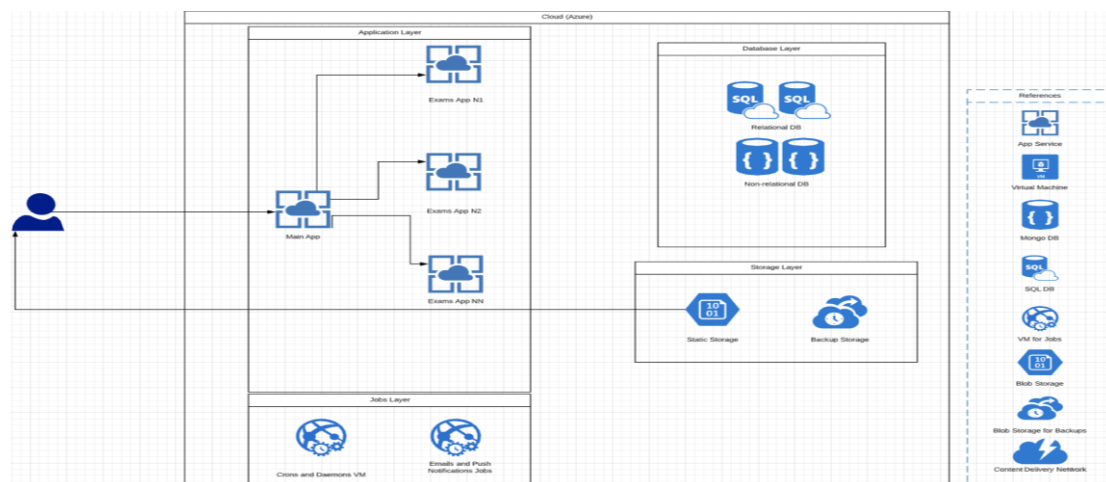
The CEA EdTest-AI solution integrates the respondus lockdown browser which is currently regarded as the “gold standard” for securing online assessments by higher educational institutions. The platform implicitly inherits the protocols like full screens which cannot be minimized; prevents access to other applications, printing, screen capture, right-click menu options and task switching were disabled.

### 3.1. Data mining

CEA’s SaaS solution incorporates data mining by using data analytics tools from the Microsoft Azure Services. Microsoft application insights facilitates the capturing of CEA business process data and transforming it into a digital footprint which is stored in Microsoft Azure Data Lake nodes. This enabled the team to use data mining techniques to synthesize the data curated by the solution and gain insights, analysis, and/or real-time process monitoring on performance. This was only possible utilising Microsoft Cognitive Services, Azure Bot Service, and the Microsoft Azure Machine Learning Studio.



Figure 1. Deployment of the SaaS solution and as displayed, the solution is hosted on the cloud (cloud computing).



Data quality/sanity is crucial to any industry as the results are only as good as the data received. The quality of data was examined upfront to ensure the curation of accurate results through the data mining process. This allowed CEA the opportunity to establish several practices—including the creation of policies to enable appropriate logs, regular data checks, and ensuring that data sources were connected appropriately—to allow for relational data flow across the entire dataset. However, CEA found several places in our processes where we had whitespace in the form of no data or not enough data being recorded by the system. For example, if we didn’t receive any information from a writer, video streaming had started and when it ended, that was considered whitespace in the continuum of our data stream. After identifying whitespace in our processes CEA suggested fixes for the issue wherever possible. TL had hard-coded business rules commonly applied by international HEI’s. However, many of these rules were not applicable to CEA and the team embarked on creating and using dynamic rulesets that account for what’s happening within CEA to continuously adjust these metrics within the processes. With the collation of all this information it is important that the data is backed up in real-time to avoid any data loss. In the coming section we elaborate on the backup and disaster recovery process for the solution.

### 3.2. Minimum technical requirements

CEAs EdTest-AI platform delivers remote proctoring and monitors the writer’s workspace during an assessment. The platform therefore requires access to either an integrated camera or peripheral. The same applies for device microphones.

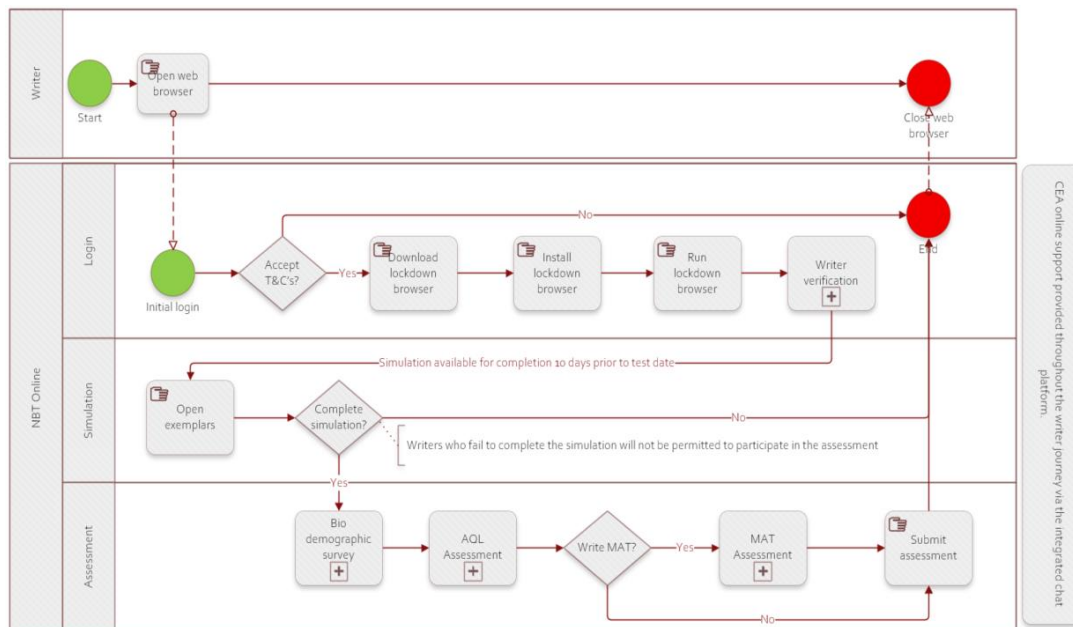
Table 1. Lists the minimum technical requirements along with the recommendations of most used devices.

Minimum device requirements to write the NBT test online				
	Desktop/Tower	Notebook/Laptop	iMac/Macbook	Apple iPad
Operating System	Windows 10; 8; and 7	Windows 10; 8; and 7	Mac Operating System 10.15 – 10.12; Mac OSX 10.11 and OSX 10.10	iPad iOS 11.0 and more recent are supported
Microphone	Microphone/Headset with mouthpiece (inserted to aux point or sound input)	Microphone/Headset with mouthpiece (inserted to aux point or sound input)	Microphone/Headset with mouthpiece (inserted to aux point or sound input)	Microphone/Headset with mouthpiece (inserted to aux point or sound input)
Webcam/Camera	Minimum of 480p, however, 720p is recommended	Minimum of 480p, however, 720p is recommended	Minimum of 480p, however, 720p is recommended	Minimum of 480p, however, 720p is recommended
Memory (RAM)/Permanent Hardrive Space	Minimum memory (RAM) required is 75 MB	Minimum memory (RAM) required is 75 MB	Minimum memory/hard drive space is 120 MB	N/A
Bandwidth/Internet line speed	512 kpbs (recommended 1 MB)	512 kpbs (recommended 1 MB)	512 kpbs (recommended 1 MB)	512 kpbs (recommended 1 MB)

#### 4. Writer journey

TL has adapted the EdTest-AI platform for many international higher education institutions (HEI). This allowed the CEA team to select a standardised web interface which has previously been tested, adapted, and implemented for existing HEI's. This is better understood through the writer's journey displayed in the business process mapping notation diagram displayed in figure 2 below.

Figure 2. Writers Journey.



The writer's journey is initiated by accessing the online platform via web browser. As displayed above writers are provided with online support through means of an integrated chat facility. The chat facility also assists the CEA online support identify exactly where in the process the writer is in real-time. This has afforded the CEA the opportunity to create saved responses to frequently asked questions. The solution also records and archives all chat history for future analysis. A detailed guide has been developed to assist writers in navigating the solution. During the writer journey there is a lot of data being collated and this data is processed through data mining which will be discussed in the coming section.

#### 5. Conclusion

The SaaS solution provides scoring and marking facilities that may need to be reviewed to allow for faster scoring of writer tests. Following the feedback received from writers, CEA will require additional staff to assist with responding to writer queries and possibly shorten the period in receiving a response. Additional collaboration may be required to assist in providing writers with alternative verification processes. The TL SaaS solution also has the facility to randomise items/questions. Additional reports may also need to be developed to assist the CEA team with post-session mitigation when reviewing the anomaly reports. It was also clear from the pilot that writers having the test section/session invalidated would impact writer score sets.

In South Africa, like other countries, switching to the online mode of teaching, learning and assessments has exposed us to challenges. Some of these challenges are:

- Very poor or no internet connection and data is very expensive
- The disadvantaged students cannot afford high internet contracts
- Absence of computers/laptops/tablets/smartphones that support online or remote learning
- The universities have experienced online instruments, platforms, and websites being disrupted due to an unexpectedly high number of students and staff getting connected. In addition, there are logistical, social, and psychological challenges.

Considering the above, the immediate support to the existing ways of assessment meant that new online platforms, and instruments had to be used to ensure the continuity and functioning of the NBT assessment. It was critical to ensure the development and adaptation of the tests for online accessibility to students. Reaching out to partners and collaborators, like Territorium strengthen our

preparedness, with dedicated support. This was not just an immediate crisis reaction, but it gave us the inspiration to move ahead with digitization and was helpful to move us beyond the crisis. A recognition of commitment, high pressure, and workload on staff to initiate new aspects of assessments, for the sake of continuity cannot be underestimated during the pandemic.

### *References*

- Cliff, A. (2014). Entry-level students' reading abilities and what these abilities might mean for academic readiness. *Language Matters*, 45(3), 313-324.
- CompTIA. (2021). What Is SaaS?. <https://www.comptia.org/content/articles/what-is-saas>
- Frith, V., & Prince, R. N. (2018). The National Benchmark Quantitative Literacy Test for Applicants to South African Higher Education. *Numeracy: Advancing Education in Quantitative Literacy*, 11(2).
- Making Moves. (2021). Simulation Preparation Package. <https://www.assessment-training.com/simulation-preparation-package>
- Microsoft Inc. (2019, January 16). How Microsoft uses process mining to accelerate digital transformation. <https://www.microsoft.com/en-us/insidetrack/how-microsoft-uses-process-mining-to-accelerate-digital-transformation>
- Microsoft Inc. (2021, June 14). From No. 2 pencils to the cloud, Territorium transforms testing, helping universities open doors for students. <https://customers.microsoft.com/en-us/story/859803-territorium-higher-education-azure-cognitive-services>
- Microsoft Inc. (2022, April 26). Disaster recovery for a multi-tenant SaaS application using database geo-replication. <https://docs.microsoft.com/en-us/azure/azure-sql/database/saas-dbpertenant-dr-geo-replication?view=azuresql>
- Myers, T. (2021, March 30). Introduction to Azure Blob storage. <https://docs.microsoft.com/en-us/azure/storage/blobs/storage-blobs-introduction#next>
- Prince, R. (2016). Predicting Success in Higher Education: The Value of Criterion and Norm-Referenced Assessments. *Practitioner Research in Higher Education*, 10(1), 22-38.
- Sango, T., Prince, R., Steyn, S., & Mudavanhu, P. (2022). High stakes online assessments: A case study of National Benchmark Tests during COVID-19. *Perspectives in Education*, 40(1), 212-233.

# PHYSICAL EDUCATION STUDENTS' INTENTION OF USING THE SPECTRUM OF TEACHING STYLE IN THEIR FUTURE WORK

**María Espada**

*Physiotherapy, Occupational Therapy, Physical Medicine and Rehabilitation Department, Physical Education and Sport Section, Health Sciences Faculty, King Rey Juan Carlos University (Spain)*

## Abstract

The spectrum of teaching styles in Physical Education is essential to achieve teaching goals and to increase students' motivation and their adhesion to physical activities and sports. The purpose of this study was to examine physical education university students' intention of using the spectrum of teaching styles according to their academic level and year. This research followed a quantitative descriptive methodology using a survey with a standardized procedure for collecting data via questions to the participants. Questionnaire based on students' beliefs about teaching styles. The sample was made up of 667 Spanish physical education university students (77.8% men and 22.2% women, aged from 18 to 30). A descriptive analysis (mean and standard deviation) and an inferential statistical analysis were carried out using different tests (Student's t test and ANOVA). The results of this investigation show that in general students prefer to use reproductive styles ( $3.24 \pm 1.53$ ) rather than productive styles ( $3.10 \pm .55$ ) in their future work as physical education teachers. The guided discovery and divergent production styles receive higher scores than other teaching styles, both of them are included in the productive styles cluster (student-centered learning). The level of academic studies (Master's degree students or Degree students) influences the intention of using reproductive styles ( $t_{(50.481)} = -2.025, p = .04$ ) and productive styles ( $t_{(47.997)} = -1.935, p = .05$ ). Furthermore, the year of studies they are currently in also influences the intention of using reproductive styles ( $F_{(4)} = 2.732, p = .02, \eta^2 = .01$ ) and productive styles ( $F_{(4)} = 9.743, p = .00, \eta^2 = .05$ ). The intention of using guided discovery, learner-designed, self-check and divergent production styles increases with the years of study. On the contrary, the intention of using the most traditional styles (command and practice) decrease with the years of study. These findings illustrate the future physical education teachers' intention of using the teaching styles in their future lessons and show how their intention changes during their years of study.

**Keywords:** *Teaching styles, physical education, university students.*

## 1. Introduction

Teaching styles in physical education are the teaching climate and the models of stimulation and organization used to teach, they are recognized by the way in which the teacher's interactions occur (Blázquez, 2017).

The theory of the spectrum of teaching styles created by Muska Mosston in 1966 has been considered internationally as the pedagogical basis in the field of physical education (Cañadas & Espada, 2023). The fundamental proposition of this theory is that teaching is governed by a single unifying process: decision making (Mosston & Ashworth, 2008). In this line of thought, Sánchez, Byra, and Wallhead (2012) suggest that the spectrum is a series of tools that provide physical education teachers with 11 different teaching options to address student diversity and achieve multiple physical education objectives.

Pedagogical models in general terms are divided into two clusters, one of them is teacher-centered learning and the other is student-centered learning. Specifically, the terms teacher-centered (direct) and student-centered (indirect) have commonly been used by researchers to categorize the reproductive and productive clusters, respectively (Mosston & Ashworth, 2008; Sympas et al., 2020).

- Reproductive styles, the teacher is a greater protagonist in the teaching and learning process since the students only perform what the teacher indicates. The following styles come within this group: command (A), practice (B), reciprocal teaching (C), self-check (D) and inclusion styles (E).

- Productive styles are those in which students have greater responsibility in the activities or tasks, they are invited to engage in discovery and creativity for the resolution of the different activities. The styles found within this group are the following: guided discovery (F), convergent discovery (G), divergent discovery (H), Learner Designed Individual Program (I), Learner Initiated (J) and self-teaching (K).

Goldberge, Ashworth and Byra (2012) determine that for the sport pedagogy scholar, the spectrum of teaching styles in physical education serves both as an organized repository for knowledge about teaching as well as a catalyst for generating new pedagogic research questions. Based on this consideration, the spectrum of teaching styles should be presented to physical education teachers during their undergraduate studies. In Spain, there are two undergraduate Physical Education Teacher Education (PETE) programs. The first one is Primary Education with its concern for the education of children between 6 and 12 years old. The second one is Sport Sciences that prepares students to teach physical education (PE) to adolescents between 12 and 18 years old. Preservice physical education students complete a master's degree program in Physical Education Teacher Education (PETE) in Spain. This master's degree focuses on the theoretical, methodological and research aspects of teaching and learning in physical education.

## 2. Objectives

The main objectives set out in this research were:

- To analyze university students' intention of using the spectrum of teaching styles according to their academic level.
- To analyze university students' intention of using the spectrum of teaching styles according to their academic year.

## 3. Methods

This research used a quantitative, descriptive, and non-experimental methodology analyzing the collected data to verify the correlation among the objectively studied variables (Cea D'ancona, 2001).

### 3.1. Participants

The sample was made up of 667 Spanish physical education university students (77.8% men and 22.2% women, aged from 18 to 30).

### 3.2. Instruments

The questionnaire used was the students' experiences with and perceptions of teaching styles (Cothran et al., 2000). The adaptation and validation for the Spanish version was carried out in order to be used in the Spanish educational context (Espada et al., 2021). A Cronbach's  $\alpha$  coefficient of 0.89 was obtained in the instrument. The questionnaire included a scenario for each of the 11 teaching styles followed by questions. This research used the item "I intend to make use of this teaching style in the future as a physical education teacher". This item was rated on a 5-point Likert scale (from 1 = never to 5 = always).

### 3.3. Procedure

After obtaining the approval for collaboration from the students, the questionnaire was administered and the information obtained was collected and recorded.

### 3.4. Statistical analysis

Statistical analysis was performed using SPSS (Windows, v.27.0). Statistical significance was set at  $P < 0.05$ . Normality was confirmed with the Kolmogorov-Smirnov test, and thus, parametric statistics were used (T-Student and one-way ANOVA).

## 4. Results

Students prefer to use reproductive styles ( $3.24 \pm 1.53$ ) rather than productive styles ( $3.10 \pm .55$ ) in their future work as physical education teachers.

Students' differences in intention to use teaching styles according to their academic level are shown in Table 1. Degree students and master's degree students prefer to use the guided discovery style ( $3.62 \pm 0.81$ ;  $3.70 \pm 0.82$ , respectively) and divergent production ( $3.54 \pm 0.84$ ;  $3.77 \pm 0.77$ , respectively). When analyzing the relation to students' level of academic studies and their intention to use the two cluster styles

there are significant differences in both reproductive styles ( $t(50.481) = -2.025, p = .04$ ) and productive styles ( $t(47.997) = -1.935, p = .05$ ) (Table 2).

Table 1. Mean (M) and Standard Deviation (SD) of the teaching style scores according to academic level.

	Degree		Master	
	M	SD	M	SD
A Command	3.06	0.94	3.20	0.93
B Practice	3.50	0.82	3.57	0.72
C Reciprocal	3.45	0.83	3.55	0.92
D Self-Check	2.83	0.93	3.02	0.97
E Inclusion	3.36	0.92	3.64	0.78
F Guided Discovery	3.62	0.81	3.70	0.82
G Convergent Discovery	3.42	0.86	3.34	0.74
H Divergent Discovery	3.54	0.84	3.77	0.77
I Learner-Designed	2.94	0.93	3.20	0.90
J Learner-Initiated	2.59	0.97	2.73	1.26
K Self-Teaching	2.45	0.94	2.91	0.98

Table 2. Students' t-test results of the teaching style scores according to academic level.

	Reproductive styles				Productive styles			
	M±SD	t	df	p	M±SD	t	df	p
Degree	3.23±0.43	-2.025	50.48	.04	3.09±0.55	-1.935	47.99	.05
Master	3.39±0.49				3.27±0.61			

Students' differences in intention to use teaching styles according to their academic year are shown in Table 3. The intention of using guided discovery, learner-designed, self-check and divergent production styles increases with the years of study. On the contrary, degree students' intention of using the command and practice styles decreases with the years of study. The year of studies they are currently in also influences the intention of using reproductive styles ( $F(4) = 2.732, p = .02, \eta^2 = .01$ ) and productive styles ( $F(4) = 9.743, p = .00, \eta^2 = .05$ ) (Table 4).

Table 3. Mean (M) and Standard Deviation (SD) of the teaching style scores according to academic year.

	1 <sup>st</sup> Degree		2 <sup>nd</sup> Degree		3 <sup>rd</sup> Degree		4 <sup>th</sup> Degree		Master	
	M	SD	M	SD	M	SD	M	SD	M	SD
A Command	3.44	1.02	3.04	0.86	3.02	0.82	2.56	0.99	3.20	0.93
B Practice	3.80	0.66	3.43	0.79	3.47	0.81	3.30	0.91	3.57	0.72
C Reciprocal	3.37	0.84	3.51	0.80	3.42	0.81	3.47	0.89	3.55	0.92
D Self-Check	2.58	0.97	2.80	0.92	2.99	0.86	2.94	0.92	3.02	0.97
E Inclusion	2.90	1.00	2.79	0.86	2.93	0.91	3.45	0.91	3.55	0.92
F Guided Discovery	3.36	0.93	3.62	0.72	3.64	0.75	4.03	0.77	3.70	0.82
G Convergent Discovery	3.30	0.92	3.42	0.83	3.39	0.87	3.69	0.73	3.34	0.74
H Divergent Discovery	3.20	0.85	3.54	0.81	3.60	0.77	4.03	0.79	3.77	0.77
I Learner-Designed	2.30	0.94	2.77	0.91	3.08	0.86	3.17	0.90	3.17	0.86
J Learner-Initiated	2.52	1.05	2.52	0.91	2.70	0.96	2.66	0.98	2.73	1.26
K Self-Teaching	2.47	1.00	2.39	0.91	2.50	0.92	2.49	0.98	2.91	0.98

Table 4. ANOVA of the teaching style scores according to academic year.

	Reproductive styles				Productive styles			
	M±SD	F	p	$\eta p^2$	M±SD	F	p	$\eta p^2$
1 <sup>st</sup> Degree	3.26±0.60	2.732	.02	.01	2.95±0.59	9.743	.00	.05
2 <sup>nd</sup> Degree	3.24±0.49				3.04±0.48			
3 <sup>rd</sup> Degree	3.27±0.49				3.12±0.57			
4 <sup>th</sup> Degree	3.08±0.59				3.39±0.49			
Master	3.39±0.49				3.27±0.61			

## 5. Discussion

The aim of this study was, on the one hand, to analyze university students' intention of using the spectrum of teaching styles according to their academic level, and on the other, to analyze university students' intention of using the spectrum of teaching styles according to their academic year. The findings of the present study show that students prefer to use reproductive styles rather than productive styles in their future work as physical education teachers. These results are in line with the study by Cothran, Kulinna, and Ward (2000) about students' physical education experiences in terms of teacher use of spectrum styles, students recollected that the styles their teachers employed were almost exclusively from the reproductive cluster (i.e., teacher-centered styles of teaching).

Regarding possible differences in intention to use teaching styles according to academic year, the data from this study show that degree students' intention of using the command and practice styles decreases with the years of study. These data could be due to the fact that the command and practice styles were most frequently identified because most physical education teachers use instructional strategies (teacher-centered styles) (Cothran et al., 2005; Kulinna and Cothran, 2003; Sánchez, Byra and Wallhead, 2012) and, when physical education students learn about others possibilities they prefer others teaching styles.

## 6. Conclusions

The conclusion from this research regarding the students' preference to use reproductive styles rather than productive styles but their intention changes during their years of study. The intention of using guided discovery, learner-designed, self-check and divergent production styles increases with the years of study.

## References

- Blázquez, D. (2017). *Métodos de enseñanza en educación física. Enfoques innovadores para la enseñanza de competencias (Teaching methods in physical education. Innovative approaches to teaching competencies)*. Barcelona: INDE.
- Byra, M., Sanchez, B., & Wallhead, T. (2014). Behaviors of students and teachers in the command, practice, and inclusion styles of teaching: Instruction, feedback, and activity level. *European Physical Education Review*, 20(1), 3-19. <https://doi.org/10.1177/1356336X13495999>
- Cañadas, L., & Espada, M. (2023). Relationship between preference in teaching styles with participation in assessment and teaching styles that support basic psychological needs in Physical Education. *Revista de Educación*, 399, 199-219. <https://doi.org/10.4438/1988-592X-RE-2023-399-567>
- Cea, M.D. (2004). *Métodos de encuesta: teoría y práctica, errores y mejora (survey methods: theory and practice, errors and improvement)*. Madrid: Síntesis.
- Cothran, D.J., Kulinna, P.A., & Ward, E. (2000). Students' experiences with and perceptions of teaching styles. *Journal of Research and Development in Education*, 33, 93-102.
- Cothran, D.J. et al. (2005). A cross-cultural investigation of the use of teaching styles, *Research Quarterly for Exercise and Sport*, 76(2), 193-201
- Espada, M.; Fernández, M.; Calero, J.C. (2021). Validación Española del cuestionario experiencia y percepción de los estudiantes del espectro de estilos de enseñanza en Educación Física (*Validation of the spanish version of the physical education students' experience and perceptions of the spectrum of teaching styles questionnaire*). *Journal of Sport and Health Research*. 13(2):305-318.
- Goldberge, M, Ashworth, S & Byra, M. (2012) Spectrum of Teaching Styles Retrospective 2012. *Quest*, 64, 268-282. DOI: 10.1080/00336297.2012.706883

- Kulinna, P. H. & Cothran, D. J. (2003). Physical education teachers' self-reported use and perceptions of various teaching styles, *Learning and Instruction*, 13(6), 597-609. [http://dx.doi.org/10.1016/S0959-4752\(02\)00044-0](http://dx.doi.org/10.1016/S0959-4752(02)00044-0)
- Mosston, M., & Ashworth, S. (2008). *Teaching Physical Education*. 1st online ed. Pearson Education.
- Sanchez, B. Byra, M. & Wallhead, T.L. (2012). Students' perceptions of the command, practice, and inclusion styles of teaching, *Physical Education and Sport Pedagogy*, 17(3), 317-330. Retrieved from <https://doi.org/10.1080/17408989.2012.690864>
- Syrmpas, I., Papaioannou, A., Digelidis, N., Erturan, G., & Byra, M. (2020). Higher-Order Factors and Measurement Equivalence of the Spectrum of Teaching Styles' Questionnaire Across Two Cultures. *Journal of Teaching in Physical Education*, 40(2), 245-255.



# DEVELOPING PRESERVICE SCIENCE TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE THROUGH REFLECTION ON LESSON PLANNING

**Lydia Mavuru**

*Department of Science and Technology Education, University of Johannesburg (South Africa)*

## Abstract

Reflection is one of the subjects most discussed in teacher development. Despite its importance in improving teacher practices, reflection has been found to be contentious amongst teachers who battle with high workload and the need to complete the curriculum in time for examinations. Thus, said reflection can be viewed as a chore to most teachers particularly preservice teachers who not only need to master the pedagogical knowledge and subject matter knowledge but also classroom management techniques amongst other skills. The current paper reports on a study on how lesson planning was used as a tool to develop preservice teachers' pedagogical content knowledge through reflection. In a qualitative case study, 50 Bachelor of Education Life Sciences students in their final year of study were each tasked to identify their 'best' lesson plan and 'worst' lesson plan and critically reflect on why they considered the lesson plans that way. These lesson plans had been designed and taught in schools during schoolwork experience (herein referred to as work integrated learning (WIL) in the first half of the year. Data was obtained from each participant's submission of the two lesson plans and the reflection, which were then subjected to content analysis. The following aspects about lesson planning were considered: knowledge of the content to be taught, knowledge of the learners including classroom context, formulation of objectives, designing of teaching and learning strategies and activities, assessment opportunities, planning for technology use, and the student's ability to realise good and bad practices in lesson planning. Thereafter they were tasked to plan and teach in their last seven weeks of WIL. The findings showed how the preservice teachers were determined to improve their lesson planning as they included in their reflections how they could plan and teach the same lesson differently including the so-called best lesson plan. Preservice teachers used words such as deficit, unstructured, misaligned, unattainable, not well thought out, to critique their lesson plans. Creativity as an aspect of the teacher skills set was evident in the way these 21st century teachers conceptualised how science should be taught. There were however some who failed to identify obvious weaknesses or strengths in their lessons plans, which showed stagnancy in development. The findings provide implications for teacher professional development practices.

**Keywords:** *Lesson planning, pedagogical content knowledge, pre-service science teachers, reflection.*

---

## 1. Introduction

The current study was aimed at improving pre-service life sciences (biology) teachers' personal pedagogical content knowledge (pPCK) through reflection on lesson planning. It was informed by the proposal by Alonzo, Berry, and Nilsson (2019) that transformation of pPCK into enacted pedagogical content knowledge (ePCK), and the reverse occurs throughout the plan-teach-reflect cycle. Planning lessons is viewed as a ubiquitous practice that produces important artefacts for effective teaching (Minken, Macalalag, Clarke, Marco-Bujosa, & Rulli, 2021). Minken et al. (2021) pointed out that the designed lesson plans are "windows into teachers' PCK" (p. 120). Hence analysis of lesson plans for evidence of PCK development can be done (Magnusson et al., 1999). In that respect teachers' well-developed PCK increases teachers' capabilities to improve students' learning (Bayram-Jacobs et al., 2019), and their instructional planning will reflect efforts to scaffold and support learners' conceptual understanding and development of skills. Well-designed lesson plans help teachers to reflect on the scaffolding strategies that help learners' conceptual understanding of science concepts. Consequently, the current study sought to answer the research question: How can lesson planning be used as a tool to develop preservice science teachers' pedagogical content knowledge through reflection?

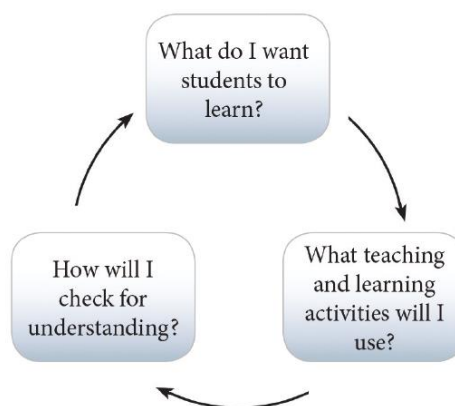
## 2. Literature review

The study was underpinned by the Refined Consensus Model (RCM) of PCK (Carlson & Daehler, 2019). In this model there is collective PCK (cPCK) which refers to the published and documented experiences of practitioners, in this case biology teachers, which informs the professional way of teaching the subject (Behling, Förtsch, & Neuhaus, 2022). These authors pointed out that when a teacher is confronted with cPCK during preservice teacher development, through engagement with content materials taught, interaction and communication with lecturers and colleagues, they integrate it internally into their own pPCK based on how they understand and experience. ePCK is developed through teachers' application of pPCK as they select teaching strategies, teaching materials and tasks to structure the learning process.

ePCK only occurs in action and is unique and cannot be repeated. As such, Alonzo, Berry and Nilsson (2019) differentiated between three steps of teaching which are: 1. A teacher plans own lesson and hence generate ePCK (Planning); 2. The teacher then teaches the learners in class using the lesson plan and ePCK (Teaching) is generated; and 3. The teacher reflects on the taught lesson and generate ePCK (Reflection). It is through this reflection that the teacher improves on the planning of the next lesson. This is called the Plan–Teach–Reflect Cycle of ePCK (Alonzo, Berry, & Nilsson, 2019). Because PCK influences learning and learning outcomes, examining developing teachers' PCK is pertinent and is an agenda for many education systems (Guerreiro, 2017).

Planning lessons "is an essential part of education and indicates the path teachers will follow throughout a lesson." (Contreras et al., 2020, p.1). Planning for effective teaching can be daunting for upcoming and novice teachers as it requires continued practice and deep critical reflection on how the teacher would conduct the lesson and how learners would respond. In the current study the author conceptualises reflection in line with Dewey's (1938) as a process of making meaning, and as an organised process where one engages in thinking due to interaction with others. Reflection plays a critical role in developing teachers' capabilities in active decision making as they identify and select appropriate instructional strategies (Borg, 2003). Reflection enables the teacher to gain insights based on experiences and learning from practice (Finlay, 2008). According to Finlay (2008) this happens when a teacher becomes self aware and critically evaluate own responses to practical situations. In the context of lesson planning, such a process is illustrated in Figure 1.

Figure 1. Key components of lesson plan design (Fink, 2005).



## 3. Methodology

The study followed a qualitative case study research design (Creswell, 2014). The design helped the participants to articulate their reflections based on their experiences and the context within the institution they were studying and the diverse nature of the schools they taught in during school experience herein referred to as work integrated learning.

### 3.1. Selection of participants

In a targeted purposive sampling technique (Patton, 2002), 50 preservice teachers enrolled for a bachelor's degree in education (BEd) specialising in Life Sciences (Biology) were selected. These students were in their final (fourth) year of study. It is in this fourth year when the focus is on methodology as they learn how they can transform the biology content knowledge when teaching in different classroom contexts to ensure learner understanding.

### 3.2. Data collection and analysis

In collecting data, the preservice Life Sciences teachers were each tasked to identify their ‘best’ lesson plan and ‘worst’ lesson plan and critically reflect on why they considered the lesson plans that way. These lesson plans had been designed and taught in schools during work integrated learning (WIL) in the first half of the year. Data was obtained from each participant’s submission of the two lesson plans and the reflection made. A total of 100 lesson plans and 100 reflections became the source of data. The researcher wanted to check the authenticity of the participants’ reflections; hence the participants were asked to submit their reflections together with their lesson plans.

The reflections were then subjected to content analysis (Bowen, 2009). The following aspects about lesson planning were considered: knowledge of the content to be taught, knowledge of the learners including classroom context, formulation of objectives, designing of teaching and learning strategies and activities, assessment opportunities, planning for technology use, and the student’s ability to realise good and bad practices in lesson planning.

## 4. Findings

The findings showed how the preservice teachers were determined to improve their lesson planning as they included in their reflections how they could plan and teach the same lesson differently including the so-called best lesson plan. Preservice teachers used words such as deficit, unstructured, misaligned, unattainable, not well thought out, to critique their lesson plans. Creativity as an aspect of the teacher skills set was evident in the way these 21st century teachers conceptualised how science should be taught. There were, however, some who failed to identify obvious weaknesses or strengths in their lessons plans, which showed stagnancy in PCK development. This also applied to some participants who failed to articulate their reflections for example one would just say, “The lesson was not well planned” instead of indicating why it was considered that way for instance where the mistake was, was it the poorly formulated objectives, the inappropriate teaching strategies, activities, or assessment tasks selected etc. The following three sections present the details of the preservice teachers’ reflections under strengths, weakness, and lessons learned for future lesson planning.

### 4.1. Strengths

Some of the strengths preservice teachers mentioned included a deliberate effort to design appropriate open-ended questions which helped in eliciting learners’ prior knowledge which not only helped as a smooth introduction to the concepts taught but also motivated learners to wanting to know what they were going to learn. As such, these short introductory interactive sessions captured learners’ attention. They mentioned the importance of formulating objectives which deliberately intended to develop learners in terms of what knowledge, skills and attitudes required for that topic. This included designing activities that provided learners with opportunities to develop manipulative, cognitive and relevant attitudinal skills that not only make them be able to answer questions in tests and examinations, but also ensure the utility value of the knowledge learned in their lives, communities, and workplaces. To this one participant wrote, “The applicability of knowledge or skills learnt should be made apparent in the classroom.” On that note the other said,

*I do not want to fall into the same trap that I went through when I learned Life Sciences concepts through memorising and only ask myself later after writing the test what it was about because I quickly forgot it.*

An important reflection made with regards to the curriculum was the need to interpret the curriculum properly which the preservice teachers indicated as an important issue if the teacher has to teach learners the appropriate content. One participant indicated how he would go out of his way to go through the content in the curriculum and also comparing the scope with the related content taught in the previous grade and to be taught in the following grade. On that note another participant indicated, “Failure to interpret the curriculum correctly results in teaching irrelevant concepts either by including concepts not needed or repeating concepts already learned from previous grades.” Another said,

*I consult with experienced teachers to check whether the content I am planning is the right one, including asking their opinions about the activities, resources and assessment tasks I plan.*

Some of the participants indicated how much they had improved in terms of lesson design from the first time they went to schools to teach at the beginning of the year. This one participant said, “When I inspect the lesson plans that I have designed during the third section of WIL, I can see a huge improvement.”

### 4.2. Weaknesses

Some of the participants reflected on their failure to plan adequate content to be taught in a lesson as they either planned less content or too much content for the time allocated for the lesson. In the case of too much content, these participants indicated that their learners became overwhelmed, and it was difficult for learners to comprehend the concepts. Those who planned less content reflected on how they struggled to manage classroom discipline as learners were not engaged completely leaving room for misdemeanors.

An aspect that many participants mentioned was their failure (for some) and recklessness (for others) to formulate well thought out lesson objectives. Some identified their mistakes as follows:

Participant 1: The verbs I used for psychomotor domain did not advocate for hands-on application of skills, rather they leaned towards the cognitive domain.

Participant 2: Designing objectives for higher order thinking skills was problematic for me particularly analysis, evaluation, and creativity. I took the lectures on these for granted.

Many participants mentioned that they struggled to formulate proper objectives that addressed the life sciences curriculum specific aim which states that learners should be involved in, “Appreciating and understanding the history, importance and applications of life sciences in society” (Department of Basic Education, 2011, p. 17). A lack of such planning meant that these preservice teachers’ lessons did not develop learners appropriately. Learners would not be able to answer higher order questions asked in the tests and examinations.

Most of the participants mentioned how they failed to plan for the questions that they would ask learners to ensure meaningful engagement with the content. One participant reminisced, “I kept on failing to ask questions to elicit my learners’ thinking which would have helped me to create links between prior knowledge and the new knowledge.” Others indicated how this failure to ask important questions resulted in learners remaining with misconceptions which they only detected in the way learners answered questions in the assessment activities. Some participants attributed most of their errors to the following: that they had no time to know their learners’ backgrounds and abilities; failure by the mentor to guide them appropriately when planning; the mentor interfering with how the preservice teachers planned and taught the lessons; and their efforts to cover as much content as possible which the mentor had allocated them for quite limited time.

An important reflection made by several participants was their poor content knowledge to be taught. They indicated that they took for granted topics such as evolution and those involving ecology. A participant indicated how she struggled to explain some of the concepts she assumed she knew hence did not prepare the content. Another preservice teacher mentioned how he failed to respond to questions posed by some learners in one of the top classes. This is what he said,

*At first I thought the learners were being naughty and wanted to me to prove myself that I was worthy to stand in front of the class as their teacher since I looked almost of their age. I only realised in the following lesson that I was in the wrong as I did not prepare the content.*

There were some whose reflections mostly focused on how they planned for the use of resources and technology to engage learners in meaningful activities. The most identified error was the use of videos which when used at the beginning in the introduction, they said it tended to be too long; when used during the lesson, videos kind of replaced the teacher. One such reflection was,

*When teaching the lesson, I felt the video was taking my place because it took learners through all the concepts that I needed to teach; I felt so embarrassed as it was a lesson that my mentor chose to observe me teaching.*

Though some participants indicated their efforts in identifying suitable teaching approaches, they bemoaned the way they used the strategies. One participant said, “I was not flexible in creating a fun and interesting environment for the learners.” Others indicated that the resources they used were very traditional, very limiting, especially regarding the context of the schools which they considered as under resourced.

Designing appropriate assessment tasks was one of the areas that preservice teachers mentioned as pertinent when planning for teaching. They indicated that the failure to design specific assessment activities for the lessons resulted in poor teaching as one would not be able to know whether learners understood the concepts taught. This also applied to the quality of test items which they mentioned should cover all the stages of revised Bloom’s Taxonomy. One preservice teacher mentioned how his failure to set rigorous test items resulted in most learners getting full marks.

### 4.3. Lessons learnt for future planning

Lesson plans act as guides to a lesson and assist a teacher in setting up an appropriate atmosphere for teaching and learning. One participant indicated that lesson planning helps the teacher to conceptualise the implementation of what, why and how to teach including the resources, activities, and assessment to make Life Sciences concepts more meaningful and relevant to the learners. A teacher should plan for effective time management during the lesson by keeping discussions brief without abruptly cutting learners short or lengthening activities unnecessarily. Preservice teachers suggested that when planning the lesson, each aspect should be allocated a specific time. In the words of one participant, “Nothing should be left to chance unless one is destined to failure.”

The preservice teachers pointed out that there are sometimes unforeseen circumstances that cannot be planned, for example, learner behaviour or participation in a lesson, unplanned load-shedding, emergencies and more. However, these issues may be corrected through reflection, practice, and experience.

## 5. Discussion, recommendations and conclusions

Some preservice teachers blamed their mentors for all the mistakes they made which shows lack of accountability. The chances of such preservice teachers to change for the better are slim considering that pPCK requires one to deliberately plan, teach and reflect (Alonzo, Berry & Nilsson, 2019). If one does not take accountability, it means there is no meaningful reflection as Finlay (2008) pointed out that reflection enables the teacher to gain insights based on experiences and learning from practice. There were preservice teachers who showed evidence of PCK development as indicated by Finlay (2008) that development happens when a teacher becomes self-aware and critically evaluates own responses to practical situations.

From the findings it shows that though the preservice teachers were in their last (fourth) year of studying for their teaching qualification, they still struggled to design 'perfect' lesson plans which shows that one needs to be a life long learner. An important aspect derived from the findings was that though most preservice teachers' reflection indicated failures in important aspects such as formulation of lesson objectives, preparation of content knowledge, poor questioning technique, and poor designing of assessment items, they reflected on their mistakes and how they intend to rectify their mistakes.

The findings have important implications for not only preservice teacher professional development but also continuous inservice teacher professional development.

## References

- Alonzo, A. C., Berry, A., & Nilsson, P. (2019). *Unpacking the complexity of science teachers' PCK in action: Enacted and personal PCK*. In A. Hume et al. (eds.), *Repositioning pedagogical content knowledge in teachers' knowledge for teaching science*, <https://doi.org/10.1007/978-981-13-5898-2>
- Bayram-Jacobs, D., Henze, I., Evagorou, M., Schwartz, Y., Aschim, E. L., Alcaraz-Dominguez, S., Barajas, M., & Dagan E. (2019). Science teachers' pedagogical content knowledge development during enactment of socioscientific curriculum materials. *Journal of Research in Science Teaching*, *56*(9), 1207–1233. <https://doi.org/10.1002/tea.21550>
- Behling, F., Förtsch, C., & Neuhaus, B. J. (2022). Using the plan–teach–reflect cycle of the refined consensus model of PCK to improve pre-Service biology teachers' personal PCK as well as their motivational orientations. *Education Sciences*, *12*, 654. <https://doi.org/10.3390/educsci12100654>
- Borg, S. (2003). Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. *Language Teaching*, *36*(2), 81-109. <https://doi.org/10.1017/S0261444803001903>
- Bowen, G. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40.
- Carlson, J. & Daehler, K.R. (2019). *The refined consensus model of pedagogical content knowledge in science education*. In A. Hume, R. Cooper & A. Boroswki (Eds), *Repositioning pedagogical content knowledge in teachers' knowledge for teaching science* (pp. 77–92). Singapore: Springer.
- Contreras, K., Arredondo, C., Díaz, C., Inostroza, M., & Strickland, B. (2020). Examining differences between pre- and in-service teachers' cognition when lesson planning. *System*, *91*, 102240. <https://doi.org/10.1016/j.system.2020.102240>
- Creswell, J. (2014). *Research design, qualitative, quantitative, and mixed method approach*, 4th ed. Thousand Oaks, California: Sage Publications.
- Dewey, J. (1938). *Experience and education*. New York: Collier Books, Macmillan.
- Fink, D. L. (2005). Integrated course design. Manhattan, KS: The IDEA Center. Retrieved from [http://www.ideaedu.org/Portals/0/Uploads/Documents/IDEA%20Papers/IDEA%20Papers/Idea\\_Paper\\_42.pdf](http://www.ideaedu.org/Portals/0/Uploads/Documents/IDEA%20Papers/IDEA%20Papers/Idea_Paper_42.pdf)
- Guerreiro, S. (2017). *Pedagogical knowledge and the changing nature of the teaching profession*. In Centre for Educational Research and Innovation. OECD (ed). OECD. <http://dx.doi.org/10.1787/9789264270695-en>
- Magnusson, S., Krajcik, J., & Borko, H. (1999). *Nature, sources, and development of pedagogical content knowledge for science teaching*. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge*. Kluwer.
- Minken, Z., Macalalag, A., Clarke, A., Marco-Bujosa, L., & Rulli, C. (2021). Development of teachers' pedagogical content knowledge during lesson planning of socioscientific issues. *International Journal of Technology in Education*, *4*(2), 113-165. <https://doi.org/10.46328/ijte.50>
- Patton, M. Q. (2002). *Qualitative evaluation and research methods* (3rd ed.). Thousand Oaks: Sage Publications.

## **EXPLORING THE INFLUENCE OF CAREER AWARENESS ON THE UPTAKE OF STEM SUBJECTS BY RURAL GIRL LEARNERS**

**Magdeline Stephen, Nomfundo Radebe, Ngonidzashe Mushaikwa,  
& Emmanuel Mushayikwa**

*University of Witwatersrand (South Africa)*

### **Abstract**

Learners in South African secondary schools are expected to choose subjects of specialization which will guide them to choose their preferred careers when they exit grade 9 in the General Education band (GET-Grade 8 and 9) where they are taught a generic curriculum to grade 10 in the further education and training band (FET- Grade 10-12). It is during this exit phase that career awareness assists them to choose subjects that guides their career choices. The low choice of science, technology, engineering, and mathematics (STEM) careers by female learners is a worldwide challenge especially for learners in rural communities, because of some cultural stereotypes and challenges that female learners face in such communities. This paper used a qualitative study to explore how career awareness might influence the choice of STEM careers and subject choice for grade 9 female learners in two rural schools in a South African province. The study revealed that after learners were exposed to the career awareness program, several learners changed their career choices resulting in an increase in the number of learners who wanted to pursue STEM related careers.

**Keywords:** *Career awareness, STEM subjects, STEM careers, female learners.*

---

### **1. Introduction and background**

The challenge of female learners accessing STEM careers has been common in many countries and persists all over the world because of the cultural biases, such as gender-specific norms and role expectations which influences the way they are taught and their choice of subjects at school (Amponsah & Mohammed, 2019). Gender-specific norms and role expectations has culminated in the underrepresentation of women in critical areas such as STEM majors, and subsequently in STEM occupations (Sainz, 2011). The low proportion of women in STEM subjects leads to the spread of a gender stereotypical image and affects young people's career choices, leading to a mutual reinforcement of gender stereotypes, and gender gaps in career related interests and choices (De las Cuevas, García-Arenas, & Rico, 2022). Initiatives to increase access to education for female learners are continuing throughout the world, especially in developing countries like South Africa. However, women continue to be underrepresented in tertiary studies and professional careers in these fields (Shepherd, 2017). Female learners in rural areas are still the most affected because of the stereotype that still exists in these communities that as females, they cannot or should not pursue STEM careers. Whereas Langdon, McKittrick, Khan and Doms (2011) argue that underrepresentation of women in STEM subjects is a result of gender and cultural bias, Else-Quest, Mineo, and Higgins (2013) argue that the shortage of females in STEM related fields is a result of women's frame of mind to STEM related fields rather than ability. For example, girls perceive working in STEM fields as being socially isolated and this limits them from pursuing STEM careers as they prefer being social and pleasant (Reinking & Martin, 2018)

Other factors that may affect STEM career choices in females is the inability to identify with women in these fields and lack of awareness. Archer, Moote, MacLeod, Francis and DeWitt, (2020) argue that female learners' lack of awareness and aspiration to science careers affect career choices in STEM fields. This can result in the fewer students accessing science careers, thereby creating a shortage of opportunities to explore science careers in authentic environments (Bennett, Lubben, & Hampden-Thompson, 2013). Learners' interests in science field do not necessarily translate into motivation and/or ability to pursue these subjects. Schools are institutions that should guide learners' subject and career choices. Kang et al. (2021) emphasise the importance of increasing science career awareness at the lower grades in secondary schools, which might assist in retaining them in the science

subjects' stream and influence their career development. In the South African schools, learners take Natural Science, Mathematics, and Technology as general subjects. When they progress from Grade 9 to Grade 10, they are required to choose subject of specialization that will lead them into their desired careers (DoBE, 2012). Shepherd (2017) argues that STEM subject choices at secondary schools have implications for female learners as they can improve economic development and growth, as well as address social inequality that continue to play a role in the inability of women to have access to higher paying employment opportunities. Thus, in Grade 10 the learners' subject choice is the key predictor of their STEM career choices. Blotnick et al., (2018) add that career awareness is a precursor of aspirations, as a result sufficient information on these careers may influence the uptake of STEM subjects in high schools. However, in rural areas, few learners have personal knowledge of professionals actively working in STEM fields and they frequently lack understanding about science careers (Archer et al., 2013). The lack of knowledge and resulting in lack of interest in STEM related subjects and careers, was a motivation for this study. We sought to establish how STEM career awareness for grade 9 female learners in two rural schools in a South African province influenced their choices in choosing STEM careers. The study seeks to answer the following research question: *How did the awareness to STEM careers influence the uptake of STEM subjects by rural female learners in grade 10?*

## 2. Theoretical framework

The social cognitive career theory (SCCT) by Lent and his colleagues (1994) is used as a lens for this paper. The social cognitive career theory (SCCT) is aimed at explaining three interrelated aspects of career development: (a) how basic academic and career interests develop, (b) how educational and career choices are made, and (c) how academic and career success is obtained. This theory explains how interest is related to a career goal and action as they are exposed to conditions and requirements for pursuing STEM careers. The career awareness program in this study was aimed at exposing learners to STEM careers with the hope of improving the uptake and retention of rural female learners in the STEM subject stream. The career awareness session took place at a central school to both schools to enable them easy access to the venue. The career awareness program included real professionals in the STEM field sharing information on their daily work and the requirements for their jobs. This enabled learners to not only get information on STEM careers but to also interact with professionals in these fields. The professionals also shared benefits of STEM careers to arouse learners' interests in these careers more.

As the professionals shared information about their jobs, there was additional information provided in career awareness booklets which were given to learners. The booklets were provided as a reference resource for learners to explore and develop understanding about STEM careers, most of which were not presented at the career awareness program. The booklets provided to learners about STEM careers contained all information that enabled them to understand the subjects required for high school, entry requirements at tertiary institutions and career pathways. The information provided through the career awareness session exposed learners to important information on STEM careers which could assist them in future to choose careers that they want. The whole session complied with the SCCT theory in trying to develop learners STEM career interest, assist them in making informed decisions in choosing STEM careers and motivate them to choose STEM subject in the FET phase.

## 3. Research methodology

A qualitative research method was used to collect data from grade 9 female learners in two rural schools in a South African province. Qualitative research emphasises gathering of data on a naturally occurring phenomenon, mostly in the form of words rather than numbers (McMillan & Schumacher, 2010). The population of the study was two hundred and sixty-seven (267) female grade 9 learners (aged between 14-16 years) from two schools in a rural place, from which 40 (20 in each school) were identified by their teachers to participate in focus group interviews on their career choice to establish their STEM careers choices. The same learners participated in focus group interviews before and after the career awareness session, although all grade 9 female learners in both schools were invited to the career awareness session. The focus group interviews were semi-structured with pre-determined questions. The pre career focus group interviews took place two months before the career awareness session. The post focus group interviews took place a month after the career awareness session. Learners were encouraged to use a language of their preference to respond to questions because one of the researchers could speak a local language, so that they did not feel intimidated or shy to respond in English. Learners' responses were captured through an audio recorder then transcribed. Data collection comprised of the pre career awareness phase and the post career awareness phase with the career awareness session in between. Data was transcribed and thematic analysis was used to make sense of the developed data. The themes which emerged from data involving learners

'career choices before and after the career awareness session were, STEM careers, non-STEM careers, a combination of STEM careers, and a combination of non-STEM careers. Table 1 below summarises the results. Ethical considerations required for this study were all adhered to.

#### 4. Results and analysis

The table below shows the career choices of the forty interviewed learners before and after the career awareness program.

*Table 1. Career choices before and after the career awareness program.*

	STEM careers	Non-STEM careers	Combination of STEM careers	Combination of Non-STEM careers
Pre career awareness interviews	9	4	1	4
Post career awareness interviews	15	1	9	5
Variance	+7	-3	+8	+1

Table 1 shows that out of the forty responses of learners who were sampled for the focus group interviews in both schools before the career awareness program, 10/40, learners STEM careers: six (6) learners indicated that they wanted to be medical doctors, mechanical engineers (3), and one (1) each indicated that they wanted to be a nurse, pediatrician, an optometrist, a dermatologist, science teacher, a psychologist and a mathematics teacher respectively. Eight out of forty, 8/40, learners choose the following non-STEM careers: an actor (3), a lawyer (3), a journalist, and a recreational therapist. There were learners who had more than one career choice, ranging from a combination of STEM and non-STEM careers. One learner had a choice between these two STEM careers: mechanical engineer or science teacher and four (4) learners chose the following combination of a STEM and non-STEM careers: a medical doctor or social worker, accountant or scientist, mechanical engineer or lawyer and a gynecologist or a lawyer. Only twenty-three (23) learners were clear about their career choices whilst seventeen (17) were not sure about their career choices. From the 23 who were clear about their career choices, at least 21/40 (52, 5%) was or included a STEM career, 8/40 (20%) had non-STEM career choices, and 17/40 (27, 5%) were not sure of their career choice and did not provide a career choice.

From a sample of 40 learners who participated in the interview prior to the career awareness program, only one learner could not attend the career awareness program. From the thirty-nine learners who were part of the pre career awareness interview and attended the career awareness program, there were learners who indicated interest in more than one career choice in the post career awareness interviews. Fifteen (15) learners chose STEM careers while nine (9) learners chose a combination of STEM careers. The following STEM careers were chosen by the learners: doctor, mechanical engineer, chemical engineering, pilot, surgeon, dentist, electrical engineering, forensic specialist, pharmacist, microbiologist, scientist, environmental specialist, nurse, psychologist, and aeronautic engineering. Six (6) learners chose the combination of non-STEM careers and only one learner chose a non-STEM career. The non-STEM careers chosen by the learners included the following: lawyer and social worker. Thus, 24/39 (61, 5%) learners choose at least one STEM career, and 6/39 (15.4%) learners had non-STEM career choices. The remaining number of learners remained unsure about their career choices.

Post career awareness program, Table 1 shows that the number of learners who chose careers that were STEM related increased after the career awareness program, whilst the number of learners who chose careers that were not STEM related decreased. An increase of one in the number of learners choosing a combination of non-STEM careers was observed, whilst a decrease of three for those that opted for non-STEM careers was observed. Table 1 shows an increase in the interest of learners in STEM career choices. For those that chose STEM careers, there was an increase of fifteen learners after the career awareness program, seven learners opting for one STEM career and eight opting for more than one STEM career. During the pre-career awareness interview, learners' career choices seemed to be based on careers that they were familiar with or those whom someone familiar to them was doing, whereas during the post career awareness interviews in addition to some of the careers that they were aware of, they chose careers that were either presented by STEM professionals or those that were in the booklets, with the exception of one learner.



## 5. Discussion

The increase in the number of learners who chose STEM careers from the pre career awareness to the post career awareness interviews indicate that the career awareness program was influential to their decisions on career choices. The exclusion of some non-STEM careers and addition of more STEM career choices seem to suggest that lack of exposure to STEM careers might affect learner career choices in those streams. This coincided with findings by Bennett et al. (2013); Archer et al. (2020), and Kang et al. (2021) that lack of awareness of authentic science related careers and aspiration can affect learners' interests and result in the fewer students accessing STEM careers, thereby creating a shortage of opportunities to explore science careers in authentic environments. After the career awareness program, learners' responses indicated some interests in these careers. Inviting STEM professionals to share information not only exposed learners to STEM careers, but also made learners to identify themselves as future STEM professionals, due to the social contacts with scientists (Archer et al., 2020). However, there were still some learners who remained undecided about their career choices even after the career awareness program. The study found that nine learners remained undecided about their career choices post career awareness program. This suggests that more career awareness programs and support is required to help these learners decide before they chose their subject choices in Grade 10. Such support may help learners choose the relevant subjects required by their choice of career.

## 6. Conclusion and recommendations

Subject choice affects career choices. The choice of specialization subjects in grade 10 allows for grade 9 teachers to provide information about these subject choices in grade 9 and provide guidance. This did not seem to have happen in the sampled schools, which could result in uninformed subject choices in grade 10. In addition to career awareness, female learners should be motivated to take up STEM subject choice if they have the potential to pursue STEM careers. This paper recommends that career awareness programs should be done throughout the year when learners get into grade 9, and they should include sufficient information about subject choices leading to the careers and, where possible, some professionals in other fields that learners can identify with.

### *Acknowledgements*

This work was made possible by the generous donations of the Female Academic Leadership Fellowship (FALF) organization.

### *References*

- Amponsah, D., & Mohammed, M. (2019). Perception of learning science: the case of females offering STEM majors in Ghana. *African Journal of Educational Studies in Mathematics and Sciences*, 15(2).
- Archer, L., Moote, J., Macleod, E., Francis, B., & DeWitt, J. (2020). *ASPIRES 2: Young people's science and career aspirations, age 10–19*. UCL Institute of Education.
- Archer, L., Osborne, J., DeWitt, J., Dillon, J. W., Wong, B., & Willis, B. (2013). *ASPIRES: Young people's science and career aspirations, Age 10-14*. London: King's College.
- Bennett, J., Lubben, F., & Hampden-Thompson, G. (2013). Schools that make a difference to post-compulsory uptake of physical science subjects: Some comparative case studies in England. *International Journal of Science Education*, 35(4), 663–689.
- Blotnicky, K., Franz-Odendaal, T., French, F., & Joy, P. (2018). A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students. *International journal of STEM education*, 5, 1-15.
- De las Cuevas, P., García-Arenas, M., & Rico, N. (2022). Why Not STEM? A Study Case on the Influence of Gender Factors on Students' Higher Education Choice. *Mathematics*, 10(239).
- DoBE. (2012). *National policy pertaining to the programme and promotion requirements of the national curriculum statement grades R – 12*. South Africa, Pretoria: Government printer.
- Else-Quest, N., Mineo, C., & Higgins, A. (2013). Math and science attitudes and achievement at the intersection of gender and ethnicity. *Psychology of Women Quarterly*, 37, 293-309.

- Kang, J., Salonen, A., Tolppanen, S., Scheersoi, A., Hense, J., Rannikmä, M., . . . Keinonen, T. (2021). Effect of Embedded Careers Education in Science Lessons on Students' Interest, Awareness, and Aspirations. *International Journal of Science and Mathematics Education, 21*, 211–231.
- Langdon, D., McKittrick, G., Khan, B., & Doms, M. (2011). *STEM: Good jobs now and for the future U.S. Department of Commerce, Economics and Statistics Administration*. Retrieved May 4, 2019, from <http://www.esa.doc.gov/sites/default/files/reports/documents>
- Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance [Monograph]. *Journal of Vocational Behavior, 45*, 79-122.
- McMillan, J., & Schumacher, S. (2010). *Research in Education*. New Jersey: Pearson, Education Inc.
- NCWIT. (2013). *By the numbers*. Retrieved May 4, 2019, from <http://www.ncwit.org/resources/numbers>
- Reinking, A., & Martin, B. (2018). The Gender Gap in STEM Fields: Theories, Movements, and Ideas to Engage Girls in STEM. *Journal of New Approaches in Educational Research, 7*(2), 148-153.
- Sainz, M. (2011). Factors that influence girls' orientations to ICT subjects in schools. Evidence from Spain. *International Journal of Gender, Science and Technology, 3*, 387–406.
- Shepherd, S. (2017). Why are there so few female leaders in higher education: A case of structure or agency? *Management in Education, 31*(2), 82–87.

# CAPTURING UNIQUE TEACHING EXPERIENCES OF FIRST-YEAR SECONDARY MATHEMATICS TEACHERS TRANSITIONING FROM VIRTUAL TO IN-PERSON INSTRUCTION

Amélie Schinck-Mikel<sup>1</sup>, Katie Paulding<sup>2</sup>, & Elsa Medina<sup>1</sup>

<sup>1</sup>Mathematics Department, California Polytechnic State University, San Luis Obispo (USA)

<sup>2</sup>School of Education, California Polytechnic State University, San Luis Obispo (USA)

## Abstract

This article reports on the findings of a study on the unique journey of pre-service teachers in a Teacher Preparation Program in 2020-2021 who then went on to their first-year teaching in person in 2021-2022. Secondary mathematics pre-service teachers who completed their clinical practice in a virtual learning environment due to the COVID-19 pandemic were followed throughout their first year of teaching in 2021-2022. Through interviews during their first-year teaching, these teachers' voices detail their journey from pre-service teacher to novice teacher in different modalities. The results of the analysis of the interview data hold many lessons for teacher educators that enhance our understanding of teacher preparation and inform topics for supporting new teachers during clinical practice and coursework during a Teacher Preparation Program.

**Keywords:** *Secondary mathematics teacher education, pre-service teachers, clinical practice, early service mathematics teachers.*

---

## 1. Introduction

Fittingly, much has been written in the research literature and the news about the impacts of the COVID-19 pandemic on K-16 students throughout the world (e.g. Mervosh, 2022; National Conference of State Legislatures, 2020). However, less attention has been paid to the huge impact the pandemic has had on Teacher Preparation Programs (TPPs). Secondary mathematics preservice teachers who went through our Teacher Preparation Program in the year 2020-2021 experienced a very different first year of teaching in 2021-2022 than any other novice teacher in the past. At the start of the 2020-2021 academic year, mathematics preservice teachers in TPPs across the United States began their clinical practice experience in a Virtual Learning Environment (VLE). This had never been done before on this scale and never at our institution. Faculty members in all disciplines in our TPP used the pause of summer 2020 to thoughtfully transition to an online delivery for our classes and support our preservice teachers (i.e. teacher candidates) who would be teaching in a VLE for the majority of the upcoming academic year. During our TPP in 2020-2021, teacher candidates' credential coursework and clinical practice experiences were completed in a VLE due to school closures.

The unique experiences and preparation of the preservice teachers in 2020-2021 thus differ drastically from previous and future cohorts (e.g. Choate et al., 2021; Cirillo et al., 2020). Years into the pandemic, mathematics TPPs continue to quickly learn and adapt to support preservice teachers in an evolving mathematics education landscape as it continues to be impacted by the effects of the pandemic (Chizhik & Brandon, 2020; Tsui et al., 2020). Since the pandemic created an unusual shift in the manner in which education was conducted, we wanted to examine some of the impacts that were felt specifically by teacher candidates who primarily learned to teach in a VLE. What challenges did they face going into in-person instruction in their first year teaching? What were they able to take with them from their experiences in a VLE and apply in the in-person classroom? Looking forward, how could our TPP learn from the rich experiences of these first year teachers to inform and improve our program?

This article addresses the following research question:

**Research Question:** What were some of the unique teaching experiences of teachers in our Teacher Preparation Program in 2020-2021 through their first year teaching in-person in the academic year 2021-2022 as reported by interviews?

Next, we continue with a brief review of research on the effects of the pandemic on many aspects of teacher education. Then, we provide background on the interviews with graduates of our program who were now first-year secondary mathematics teachers in 2021-2022. In the findings we give first-year teachers in 2021-2022 a voice by reporting the results of interviews throughout the year using the teachers' own words. Finally, we provide lessons for TPPs and mathematics teacher educators leveraged from the unique experiences of first-year teachers in 2021-2022.

## **2. Literature review**

### **2.1. Coteaching**

Our teacher preparation program uses a coteaching model of clinical practice in which one teacher candidate (preservice teacher) is paired with one cooperating teacher (in-service teacher) to engage students in learning (Tobin & Roth, 2005). This model seeks to increase the collaboration between teacher candidate (TC) and cooperating teacher (CT). It has been said that all teachers were essentially new teachers in the 2020-2021 academic year (e.g. Choate et al., 2021.) The closure of schools and pivot to online learning during the pandemic influenced the collaborative nature between teacher candidate (TC) and cooperating teacher (CT). As stated by Barnhart (2020), "One "rethink" the pandemic appears to have stimulated is a recognition of the skills and knowledge novices bring with them to classrooms. Though lacking in teaching experience, novices bring several assets to the fieldwork partnership with their mentors." (p.126).

### **2.2. Relationships and socio-emotional health of students during pandemic**

The literature offers some insights about the ways that teachers can encourage meaningful teacher-student relationships such as being authentic in the classroom, placing a focus on forming relationships in which the teacher learns about students' interests and shares some of their hobbies, likes and dislikes, and a valuing of students' socio-emotional health. During the pandemic, teachers and preservice teachers were encouraged by administrators, parents, and students to focus on building relationships with and among their students. Preservice teacher education was thus tasked with teaching preservice teachers how to form such relationships with their students during clinical practice in a VLE and beyond.

### **2.3. Classroom management and educational technology during the pandemic**

First in Spring 2020 and continuing into the 2020-2021 academic year, teachers reported challenges in classroom management such as difficulties with communication or providing feedback to their students, and a lack of accountability structures, motivation, engagement and participation on the part of their students (e.g. Leech et al., 2022). For teacher candidates, learning to teach in a VLE during the majority of their credential program in 2020-2021 did not provide many (if any) experiences in managing a physical classroom and facilitating in-person instruction.

## **3. Method**

### **3.1. Data collection**

We followed five graduates from our single subject credential program in mathematics in 2020-2021 as they began their first teaching job in August 2021. We gathered data on their first year teaching experiences via three semi-structured interviews administered and recorded via Zoom during August 2021, October/November 2021, and May 2022. Transcripts of each interview were created for coding and data analysis. The interview protocol was developed in 2021 using a review of the literature out at the time about the impacts of the pandemic on education (e.g. Barnhart, 2020; Cirillo et al., 2020; Tsui et al., 2020).

### **3.2. Data analysis**

Analysis of interview data involved a thorough reading of each interview transcript by both authors, separately identifying and making note of emerging themes. The authors then compared and contrasted themes to focus on commonalities between experiences of first-year teachers to develop codes. Both authors then extracted relevant interview excerpts for each theme. The authors wrote a description summarizing each quote and organized them by theme. The themes were cooperating teacher/teacher candidates (CT/TC) dynamic, relationships/Socio-Emotional Learning (SEL), classroom management, and technology. Qualitative coding was then applied to the transcripts of the interview.

## 4. Findings

Three main themes emerged from our data analysis as follows: cooperating teacher/teacher candidate dynamic, relationships/socio-emotional learning, and classroom management/technology. We discuss each below.

### 4.1. Cooperating Teacher/Teacher Candidate dynamic

“Yeah, I think that he was pretty open to trying new things, because I mean, I think it was just such a new environment, that he was open to whatever to have the most successful year.”

The willingness on the part of the cooperating teacher to accept new ideas and allow opportunities for more creativity in teaching was a striking feature of the 2020-2021 academic year. Due in large part to the technical knowledge the teacher candidates had going into the program and the reliance on technology for remote instruction in Fall 2020, teacher candidates and cooperating teachers maintained this collaborative relationship which continued throughout the year, even as schools returned to in-person instruction.

Although the data suggest a more collaborative CT/TC dynamic for the year 2020-2021, when looking back at their time in clinical practice and comparing it to their in-person teaching experiences, novice teachers reflected on the fact that the relationship with their cooperating teacher was much more isolated or felt more isolating to them. This may have been due to the structure of online learning during that time period. To alleviate this issue for future cohorts, they recommended that teacher candidates go observe as many teachers as possible, ask questions to many teachers about classroom management surrounding homework, grading, absences, etc. For example, one novice teacher suggested, “Get ideas from everyone, even if it's just at their school site that they can go watch a period and just see. That's probably honestly, one of the things that I missed.”

**LESSON 1:** The willingness of the cooperating teacher to include the teacher candidate's input early on in the year really set the tone for a collaborative and creative year where both parties were open to new ideas. This is something to harness and encourage for future cooperating teacher/teacher candidate dynamics.

**LESSON 2:** TPPs should be careful not to let the cooperating teacher/ teacher candidate dynamic be isolated or become isolating during a credential program, whether the instruction takes place in person or a virtual learning environment. Encourage novice teachers to collaborate with a broader group, such as with other teacher candidates, other teachers at their site, and their administration.

### 4.2. Relationship with students and socio-emotional health

A theme that was mentioned often during the interviews is the focus on building relationships with students and supporting their socio-emotional health. In 2020-2021, preservice teachers in our program were asked to prioritize students' well-being, lives, and interests. As new teachers in 2021-2022, they carried the lessons from clinical practice forward and thus were uniquely positioned to be caring, inspirational teachers that placed great value on their students' socio-emotional health as well as their mathematical growth. They went into their first-year with concrete plans to engage students, actively form relationships, and have socio-emotional check-ins. One novice teacher used a fun activity at the beginning of the 2021-2022 academic year to quickly build community and get to know her students: “We had kind of a fun activity that I did at the beginning of the year...but it was this giant like March Madness-style tournament of favorite candy bars in every class, and so it started with these like 64 candies and we finally got two winners in every class and, every day kids were, like, “Can we do the candy tournament today?” [...] things like that, that are just fun and not math related to try to get kids talking and talking with each other.”

The focus on relationship building with students and daily check-ins with students continued throughout the year for all teacher candidates interviewed. One novice teacher directly observed the effects of intentionally building relationships when a student chose to confide in her about a very challenging situation the student was facing.

**LESSON 3:** The major lesson we learned about relationships and socio-emotional learning is that teacher candidates from 2020-2021 were uniquely positioned to be teachers who put relationships in the forefront due to their teaching experiences in the pandemic. This focus on relationship building with students and among students should continue to be a priority for teacher preparation programs and mathematics teacher educators.

### 4.3. Classroom management and technology

Another major theme that arose in our analysis is classroom management. Unsurprisingly, when interviewed, these first-year teachers who felt very confident about their plans and ability to form relationships with students, reported less confidence in their in-person classroom management proficiency. They were now finding out that classroom management in an in-person setting is more difficult than a VLE. Although all of them reported being extremely excited to be teaching in person after going through the majority of their TPP virtually, data from our interviews in September and November indicate it is evident these first-year teachers had been learning some classroom management lessons “on the job” so to speak, lessons that teacher candidates in the program before or after 2020-2021 would typically learn during their clinical practice experience.

A challenge these first-year teachers faced regarding classroom management revolved around establishing norms for classroom behavior. They reported more behavioral issues occurring in the classroom due to missed in-person interactions during online learning the previous year. One novice teacher shared their experience of learning to manage physical school supplies in the classroom as follows: “It sounds kind of crazy, but not having tangible things in front of them can help them in a way, if they’re just doing things on a computer and, like their attention is just there because I’ve had my students glue things into their notebook and then they treat the glue stick like a toy and they started drawing all over the desk and I’m like, “Oh my gosh! I need to teach you how to use a glue stick now.”

Since their students had been in a VLE for several years, there was a general consensus among the first-year teachers that they needed to provide explicit instruction regarding their expectations for student preparedness for class and managing supplies (e.g. having a sharpened pencil, a charged laptop, where to write their names on papers, how to take notes during lessons.)

During the interviews, we also asked the first-year teachers to describe the pros and cons of using various educational technologies to increase learning and facilitate classroom management. Having taught primarily online during their TPP, and in-person during their first year of teaching, these novice teachers could describe in detail the benefits and drawbacks of each approach. In general, they felt that the in-person teaching environment allowed them to check-in with students both emotionally and academically, helping them form better interpersonal connections with students. Many expressed delight in being able to obtain immediate feedback from students during lessons. They explained that in-person teaching allowed them to “read the room” and determine when to modify lessons or clarify a point in the moment, opportunities which were not available in the VLE. Here is an excerpt from an interview that captures novice teachers’ discovery of the power to read the room: “When in person, I can actually see what they’re doing and I can gauge like “Okay, they need a little bit more time” or it’s kind of getting loud that means they’re done, and they need instruction now. I definitely prefer in person instruction, because there’s so much more that you can read in a classroom like from your students that helps you navigate how the lesson is going to go.”

While first-year teachers largely preferred teaching in person over a VLE, they did identify some benefits to teaching in a VLE. Classroom management was easier online (i.e. use of mute button) and the ability to put students into groups efficiently and quickly via breakout rooms. They were able to do quick check-ins on Desmos, easily do one-on-one check-ins with a student in a separate, private, breakout room, adapt instruction for students who finished assignments early, easily incorporate technology into instruction, and facilitate submission of homework assignments. Of particular note, one novice teacher explained that her students felt more comfortable asking questions and developed more confidence while learning in a VLE due to the anonymous identifiers utilized in online learning platforms such as Desmos. This teacher was now thinking of a mechanism to anonymize questions, at least some of the time, while teaching in person.

However, novice teachers also listed multiple drawbacks to teaching in a VLE. Having spent time teaching in an in-person setting, first-year teachers recognized challenges to student engagement and participation, a lack of hands-on learning experiences, and difficulty making connections with students when teaching online. They noted that since it was harder to see students’ work online, they relied more on direct instruction instead of an inquiry-based method when teaching in a VLE. The following quote elaborates on these ideas: “In a virtual setting, I think we relied a lot on the direct instruction, and so I feel like presenting material from a direct instruction sort of lens, I feel comfortable with. And I don’t want to use it all the time, because I know that that’s not beneficial.”

While completing their credential program, teacher candidates had extensive time to learn how to use new programs and applications, as well as determine their usefulness during instruction. Now, having experienced both remote and in-person teaching, first-year teachers are realizing that student retention of concepts is different when using an online tool vs in-person interaction. They notice these differences even when utilizing technology in the in-person setting. In addition, when using online tools in the classroom, they can be enhanced with other supports, such as guided notes. The following quote elaborates on these realizations: “I use a document camera for showing my kids how to use a calculator...but I found that I

really need worksheets to go alongside them or something that they have to do in their notebook, because they weren't actually retaining the stuff that they did on the slides because they wouldn't write it all out or they wouldn't draw the triangle, or whatever. That's something I wouldn't have realized last year with my virtual teaching.”

However, first-year teachers also recognized the value of the recorded videos that teachers made in 2020-2021 which now may be integrated into current instruction. The videos can be made accessible and available to students for review and preview as one novice teacher explained as follows: “We've talked a lot about the types of videos the other teachers made last year, like the lesson I just did today: Oh, I have a video on that and they recorded videos for all their lessons and so all of them were saying wow I'm really glad that I have those now.”

Having experienced teaching in both the in-person setting and a VLE, first-year teachers expressed the desire to strike a balance between the benefits and drawbacks of each modality (i.e. VLE and in-person). In certain situations, tactile, tangible tools such as Algebra tiles, counters, and number lines may be more effective than a technology simulation in an in-person environment. At other times, the integration of technology in the in-person setting may be a better choice. However, they also highlighted the importance of face-to-face instruction for hands-on learning and the development of social skills.

**LESSON 4:** Teacher educators should become familiar with the benefits and drawbacks to teaching in a virtual learning environment and integrate this knowledge into credential coursework. Future teachers should continue to learn about relevant educational technology in their credential programs (e.g. coursework and clinical practice) even if they are teaching in person. They should be encouraged to consider adapting the pros of a VLE (e.g. anonymizing questions, space for shared work) while in-person teaching.

## 5. Conclusion

Teaching in a virtual learning environment during clinical practice in 2020-2021 provided novice teachers with a unique set of teaching skills such as a fluent use of educational technology, a nuanced understanding of the benefits and drawbacks of the different modalities, and a deep appreciation of the importance of building relationships with students. By relying on each other's expertise, the power dynamic of the coteaching pair shifted and they were able to create and teach innovative, engaging lessons for their students. Teacher preparation programs can capitalize on these lessons learned during the pandemic and apply them to future credential coursework and clinical practice experiences.

## References

- Barnhart, T. (2020). Co-innovating a paradigm shift from a pandemic. *Issues in Teacher Education*, 29(1-2), 122-131.
- Chizhik, E. W., & Brandon, R. R. (2020). Making virtual co-teaching work in a Covid-19 environment. *Issues in Teacher Education*, 29(1-2), 142-148.
- Choate, K., Goldhaber, D. & Theobald, R. (2021) The effects of COVID-19 on teacher preparation, *Kappan*, 102(7), 52-57.
- Cirillo, M., LaRochelle, R., Arbaugh, F., & Bieda, K.N. (2020). An innovative early field experience for preservice secondary teachers: Early results from shifting to an online model. *Journal of Technology and Teacher Education*, 28(2), 353-363. Waynesville, NC USA: Society for Information Technology & Teacher Education. Retrieved May 13, 2022 from <https://www.learntechlib.org/primary/p/216305/>.
- Leech, N.L., Gullett, S., Cummings, M. H., & Haug, C. A. (2022) The challenges of remote K-12 education during the COVID-19 pandemic: Differences by grade level, *Online Learning Journal*, 26(1), 245-267.
- Mervosh, S. (2022). Students Are Learning Well Again. But Full Recovery? That's a Long Way Off. *New York Times*. Retrieved August 10, 2022 from <https://www.nytimes.com/2022/07/19/us/pandemic-learning-loss-recovery-time.html>
- National Conference of State Legislatures. (2020). *Public education's response to the Coronavirus (COVID-19) pandemic*. Retrieved April 21, 2021, from <https://www.ncsl.org/research/education/public-education-response-to-coro-navirus-covid-19.aspx>
- Tobin, K., & Roth, W. M. (2005). Implementing coteaching and cogenerative dialoguing in urban science education. *School Science and Mathematics*, 105(6), 313-322.
- Tsui, A. B., Chan, C. K., Harfitt, G., & Leung, P. (2020). Crisis and opportunity in teacher preparation in the pandemic: exploring the “adjacent possible”. *Journal of Professional Capital and Community*, 5(3/4), 237-245.

# LEARNING TO TEACH: AN EVALUATION OF THE PREPARATION OF DOCTORAL STUDENTS TO LEAD THEIR OWN TEACHING

**Karel Němejc**

*Department of Pedagogy, Institute of Education and Communication,  
Czech University of Life Sciences, Prague (Czech Republic)*

## Abstract

Studying in doctoral study programmes of universities is quite often based on individual study plans of PhD students, under the guidance of a supervisor, or with the participation of a consultant. The main content of such studies is systematic creative scientific work with an emphasis on the topic of the dissertation. However, among other things, students usually participate in the management and preparation of teaching in bachelor or master study programmes to the required extent as a part of the study plan. Therefore, it is quite common for the students to teach on top of undertaking their research, and for this teaching practice, they should be provided with quality training on how to teach. In this context, the paper focuses on the multidisciplinary course “Didactic and Presentation Skills” for students of doctoral study programmes of one of the public universities in the Czech Republic. The course mainly covers the basics of university teaching, psychology and other areas that develop didactic and presentation skills of university members as often some will remain at the university in the positions of junior academics and scientists. In addition to the theoretical fundamentals, considerable space is devoted to seminars with video training of skills with their analysis and self-reflection. The aim of the paper is to introduce the current experience of the university institute of a Czech university with the development of doctoral students' competences needed for teaching. Furthermore, the results of the course evaluation in the academic year 2021/2022 from the perspective of doctoral students are presented. Among the topics provided, the respondents themselves attach the greatest weight to practical seminars on didactic and presentation skills, which they put in first place. Theory of communication and presentation skills and educational evaluation and educometrics are also considered essential by respondents, closely followed by the use of digital technologies in education, university pedagogy, psychological aspects of teaching, and activation methods. The study confirms the importance of preparing novice PhD students to adapt in teaching, to feel comfortable in a large auditorium, and to be confident in various situations that may happen at any time.

**Keywords:** *Evaluation, university education, development of skills, doctoral studies, teaching.*

## 1. Introduction

Within universities, PhD students have the opportunity, sometimes even the obligation according to their individual study plan, to participate in a range of teaching activities including conducting seminars and tutorials as well as laboratory practical demonstrations.

Teaching during a PhD is a great way to learn a range of transferable skills that are highly valued by employers both on and off campus. Project management, communication, coaching and problem solving are just some of the skills that will be used in any classroom management. Teaching can also help PhD students to learn how to communicate their research findings clearly to a range of different audiences, a critical skill for a successful researcher, etc. While building up vital work experience they can decide if to follow a career in academia (Bradley, 2009; Wilson, 2022). However, in scientific discourses, the question of the possibility or obligation of doctoral students to teach or not to teach is discussed quite frequently, e.g. Homer (2018), Brightman (2009).

Also, the Framework for Researcher Development (CRAC, 2011), for planning, supporting and promoting the personal, professional and career development of researchers in higher education articulates the knowledge, behaviours and skills and attributes of successful researchers and encourages them to reach their potential. To identify the characteristics of excellent researchers, these are expressed in the framework using four domains and twelve sub-domains. These include knowledge, intellectual



abilities, techniques and professional standards to do research, as well as the personal qualities, knowledge and skills to work with others and ensure the wider impact of research. For example, Domain “D” represents “Engagement, Influence and Impact”, including teaching, thus the knowledge and skills to work with others and ensure the wider impact of research. This confirms that PhD students should be effectively supported when involved in teaching, mentoring, coaching, etc.

According to this Researcher Development Framework (CRAC, 2011), in the context of teaching, doctoral students should be prepared and actively involved in:

- contributing to teaching at undergraduate level;
- participation in research meetings (seminars, workshops, conferences, etc.);
- having a developing awareness of research methods;
- influencing and interacting with teaching;
- improving own approach and developing a wider repertoire of teaching styles and techniques;
- being involved in the assessment of student knowledge and supervision of projects;
- contributing to and managing the teaching and learning programmes in the department and contributing to curriculum development in own area;
- leading teaching programmes and their assessment/quality assurance procedures;
- actively encouraging and promoting a culture that links research and teaching.

For example, The University of Bath offers a self-directed course “The First Steps into Teaching” to support the entry of their doctoral students into teaching. The course aims to provide them with a brief introduction to teaching and resources to support them at the start of their teaching pathways (University of Bath, 2022).

Here, the experience of the Institute of Education and Communication of the Czech University of Life Sciences Prague can also be mentioned, which, in addition to developing the competences of academic staff, has more than fifteen years of experience in educating doctoral students of selected faculties, often including those who will remain at the university as beginning teaching and research staff.

The “Didactic and Presentation Skills” course is designed to be multidisciplinary, as an introductory entry and insight into the issues of university pedagogy, didactics and presentation skills. The main aim of the course is to motivate PhD students to be able to reflect on basic didactic principles in their teaching and to be capable of self-reflection and evaluation of teaching in general. It is important for them to be aware of the objectives of their teaching, to be able to self-critically reflect on the verbal and non-verbal features of their presentation, not only in teaching but also, for example, when defending the results of their creative activity in the scientific circles. Therefore, the course includes the basics of university pedagogy and didactics, the basics of educational psychology, the basics of evaluation and educometrics, the basics of presentation skills and rhetoric, and the basics of IT skills in education. Practical training in didactic and presentation skills is absolutely necessary.

The course “Didactic and Presentation Skills” is designed as a face-to-face course with home preparation. It consists of 16 hours of theory and 16 hours of practical training. It includes both theoretical teaching (interactive lectures on selected topics) and practical exercises - microteaching. To intensify education, the PhD students are divided into several parallel groups for the practical training. For each of them a video recording is made, followed by a group analysis and student self-reflection. In this way, necessary aspects of teaching can be highlighted and the positives and negatives of their performance can be pointed out. Students deliver two types of output, namely a demonstration of their own teaching (lectures or seminars), and a presentation of a research report. Students complete the course with a committee examination divided into written and oral parts. Their knowledge and skills are tested, including self-reflection and their possible future use in educational and scientific activities (Němejc et al., 2023).

In this context, the aim of the paper was to introduce the current experience of the university institute of a Czech university with the development of doctoral students' competences needed for teaching, as they need to learn how to teach. Furthermore, the results of the course evaluation in the academic year 2021/2022 from the perspective of doctoral students are presented.

## **2. Methodology**

The survey tool used was a questionnaire focused on the evaluation of the “Didactic and Presentation Skills” course. The purpose of the anonymous questionnaire administered at the end of the course was to find out the subjective opinions of the PhD students about the teaching of the evaluated course in terms of:

- the teacher;
- the comprehensibility of the teaching;
- the duration of the course;
- the relevance of the taught areas;
- and the quality of the learning resources.

The PhD students expressed their opinions on the presented even Likert scale, with a minimum value of 1 and a maximum value of 6. They expressed their opinions on the elements that were included in the course, such as the following topics:

- Activation methods;
- Teaching evaluation and educometrics;
- Communication and presentation skills;
- Psychological aspects of teaching;
- Use of ICT in teaching;
- Fundamentals of university pedagogy;
- and Practical training in didactic and presentation skills in teaching.

Specifically, an exploratory survey sample was obtained from 53 domestic and international PhD students of selected faculties of the university (Faculty of Forestry and Wood Science, Faculty of Environmental Sciences) who had completed the “Didactic and Presentation Skills” course for the academic year 2021/2022.

The return rate of the questionnaires was 100%, with all questionnaires being valid. The data were analyzed using the mean and mode of the scale values for each of the examined areas. The data were processed and interpreted.

### 3. Results and discussion

The empirical survey deals with the first results of the evaluation of doctoral students of selected university faculties towards their participation in the “Didactic and Presentation Skills” course. The results are presented in Table 1.

*Table 1. Doctoral students' opinions on the course Didactic and Presentation Skills (mean, mode - significance, time range, teacher, comprehensibility, learning resources).*

Assessed aspects of the course Scale: 1 = minimum - 6 = maximum N = 53	Evaluation of the significance		Overall evaluation of the course (significance, time range, teacher, comprehensibility, learning resources)	
	[mean]	[mode]	[mean]	[mode]
Activation methods	4.83	6	4.89	6
Educational evaluation and educometrics	5.00	6	5.03	6
Communication and presentation skills	5.15	6	5.12	6
Psychological aspects of teaching	4.89	6	4.90	6
Use of ICT in education	4.91	6	4.92	6
Fundamentals of university pedagogy	4.90	6	4.95	6
Practical training in didactic and presentation skills	5.40	6	5.34	6

It can be seen from Table 1 that, among the topics provided, the respondents themselves give the greatest weight to practical training seminars on “Didactic and Presentation Skills” (mean 5.40 for study area significance; mean 5.34 for overall evaluation; modus 6 on a scale of 1 to 6). They put it in first place.

The theory of Communication and presentation skills (mean 5.15 for study area significance; mean 5.12 for overall evaluation; modus 6) and the Educational evaluation and educometrics (mean 5.00 for study area significance; mean 5.03 for overall evaluation; modus 6) are also considered essential by respondents, closely followed by the Fundamentals of university pedagogy (mean 4.90 for study area significance; mean 4.95 for overall evaluation; modus 6), Use of ICT/digital technologies in education (mean 4.91 for study area significance; mean 4.92 for overall evaluation; modus 6), Psychological aspects of teaching (mean 4.89 for study area significance; mean 4.90 for overall evaluation; modus 6), and Activation methods (mean 4.83 for study area significance; mean 4.89 for overall evaluation; modus 6).

Thus, it can be concluded that the most beneficial for PhD students is the practical side of the course and so recording their speech and performance on camera so that they can see what they actually say and do. They evaluate such feedback with elements of constructive criticism very positively, although it may not always be pleasant, especially at the beginning of their teaching experience. The course is therefore very helpful in making them aware of many practical aspects in teaching as they will use much of this directly in their teaching practice. The exemplary interactive learning conditions should optimally serve as a learning environment where students can also confirm whether they will choose an academic or scientific career in the future.

Likewise, the lecturers conduct the courses at a professional level with maximum integration of theory and practice, listening to the needs of the course participants and leading professional discussions with the PhD students. Their aim is to support doctoral students and to strengthen their confidence in conducting their own university teaching and presenting their research results.

The feedback from PhD students shows that they perceive the integration of the course in their study plan positively, especially if they also teach during their PhD studies and therefore they are responsible for lectures, seminars or excursions. They also welcome the opportunity to try out, often for the first time, their research presentation at a conference as well as a demonstration of conducting their own teaching, for which they receive immediate feedback on their verbal, non-verbal expressions and the technical performance of the presentation, as well as a unique opportunity to see their own performance with all its pros and possible shortcomings. The opportunity to experience, observe and share their own and other PhD students' performances in a group is what pushes them in presentation skills, rhetoric and didactics of teaching preparation, including the use of numerous IT tools and presentation environments, and makes them aware of all aspects of university teaching.

#### **4. Conclusions**

The Institute of Education and Communication of the Czech University of Life Sciences Prague provides a range of educational activities, it is involved in the evaluation processes of the university and also offers long-term professional development opportunities not only for university teachers, but also for the university's doctoral students. Therefore, emphasis is also placed on social science topics and on lifelong learning. The development of the competences of staff and doctoral students is thus well founded at the university.

As a result of the exploratory survey, the doctoral students of the selected faculties of the university concerned, in the “Didactic and Presentation Skills” course which is a compulsory part of their individual study plan, find the following aspects the most beneficial for their teaching and research activities. The greatest weight is given to Practical seminars on didactic and presentation skills. The theory of Communication and presentation skills and Educational evaluation and educometrics are also considered essential by the respondents, closely followed by the Use of ICT/digital technologies in education, University pedagogy, Psychological aspects of teaching, and Activation methods. It is favourable that all areas are evaluated very positively by the PhD students, and are perceived as very significant for them.

The study confirms the importance of preparing novice PhD students to adapt in teaching to feel comfortable in a large auditorium and to be confident in various situations that may happen at any time. The topic is relevant and the results can be beneficial for future studies and training programmes, however, it will be necessary to monitor and compare the development of the needs also in the context of changes in the educational reality over time.

### References

- Bradley, K. (2009). *Teaching as a PhD Student*. Coventry: History at the Higher Education Academy, University of Warwick.
- Brightman, H.J. (2009). The Need for Teaching Doctoral Students How to Teach. *International Journal of Doctoral Studies*, 2, 1-11.
- CRAC (Careers Research and Advisory Centre). (2011). *Researcher Development Framework*. Retrieved February 7, 2023, from <https://www.bath.ac.uk/publications/the-researcher-development-framework-professional-development-framework-for-researchers/attachments/researcher-development-framework-vitae.pdf>
- Homer, S.R. (2018). Should PhD students teach? *Psychology Teaching Review*, 24(2), 77-81.
- Němejc, K., & Smékalová, L., Tomšíková, K., Jirsáková, J. (2023). The Role of the Institute of Education and Communication in the Development and Evaluation of Teaching Competences of Teachers and Students of Doctoral Study Programmes at the Czech University of Life Sciences Prague. *Pedagogická orientace*, (in press).
- University of Bath. (2022). *How to Start Teaching as a Doctoral Student*. Retrieved February 7, 2023, from <https://www.bath.ac.uk/guides/how-to-start-teaching-as-a-doctoral-student/#main-content>
- Wilson, C. (2022). *Teaching During your Doctoral Studies*. University of Bath. Retrieved February 7, 2023, from <https://www.bath.ac.uk/campaigns/teaching-during-your-doctoral-studies/>

## **COOPERATION BETWEEN THE UNIVERSITY AND THE OMBUDSPERSON FOR CHILDREN IN THE EDUCATION OF TEACHER'S FACULTY STUDENTS FOR THE PROTECTION OF CHILDREN'S RIGHTS**

**Ana Babić, & Helenca Pirnat Dragičević**  
*Ombudswoman for Children (Croatia)*

### **Abstract**

Protection and promotion of children's rights is an indispensable part of teachers' work. Unfortunately, the majority of violations of children's rights are perpetrated by persons closest to the child, including teachers. In addition to home, school is the place where children spend most of their time and, consequently, challenges, responsibility for recognising violations of children's rights and potential for protection of children at school is significant. That is why it is important for teachers to have information about children's rights, to recognise the situations in which children are endangered and means and mechanisms of their protection. This paper presents an elective course on children's rights, which is a part of future teachers' education for the protection of children's rights, and which is realised in cooperation of the University of Split and the Ombudsman for Children. The aim of the course on children's rights is to familiarize students with children's rights and to make them critically reflect on protection, exercise and promotion of those rights. As a part of the qualitative and quantitative analysis, the paper includes students' evaluations and feedback and the lecturer's reflexion. Students and the lecturer estimate the contents of the course as very important and useful for working with children and their future profession, and the course can serve as an example of positive practice for other universities.

**Keywords:** *Education, rights of the child, ombudsman, students, evaluation.*

---

### **1. Introduction**

The educational curriculum on protection and promotion of children's rights is of crucial importance for future teachers if one takes into account the extent of teachers' influence and their role in the upbringing, education and protection of children. The Convention on the Rights of the Child, as well as other international and national documents, guarantees children the exercise of all their rights. Unfortunately, most violations of children's rights are perpetrated in the places where children should feel safest, i.e. in their homes and schools, by persons closest to the child, such as parents and teachers. The institution of the Ombudsman for Children in the Republic of Croatia monitors, protects and promotes children's rights. It monitors the harmonisation of national regulations with the Convention on the Rights of the Child, monitors whether the Republic of Croatia meets the obligations it has as a party to the Convention and observes individual violations of children's rights. According to reports on violations of children's rights that the Ombudswoman for Children receives, most violations occur in schools. The range of violations that children experience in schools is wide, including exposure to violence by peers and adults, inaccessibility of education, violations of privacy, violations of the right to participation and expression of opinion, and the right to information. The rights of children with special needs – children with disabilities, children of national minorities, children with behavioural problems, foreign children, children with health problems and other specific groups of children are violated as well. Violations occur especially in the process of continual assessment and evaluation of children and imposing pedagogical measures. When analysing violations in the area of education, one can notice that some violations result from insufficient awareness and information on the concept of children's rights and on the possibilities of child protection, a lack of content on children's rights within the framework of both the initial education of teachers as well as their professional development. According to Hedbjörk, Per Helldahl, Tegler, and Steele, (2019) "In higher education, there is space for improvement in formalisation and quality assurance of learning outcomes related to human rights." This view is based on the reports of three countries on education for human rights in numerous programmes in Croatia, Portugal and Sweden. Surveys clearly indicate the importance of teachers and their competences, as well as their attitude to education for human rights. A hesitation or resistance to include contents related to human rights is sometimes present among teaching staff, and normative aspects of the issue of human rights are sometimes perceived as opposite to the scientific base of higher education. Reports show that shifting focus on knowledge, competences and skills

that students need to develop for their future professional life, in line with a stronger formalisation of the intended learning, might be an efficient way of avoiding such conflicts between science and education for human rights. Furthermore, there is space for greater involvement of teachers, working in other departments, non-governmental organisations or as practitioners. It seems that national legislation and government's initiatives play an important role in integrating the content of human rights in higher education programmes. "Since the area involved is the field of human rights, it is surprising that only 24% of programmes include professionals from the non-state sector, and less than 14% from the public sector specialised for this domain. In under 5% of programmes, lectures on human rights are not given by their staff at all" (Matešić, Ivković Hodžić, 2018, p. 48). "State reports show that in those countries where special goals in relation to human rights are defined by national legislation, respondents more explicitly name them as important" (Hedbjörk, Per Helldahl, Tegler, and Steele, 2019, p. 5). National action plans for rights and interest of children in the Republic of Croatia name future teachers' education on children's rights as one of the measures. "The current state strategy in Croatia puts the concept of the child/student as an active citizen in the focus of the educational process, and civil education is currently conducted as a cross-curricular topic in primary and secondary schools throughout the country. The implementation of these policies obviously affects higher education because professionals in the field of education need to have knowledge and awareness of human and children's rights, as well as skills for fostering civic participation" (Hedbjörk, Per Helldahl, Tegler and Steele 2019, p.17). As a result of the lack of teaching staff and interest, there are very few courses on children's rights at universities, and most of them are conducted as elective courses. Higher education plays a vital role in providing students with knowledge and skills required for facing situations they might encounter in their future careers when human rights are violated or endangered. "It is crucial to empower higher education on human rights in all areas where professionals are expected to protect children's rights in daily practice (education, healthcare, social care, judiciary, police, leisure time). Theoretical knowledge should be clearly connected with practical skills. Therefore, a closer cooperation with practitioners and professionals, as well as valorisation of former students should be encouraged" (Hedbjörk, Per Helldahl, Tegler, and Steele, 2019, p.7). Employees of the Office of Ombudswoman for Children occasionally hold lectures on children's rights as guest lecturers at faculties educating students for working with children, and these are primarily teacher education faculties. Students, as well as university professors, consider such lectures useful for their future work and the University has engaged an employee of the Office specialising in pedagogy with the experience of working at school as an associate teacher in conducting the course Law in everyday life at the Department of Teacher Education of the University of Split. The aim of this paper is to present the elective course on children's rights as a part of future teachers' education for children's rights. The course is taught in cooperation of the University and the Ombudsman for Children.

## **2. Course description "Law in everyday life"**

The cooperation of the Office of Ombudswoman for Children and the University aims at facilitating the enrichment of the study programme of teacher education with contents on human rights. The starting point in joint design of learning outcomes of the course was the issue of competences, i.e. knowledge, skills and attitudes that students need to develop in order to be ready to comprehensively and in a timely manner protect children's rights and actively participate in realisation and promotion of children's rights. Future teachers are expected to know and be able to face situations endangering children's rights (family, peer violence and cyberbullying, inappropriate behaviour of parents towards children during divorce, too low and too high parents' expectations, parents' failure to follow recommendations of educational professionals in relation to education of children with developmental difficulties, relation with media in case of harm to children, taking children from parents and placing them in foster families or social welfare institutions, inappropriate behaviour of children endangering the child and others in the class, children with mental health problems and other family or social problems). This presupposes being familiar with human rights, national legislation and procedures, i.e. protocols for handling such situations. The aim of the course is to learn about children's rights and to critically reflect on their protection, realisation and promotion. The course is realised in the form of 15 hours of lectures and 15 hours of exercises. The expected learning outcomes are: to understand the concept of the child's needs, rights and best interests; to understand the importance of timely and comprehensive child protection; to be able to identify situations of vulnerability of children and know the ways and mechanisms of their protection; to build awareness of personal and professional responsibility to protect children and promote children's rights; to understand the importance and needs of human rights education; to be able to promote the rights of the child and create protective prevention programmes; to have a critical approach to child protection issues. The course is elective within the teacher education programme and it has been conducted in the winter semester since the academic year 2011/2012. Teaching methods used within the course include: workshops; discussions and work in small groups; pair work; field work – visits to social welfare institutions accommodating children and educational institutions providing education for children with special needs, visiting the institution of

the Ombudsman for Children; case studies and problem solving; keeping a log recording cases of children's rights violations, and role-plays. Students are encouraged to research and participate in resolving specific questions and issues. That enables students to develop critical perspective on human rights issues, while theoretical knowledge is clearly matched with practical skills. When it comes to education for human rights, "students emphasise the importance of flexibility in learning methods and promotion of cooperation between students and teachers. They emphasise the need not only for informative courses but also interactive courses which would equip students with tools for facing challenges of human rights in their future professional lives" (Hedbjörk, Per Helldahl, Tegler, and Steele, 2019, p.6). Students also have an opportunity for self-reflection through workshops, and at the end of the course an analysis of students' competences required for timely and comprehensive protection of children is conducted. Students do a self-assessment of the competences they possess and which they are satisfied with as well as of those they should develop further. Students' responsibilities include: participation and performing teaching and extracurricular (individual and group) activities that enable the acquisition of learning outcomes provided by the course; writing and presenting a seminar paper (workshop or research); passing an oral exam; if desired, keeping a log of the observed violations of children's rights (in media, in the family, in the surroundings). Grading and assessing students during lessons includes: student activity during class (regularity, critical discussion, conclusions) - 20%. Students have to complete one essay on a given methodical topic in agreement with the teacher. The seminar is publicly presented and evaluated - 30%, and there is an oral exam - 50%. The final grade of the course will be formed on the basis of all the named grades and student's self-assessment. After having attended the lectures, students take the oral exam.

Human rights have to be observed as an umbrella concept, a part of the learning process, and not an end in itself. Human rights should be taught about in the atmosphere which respects those rights and a comprehensive understanding of the concept of human rights is required. Therefore, teachers' competences are crucial for learning outcomes of the course. The lecturer of the course is a pedagogue and possesses knowledge and extensive experience in the field of monitoring realisation of children's rights in the area of education, which presents a significant quality contribution in designing, conducting and evaluation of the course programme.

*Table 1. Course content detailed by weekly class schedule (syllabus).*

<b>LECTURES:</b>	
Introductory lecture.	1 lesson
The needs, rights and best interests of the child - fundamental determinants.	1+1
International and national regulations governing the protection of children. The Ombudsman for Children and other institutions for protecting children.	1+1
The level of protection and the state of children's rights in the Republic of Croatia and in the world. The most common forms of violation of children's rights.	1+1
Protection of children in the family (the rights and duties in the relationship between parents and children, violation of the rights of children in the family, support to the family in child protection)	1+1
Child abuse and neglect - types, causes, symptoms, treatment (domestic violence, violence in educational institutions, bullying, cyberbullying, violence on the street).	1+1
Comprehensive protection of children in the educational system (kindergartens, schools, clinics).	1+1
Protection of children with special needs - recognition, needs, opportunities, problems (children with disabilities, gifted children, chronically ill children, children with behavioural disorders, children belonging to minorities...).	1+1
Competence of teachers in identifying violations, the protection and promotion of children's rights.	1+1
Education for human rights - challenges-opportunities-difficulties.	1+1
Cooperation of families, kindergartens/schools and the community - fundamental factor of comprehensive protection of children (forms, opportunities, difficulties, challenges).	1+1
Protecting children in their free time. Cultural rights. Participation. Media and the child (protection of children's privacy, positive activities for children and about children).	1+1
Health care rights of the child. Protecting children from accidents.	1+1
Social, economic, judicial protection of children's rights. Child labour and child trafficking.	1+1
Creating a preventive protection programme.	1+1
The evaluation of the programme.	1

### 3. Methodology

As a part of the qualitative and quantitative analysis, the paper uses the University's surveys and students' feedback obtained through an individual interview with each student as well as the lecturer's reflection containing the grade point average students achieved at the exam. The first part of the survey refers to students and contains the question: Assess your own ability to meet the course requirements. The second part of the survey refers to the quality of teaching and teaching work, and it includes the following questions: the course teacher/associate teacher introduced the content and syllabus in a clear and comprehensible manner, the course teacher/associate teacher clearly determined the manner and criteria of students assessment, lectures are held on time and regularly, the course teacher/associate teacher presents teaching contents intelligibly, teaching is conducted in line with the syllabus, teaching materials are appropriate and comprehensible, the course teacher/associate teacher is committed to presenting teaching content in a quality manner, the course teacher/associate teacher encourages students to be active during lessons, the course teacher/associate teacher is polite in communication with students. Students have an opportunity to write additional comments within the survey.

Participants: students of the Department of Teacher Education of the University of Split attending the course in the last 10 years. On average 20-30 students take the course each year, and 256 students participated in the evaluation.

### 4. Results and discussion

The process of implementing new courses includes the evaluation of teaching within those courses, while students provide direct information on what they really think about the course (Hounsell, 2003). Each year, within the institutional evaluation of the quality of teaching work, the Faculty of Humanities and Social Sciences in Split conducts student surveys including questions on students, the quality of teaching and teaching work. The global index in all components of the course Law in everyday life in the academic years 2011/2012, 2012/2013, 2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021 and 2021/2022 ranged from 4.8 to 5.0 in the given range from 1 to 5. Summative assessment according to Patton (2002) examines the overall effectiveness of the programme, policy or product effectiveness to make a decision on the continuation and assesses the possibility of enhancing it in other situations. Evaluation of the teaching process is an important part of professional practice of each teacher, so with the aim of improving her practice the lecturer herself conducted interviews with each student after the exam to obtain a deeper insight and details that cannot be obtained only through quantitative data. Interview questions were open-ended and the same for all students: How did they like the course and what shall they take from it? Did the course fulfil the expectations they had stated in the introductory lecture? What would they improve, i.e. what can we do to make the course better? Students rarely participate in evaluation of the teaching process and rarely have an opportunity to offer their suggestions with the aim of improving it, so they participated gladly. Interviews with students prove to be a very valuable data source, because data were collected in a relaxed atmosphere after the exam had been passed.

Here are some students' answers to the first question in the interview: "The most valuable and useful course, it has absolutely met my expectations.", "Nobody has ever informed us on the means of protecting children.", "Now I feel safer and I know how to react in certain situations.", "The best course, exceeding my expectations", "The most interesting part were specific situations showing us how children's rights are violated and what can be done about it.", "I liked when we visited the Office of the Ombudswoman for Children. Then I saw for the first time the book – the Convention on the Rights of the Child and not just any but written in Braille.", "The most useful part was practicing giving statements to media, and learning what I am allowed to say without additionally violating the rights of the child.", "I liked the workshops on the protection of children from violence and problem-solving.", "So far, nobody has prepared us for work with conflicting parents in this way.", "The most interesting course which is directly connected with practice", "The course which helped me become aware of my competences.", "I was particularly impressed by the topic of enforcement, i.e. taking a child in school and placing it in a social welfare institution and how to react in such a situation.", "Before this course I had not known that I could come upon such situations in my practice.", "After this course the responsibility and the role of a teacher are much clearer to me.", "The topic of treatment of divorced parents, their rights and responsibilities towards children has impressed me a lot.", "No objections at all. A very interesting content of the course and a great lecturer, who is always available for all student questions.", "The lecturer is accessible, interesting, and she accepts our opinions.", "The lecturer has extensive knowledge and experience, which she gladly shares with us, and at the same time she wants to hear our opinion.", "One of the best courses and one of the best lecturers.", "The lecturer is very accessible, and a great teacher.



Compliments for her work.” All students agree that this course should be a compulsory course and that students of all majors should attend it.

The answer to the second interview question mostly was that they would not change anything. The following were some additional answers: “This course should include more hours,” “The course should be an obligatory course,” “Even more field work and visits to institutions,” “All contents should be presented through problem-solving scenarios,” “Not enough hours for such important topics.”

As summative evaluation implies evaluation of educational outcomes and it is performed at the end of a certain course, a semester or a year it included the analysis of final grades of students. The grade point average of students’ final grades in this course depending on the year ranged from 4.8 to 4.9 of the maximum 5.0.

The results of evaluation over 10 years show efficiency of the course in all areas. Students and lecturers assess the content of the course as important and useful for working with children and their future profession. In addition to acquiring knowledge on the concept of children’s rights, working on problem tasks, self-reflection and other practical tasks empowered students and contributed to their professional development.

## 5. Conclusion

The cooperation of the Ombudsman for Children and the University of Split proved to be an example of good practice and partnership of the two institutions for the wellbeing of students and eventually children they will teach. The cooperation will be complemented, extended and deepened. The combination of the theory on the concept of children’s rights, methods of education for human rights and experience in monitoring of realisation of children’s rights proved to be an excellent combination in creating contents and outcomes of this course and one-time lectures and workshops which the Office employees hold at faculties. The extraordinary contribution of this cooperation is visible not only in spreading the knowledge on the concept of children’s rights but also in their direct protection as well as the development of professional interest of students for the topic of children’s rights.

## References

- Hedbjörk, U., Helldahl, P., Tegler Jerselius, K., & Steele, S. (2019). *Modernization, education and Human rights – Quality assurance of learning outcomes and the student perspective*. Swedish Higher Education Authority (UKÄ).
- Hounsell, D. (2003). The Evaluation of Teaching. In H. Fry, S. Ketteridge, & S. Marshall (Eds.), *A Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice*. 2nd Revised Edition (pp. 200-212). Kogan Page.
- Matešić, M., & Ivković Hodžić, Ž., (2018). Report Human rights, children's rights and participation, and children/pupils as active citizens – Assessing learning outcomes in higher education on human rights, active citizenship and democratic values in programmes in education. Croatian Agency for Science and Higher Education (ASHE)
- Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods*. (3. izdanje). California: Sage Publications.

# EXAMINING STUDENT TEACHERS' OPPORTUNITIES AND BARRIERS ASSOCIATED WITH FORMATIVE ONLINE ASSESSMENTS AT A UNIVERSITY OF TECHNOLOGY

**Paseka Patric Mollo**

*Department of Educational and Professional Studies, Central University of Technology (South Africa)*

## Abstract

During the COVID-19 pandemic, many sectors were affected including education. As a result of this pandemic, university lecturers had to change their pedagogic practices, teaching and learning approaches, and assessment strategies. Due to the suspension of face-to-face activities, the use of Information Communications Technology (ICT) was accelerated, and most universities were forced to adopt online assessment strategies. The Central University of Technology (CUT) like many universities around the world used online assessments to assess its students during this period. This study examined opportunities and barriers to using formative online assessments. Twenty (20), first and second-year Bachelor of Education student teachers were purposively selected to participate in this study. The student teachers were interviewed after participating in their respective online test that was part of their formative assessment. Telephonic interviews were conducted to collect data. The interviews were then analysed to determine the possible opportunities and challenges that student teachers experience during the formative online assessments. The findings revealed by integrating technology for teaching, learning, and assessment can enhance student teachers' ICT skills. Student teachers also believed that the approach helped them to be actively involved in their learning and enhance their participation in their learning. Several challenges and barriers were recognized as well. Student teachers described how ICT competencies and inadequate ICT infrastructures, in our country, such as poor internet connectivity and lack of ICT equipment, limited their ability to fluidly engage in formative online assessments. The study provides suggestions for future research that can contribute to understanding online assessments and proposes better approaches to online assessments at the CUT.

**Keywords:** *Covid-19, information communications technology (ICT), online assessment, formative assessment.*

---

## 1. Introduction

During the COVID-19 period universities had to adapt their pedagogic practices, teaching, and learning approaches, and notably their assessment strategies. The suspension of face-to-face activities forced lecturers to use Information Communications Technology (ICT) for teaching, learning, and assessment. Assessment in any form is at the heart of every formal higher education institution. It is the core component of effective teaching and learning. Within the teaching, process assessment provides ongoing support for scaffolding learning and assists learners to develop self-regulated learning dispositions. It provides students with an opportunity to demonstrate their developing abilities and obtain support to improve learning (Gikandi, Morrow & Davis, 2011). Assessment is referred to as the measurement of the learners' achievement and progress in the learning process. It is used to explain the operations associated with measuring the achievements of persons in relation to expected outcomes.

Assessment can either be formative or summative (Baleni, 2015). Formative assessment refers to an assessment that supports the process of learning. It is in many cases applied in the learning environment to provide ongoing feedback to improve teaching and learning. It focuses mainly to support learning and its activities are embedded within teachings to monitor learning and assess learners' understanding (Baleni, 2015). Feedback provided through formative assessment is not only based on monitoring progress towards the desired learning outcomes but also enables students to develop effective learning strategies. So, formative assessment is an assessment of a student's progress throughout a learning unit or subject, or course in which feedback from learning activities is used to improve student attainment. This has made one believe that assessing students' learning and progress is critical to effective teaching and learning. Ibrahim, Yusof, and Rahim (2021: 92) suggest that it was revolutionary in the sense that formative assessment

reinvented the purpose of assessment beyond simply being interchangeably regarded as an examination (Ibrahim et al., 2021). Similarly, Biggs (1998: 104) has held the view that the effectiveness of formative assessment is dependent on whether learners perceive the gap between where they are now and where they should be, and if so, what they are willing to do to close it (Biggs, 1998).

Summative assessment, on the other hand, relates to validation and accreditation (Gikandi et al., 2011). Its role is to measure what students have learned at the end of a learning unit, learning programme, or after a unit standard. It ascertains that the desired aims or goals of learning have been met (Baleni, 2015). Summative assessments are usually applied at the end of a period of instruction to measure the outcome of student learning. According to Gikandi et al. (2011: 2336), this type of assessment has been linked to unfavorable learning strategies that may promote surface learning and low order thinking because, in most instances, it evaluates declarative knowledge and basic application without any indication of individual reflection or in-depth understanding.

During the Covid -19 period most higher education institutions were forced, by circumstances, to provide tuition through distance learning. Distance education is any type of education that doesn't require the teacher and students to be present at the same location and time and instead disperses teaching and learning activities over time and space. Recently, for this to happen, most higher education institutions (HEI) were required to use the Internet and / web-based information and communications technologies (ICT). So, HEI had to embark on online learning. Online learning is a type of remote education that supports teaching and learning primarily via the use of ICT. It includes 80% or more of learning and teaching activities carried out by ICT and does not require the teacher and the student to be present at the same time and location (Gikandi et al., 2011).

Most research that has been done, has been done on e-learning, blended teaching, and learning, online teaching, and the application of technology in teaching and learning. However little research analysis has been done on electronic assessment or e-assessment as a term used in this study. The terms e-assessment and online assessment are in most cases used interchangeably (Baleni, 2015). These terms refer to assessment that is enabled and primarily conducted through web-based ICT. They use the Internet to bridge the distance between assessment and the students and does not require the teacher and the learner to be available at the same place and time.

The combination of formative assessment and ICT results into a concept that is in most cases named as formative e-assessment or online formative assessment. These terms refer to the use of ICT to support the interactive process of gathering and analysing information about student learning by teachers and learners (Gikandi et al., 2011). It is the application of formative assessment within online teaching and learning wherein teachers and learners are separated by time and/ or space and where a substantial proportion of learning or teaching activities are conducted through web-based ICT (Baleni, 2015; Gikandi et al., 2011).

### 1.1. Conceptual framework

This article is framed around Kirkpatrick's 2003 Evaluation Model to examine the diffusion, adoption, and appropriation of emerging technologies in South African higher education institutions (HEI). It is a widely renowned tool for assessing and analysing the outcomes of educational, training, and learning initiatives (Bates, 2004). There are four different judgment levels in it: reaction, learning, behavior, and results (Bates, 2004). The effectiveness of a training program is more precisely measured at each level of the model the model and this model is diagrammatically represented as follows:

Figure 1. Kirkpatrick's 2003 Evaluation Model.



When using this model, the researcher ought to use data from each level serves as a foundation for reviewing data from the next level. While each successive level represents a more reliable measure, it also necessitates a more thorough and time-consuming analysis. Additionally, Bates (2004: 341) argues that the models used to inform evaluations are inextricably linked to the usefulness and effectiveness of those evaluations... inevitably, the models and the ways in which they are used also have ethical implications, so it is crucial to continuously reflect on and analyse our models from a variety of angles. The popularity of this four-level model is also because of its function and of its potential for simplifying the complex process of training evaluation (Bates, 2004).

## 2. Methodology

For this research paper, a qualitative methodology was chosen because it uses words rather than numerical data (quantitative methods) and flows predominantly from concreteness to abstractness (Joubish, Khurram, Ahmed, Fatima & Haider, 2011). Telephonic individual interviews were conducted to collect data. The individual interviews were used because of their suitability for collecting the qualitative type of data required. Interviews were chosen because they characterise the interpretive paradigm. Interviews are critical within the interpretive paradigm because interpretive research is in most cases idiographic. Idiographic means “describing aspects of the social world by offering a detailed account of specific social settings, processes or relationships” (King & Horrocks, 2011: 11). So, interviews were chosen in this study to understand social settings, processes, or relationships that student teachers find themselves in.

Second, everyday conversations are mostly face-to-face, and this makes researchers feel at ease when using this technique (King & Horrocks, 2011). The researcher felt at ease in using this technique and it also assisted the researcher to build a rapport with the interviewees. Third, interviews were chosen for this study because qualitative research interviews are flexible, they emphasise open-ended, non-leading questions, and they focus on personal experience (Cohan, Manion & Morrison, 2018; King & Horrocks, 2011; Marvasti & Fricie, 2017).

Last, interviews were preferred in this study because they focus on people's detailed experiences. They encourage a relationship between the interviewer and the interviewee, and a high level of confidentiality and anonymity, especially in this qualitative research. Below are the types of interviews used in this study.

Twenty (20), first and second-year Bachelor of Education student teachers from the Central University of Technology in South Africa were purposively selected to participate in this study. The student teachers were after participating in an online test that was part of their formative assessment for the semester. The researcher selected these students because some of them wrote an email to the lecturers to indicate that they experienced some challenges while they were busy with the online tests. Some were chosen because they performed well in their online tests and were interviewed to determine their experiences.

## 3. Results

The first group of questions revolved around the student teachers' biographical information. The researched wanted to find information about the locations of student teachers when they were engaged in these online assessments. The findings on this theme were that most of the student teachers were from rural and semi-rural areas of the country. Because of these locations student teachers indicated that connectivity was posing a challenge to them because of this some were unable to finish their online tests. For example, these were the responses that were given by students:

Student 4 *“Every time when I have an online class or test, I have to go to my grandmother's house on the other side of the township because there the connectivity is better”.*

Student 9 *“Many are times when I'm busy, my laptop would freeze because of connectivity challenges”.*

Student 13 *“During load shedding, I'm unable to connect to the Internet due to lack of electricity”.*

The next group of questions were about the effectiveness or ineffectiveness of online formative assessments. Student teachers indicated that online formative assessments encourage peer and lecturer dialogue around learning; it also encourages positive motivational beliefs and self-esteem among students and the provide students with the required feedback to shape their learning.

Student 7 “*I can easily discuss content before and after the test with my fellow students*”.

Student 19 “*We are able to help one another, and this makes our learning easy*”.

However, it was also discovered that there is a high risk of dishonesty during these online tests and some students are dishonest when are subjected to these. Students indicated that the risk with online assessments are that:

Student 3 “*Some students quickly share answers among themselves, and it becomes unfair to us*”.

Student 8 “*Other senior students write tests for other students, and this they do for a fee*”.

Student 1 “*Other students cheat during online tests and we request that there be so sort of invigilation*”.

The finding of this paper indicated both opportunities and barriers of online formative assessments. Most student teachers felt that in as much as they enjoy these kinds of assessments the sometimes experiences challenges that in most cases not of their making. Connectivity and electricity challenges in our country poses a huge challenge for these kinds of assessments.

#### 4. Conclusions

This study has revealed several things both positive and negative about online formative assessments. Formative online assessment has the potential to offer structure for sustained meaningful interaction among students and lecturers and among students and their peers (Gikandi et al., 2011). It can also be the starting block to foster development of effective learning communities among students which will intern provide a systematic structure for effective learning support and the provision of adequate formative feedback. Among other things the time allocated for online formative assessments can be controlled i.e., live availability (Baleni, 2015; Gikandi et al., 2011). Using these kinds of assessments can contribute towards students’ deep understanding of concepts, it can encourage individuals’ reflections, peer feedback and lecturers’ feedback.

Some of the of the challenges that student teachers encountered during the COVID-19 period about the online formative are among others. The lack of stable WIFI connectivity at their respective homes or at university campuses, lack of sufficient bandwidth at the locations that the student teachers found themselves and the protection of the academic integrity of online formative assessments due to unethical behaviour.

#### References

- Baleni, Z. G. (2015). Online formative assessment in higher education: Its pros and cons. *The Electronic Journal of e-learning*, 13(4), 228-236.
- Bates, R. (2004). A critical analysis of evaluation practice: the Kirkpatrick model and the principle of beneficence. *Evaluation and Program Planning*, 27(3), 341-347.
- Biggs, J. (1998). Assessment and Classroom Learning: a role for summative assessment? *Education, Principles, Policy and Practice*, 5(1), 103-110.
- Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education*. Los Angeles: SAGE Publications.
- Gikandi, J. W., Morrow, D., & Davis, N. E. (2011). Online formative assessment in higher education: A review of the literature. *Computers & Education*, 57(4), 2333-2351.
- Ibrahim, M. S., Yusof, M. S. B., & Abdul Rahim, A. F. (2021). Why assessment which carries no grades and marks is the key for the future education? *Education in Medicine Journal*, 13(2), 91-95.
- Joubish, M. F., Khurram, M. A., Ahmed, A., Fatima, S. T., & Haider, K. (2011). Paradigms and characteristics of a good qualitative research. *World Applied Sciences Journal*, 12(11), 2082-2087.
- King, N., & Horrocks, C. (2011). *Interviews in qualitative research*. Los Angeles: SAGE Publications.
- Marvasti, A. & Freie, C. (2017). Research interviews. In D. Wyse, N. Selwyn, E. Smith, & L. E. Suter, (Eds), *The BERA/SAGE Handbook of Educational Research*. Los Angeles SAGE Publications.
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th Ed.). California: Jossey-Bass.

## “THE VISUAL CODE”: EDUCATING IN AN AGE OF VISUAL CULTURE

Noam Topelberg<sup>1</sup>, & Jonathan Ventura<sup>2</sup>

<sup>1</sup>*Teaching Certificate Program, Faculty of Education, Bar-Ilan University (Israel)*

<sup>2</sup>*Design and Technology, Shenkar - Engineering. Design. Art. (Israel)*

### Abstract

Over the past two decades, we have been witnessing a veritable revolution in the ever-expanding visual and material culture studies. As a result of technological advances, visual texts have become the most common carriers of information and meaning as well as shapers of people's perception of reality throughout the world. To keep up with these current and future changes, new tools of visual literacy and critical thinking are needed for teachers and educators. We argue that implementation of such tools in teacher training programs, across all disciplines, is extremely important and can be used as catalyst to foster critical thinking processes and promote active and relevant teaching and learning. Moreover, with our unique approach, we offer a much-needed innovative perspective towards new and expanding visuo-material disciplines ranging from the myriad venues of design, through architecture to visual communication.

Our study presents a tool developed for Design and Visual Culture curriculum taught in more than 250 high schools in Israel. This tool, we call "The Visual Code" aims to cultivate skills of deciphering visual codes through diverse visual texts. Our approach surpasses the classic and somewhat redundant focus on Art History and allows a much broader understanding of our visuo-material surroundings, ranging from smartwatches, through buildings and urban settings, to websites, apps, and digital service platforms. We suggest observing this rich world through three prisms, suitable for different types of training: semiotic observation, suitable for teaching an training students, teachers (on and pre-service) and pupils of all disciplines; hermeneutic understanding, triggering deeper observation, suitable for those specifically engaged in visual studies, such as art and design; and in-depth phenomenological interpretation suitable for practitioners, experts, and researchers in the various fields of art and design. During our research, qualitative questionnaires, and activity, as well as visual content analyses will be used in classrooms, teachers' development courses as well as some academic courses to evaluate the impact of this tool on classroom discourse and learning processes.

**Keywords:** *Visual literacy, education, art, design, interpretation, meaning-making.*

### 1. Introduction

In our current reality, visual information exceeds its textual counterpart in quantity and sometimes even in complexity. In this fast, ever-changing reality, through all platforms of information, we are surrounded by countless visual representations. Thus, viewers and end-users (or design partners in contemporary parlance) must make an effort to decipher and understand cultural products in order to identify concepts, messages, logos, limited edition products, apps, digital services, graphic changes in user interfaces caused by software updates, and so on.

This reality corresponds directly with what Roey Tzezana calls the "Revolution of Personal Production", a revolution in which "each person receives the power to create outputs, products, and objects, which in the past required an entire factory to produce, for his own use" (Tzezana, 2013, p. 13). This revolution stems from technological developments, which have changed our ways of thinking and creating. Computers, the Web, Smartphones, 3D printers and scanners, and now Artificial Intelligence (AI), are constantly advancing this revolution. In the past two decades, these means have become accessible to everyone, as early as childhood, and their use requires little or no learning. Combined with social networks, which allow for the rapid distribution and consumption of each person's visual information, this "Revolution of Personal Production" led to far-reaching changes during the first two decades of the 21<sup>st</sup> century.

As part of these changes, visual texts are created, distributed, and consumed, both by professionals and amateurs, across a variety of media and their modes of interpretation are changing as well. These deep processes are leading toward the establishment of a visual culture that increasingly pushes the written word in favor of the image and the video. But although the reality described above is

known to everyone, the various calls for adaptations of the education systems to the 21<sup>st</sup> century, such as the learning compass, presented by the OECD in "Education 2030", hardly consider the fact that reality is mediated mainly through visual texts. Moreover, the degree to which these visual texts allow for the emotional manipulation of the lay viewer is hardly discussed.

We claim that visual literacy skills that will help today's students, develop critical thinking and reflective abilities are bound by reality. Our study presents a tool we call "The Visual Code" which aims to cultivate skills in deciphering visual codes through diverse visual texts. Our approach surpasses the classic and somewhat redundant focus on Art History and allows a much broader understanding of our visual-material surroundings, ranging from smartwatches, through buildings and urban settings, to websites, apps, and digital service platforms

## 2. The Evolution / revolution of Visual Culture

Whether as an emotional or utilitarian expression, Visual Culture has been an integral part of humanity from the beginning of time. "Man's first expression, like his first dream, was an aesthetic expression," writes Newman in his iconic essay (Newman, 1947, p. 59). But references to Visual Culture as an actual revolution appears towards the end of the 20<sup>th</sup> century. Mirzoeff claims that Visual Culture is not merely a part of our lives, but life itself, expressed by visual events that provide meaning, pleasure, or information to viewers. According to him, these events make use of "visual technologies", that is, devices that allow one to create, distribute, and consume (Mirzoeff, 1999, p.3). This definition, which encompasses all the elements of what we term the "visual culture process" i.e. the making of the visual text, its circulation, consumption, and interpretation, points to a process of bridging the inherent gap, introduced by Marcel Duchamp celebrated 'Art Coefficient', between the work of art or the object and the mediating ways of the viewing experience (Duchamp, 1975, p. 139).

Among contemporary thinkers, we can increasingly find the idea that opposed to the classic Art History discourse, in which boundaries can be clearly defined, visual culture discourse involves every visual representation around us. An example can be found in the words of visual culture researcher W.J.T. Mitchell in an interview he gave with Margaret Dikovitskaya: "Art History – at least in its traditional formations (and this is changing today) – is not enough by itself for the study of visual culture because it is grounded in a distinction between (for instance) mass media, mass culture, kitsch, commercial art, and 'fine art' proper. Art History is not concerned with ordinary everyday practices of seeing, what I call 'vernacular visibility', all the social constructions of the visual field that lie outside image-making, and artistic image-making. Before people make images, much fewer works of art, they look at each other and look at the world. Visual culture, I think, is the study of that aspect as well as the visual arts" (Dikovitskaya, 2005, p. 240).

Even though our discussion focuses on the contemporary zeitgeist, its roots can be traced back to earlier modern thinkers such as Husserl and Heidegger, who challenged and reframed modernist values and truths. Husserl, for example, calls for returning "back to the things themselves", avoiding, as much as possible, preliminary assumptions (Husserl, 2012, p. 168). Furthermore, common to all five characteristics of modernity described by Heidegger was the Modernist idea that the very concept of "Truth" should be explored by experience and experiment rather than by a-priori beliefs (Heidegger, 1977, pp. 71-72). By challenging values of objectivity and absolute truth, Heidegger, Husserl, and other thinkers outlined the foundations for later philosophical ideas such as phenomenology, existentialism, and deconstruction, all teachings that challenge the modernist concepts of truth and theorize the origins of postmodern subjectiveness through which we, as thinking beings, decipher the world around us.

Important to our discussion is Heidegger's idea that "World picture ... does not mean a picture of the world, but the world conceived and grasped as a picture" (Ibid, p. 129). This statement accurately predicts many of the characteristics of the visual culture revolution we are experiencing in the second decade of the 21<sup>st</sup> century, following the development of smartphones and image-based social networks such as Instagram, TikTok, and others. In this late "post" culture, the boundaries between reality and its visual representations are increasingly blurred. It is an experience of returning to an animistic, pre-Socratic worldview, in which visual texts are not simply representations, but become truths *in and for* their own right.

## 3. Praxis of the visual culture revolution

In recent years, design and art schools across the world have been offering more courses that focus on visual and material culture than on Art History. Underlined by the argument that design is the actual source of visual representation, this trend places Art History within both the visual and material culture and incorporates theories from communication, social and cognitive psychology, history, technology studies, STS, anthropology, anthropology, sociology, and more (Segal & Ventura, 2019).

Unlike the history of Art, which is based on a closed and professional body of knowledge, we interpret, understand, and produce visual and material culture every day, endlessly and almost without paying attention. Starting with the design of a presentation, through writing a prompt for OpenAI. It is no longer a matter of professional tools, but a natural way in which we are expressing ourselves. Almost every component of the everyday world that surrounds us consists of visual components, some are material (3D), others just visual (2D), and an increasing number of them are virtual. We are so used to thinking visually that we have almost stopped thinking about reality verbally - we communicate using emojis, send gifs and memes, and live the news around us through streaming and social networks that are updated almost every minute.

The visual culture revolution, therefore, is not merely manifested in how much we use visual texts, but also in numerous new ways in which we experience products and events that might have not been experienced visually before, even in disciplines that are not visual by nature, such as medical diagnoses and music.

Based on the challenges described above, we propose critical thinking processes which can assist in observing and reasoning intuitive meanings derived from a set of visual components packaged in any visual text.

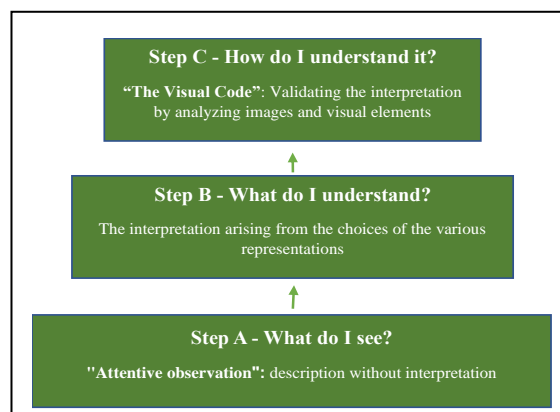
#### 4. Definition and operation model of the “Visual Code”

The term “Visual Code” is proposed here as a tool for critical reading of the visual text. A tool through which, by focusing on an "attentive observation" process, we seek the nurturing of visual literacy, reflected in a critical, interpretive, and in-depth reading of the visual text - whether it is a work of art, a documentary photograph, advertisement poster, a car, or a pair of sneakers.

This term relates to a system of cultural conventions expressed in the choices of representation, and especially the way they work in the visual text on different levels, from the basic elements of the language to choices of iconography. We call it a code because these are cultural conventions, encoding a message or intention in the visual text, and deciphered in the minds of us all. These codes intuitively work on us. Usually, it is so obvious, we don't even stop to think about it. It just makes sense. Codes, which are the choices and descriptions of images made by the creator, allow the viewer, unconsciously and automatically, to experience a wide range of emotions and associations, so that interpretations can take place in the contexts of culture, zeitgeist, and personal experience. All visual creators use these conventions to communicate their desired meanings and ideas. Successful creators that have a deeper understanding of the visual codes' powers make sophisticated use of these conventions in order to convey and convince. Exposing these codes, and especially discussing the ways in which they affect us, is exactly the kind of critical thinking that we all require.

This concept relies on a long-standing tradition of post-structuralist criticism associated with thinkers such as Foucault, Deleuze, Derrida, Lacan, and mainly Roland Barthes, which sanctifies the connotation and negates denotation as a central tool for conveying a message and meaning. According to Barthes, although people feel that their interpretations of the photograph originate from their personal feelings, it is actually based on a system of cultural symbols (Barthes, 1977). This is one of the foundations of the Visual Code concept - the viewers feel a certain sensation whose origin they usually do not seek to understand. We stress that this feeling is motivated by the use that the creator of the visual text makes of those cultural conventions and symbols. An analysis of the visual code will focus, therefore, on defining and reasoning of that personal feeling, based on an "attentive observation". The following taxonomic operation model describes the process we propose to integrate into teacher training and classrooms:

Figure 1. Visual Code taxonomic operation model.





The three steps of our model stem from each other taxonomically. In step A, the student establishes the “facts” of the visual text i.e., what is actually shown in the text, through an “attentive observation” process, devoid of interpretation. Only then can one move to step B and explain what one deduced or concluded from the visual facts investigated in the first step. Finally, step C allows one to validate and prove one's insights (presented and discussed in Step B) through a more in-depth analysis of the visual text's various modes of representation.

Each step requires a specific skill set, at an increasing level of complexity. Step A requires habits of "attentive observation", depicting all the minute details visible in the visual text. Developing this skill may lead to two main challenges: The first is neutralizing the common habit of projecting the viewer's inner world and experience onto the visual text without in-depth observation. The second is converting the visual text into a verbal one. Dealing with these challenges involves long-term training and the continuous, regular use of a fixed pattern description, question asking, and discussion using methods like VTS (Visual Thinking Strategies) and various thinking games, many of which can be found in Project Zero of Harvard University for example and implementing these in the classroom.

Step B requires actively applying an interpretive reference to the text, after observing its “facts”. In this step, the students are expected to fuse their inner world with the discussed visual text, but only after a thorough investigation of the details presented in step A. This is also a dual challenge: on the student's part, the combination of subjective and objective observation, and the avoidance of a return to old habits and intuitive beliefs in order to create a synergy between the subject and the object of investigation. On the teacher's part, offering openness, and legitimacy for a plethora of diverse opinions, devoid of judgment. As with the previous step, long-term training, and the cultivation of continuous discourse in the classroom are required, to further legitimize and encourage the students to express their insights, based on "attentive observation", in a safe environment.

In step C, the most complex of the three, students are asked to justify their interpretations, presented in step B. The required skills for this step can be divided into two levels of analysis: The first is suitable for all teachers and students, from all disciplines and is based on the images shown in the text, their spatial organization, and the relationship between them. The second requires an analysis of visual elements such as composition, configuration, color, space, materials, texture, lines, and shapes, using professional terminology, thus suitable for teachers and students of visual disciplines such as design, branding, art, etc. The main challenges of step C are the development of critical thinking habits, and a willingness to withdraw from earlier conclusions if they turn out to be wrong, and for the ones dealing with visual disciplines, also the learning of various concepts and their correct use.

## 5. Conclusion

As a result of the "visual culture revolution", integration and assimilation of visual literacy skills have become essential for education systems that aim to equip students with the skills needed for independent and critical observation and thinking. Based on Paul Virilio (1994) and Bernard Stiegler (2017) studies, dealing with the influence of screen-based media on the way in which youth interpret reality, Jagodzinski claims that our starting point must be that: “The dromospheric generation of the 21<sup>st</sup> century is easily captured by the seductions of the videogame image forcing visual pedagogy to recognize its dangers. Is the machinic turn toward the manipulation of sensibility eating our young?” (Jagodzinski, 2023, xviii). According to Strigler (2017), this "mediated by screens" reality leads to the "proletarianization of sensibility", that is, converting activism into passive consumption (Ibid). We have suggested that this reality, calls for impartation of visual literacy tools.

The "Visual Code" model presented is part of a curriculum developed by Noam Topelberg for Israeli high school students of "design arts" subject. It is implemented among diverse populations in more than 250 high schools. The model is taught and practiced through the first year of studies (10<sup>th</sup> grade), fostering visual literacy and critical reading of the visual text, basic skills for those about to engage in any visual field. In order for us to research the significance of our model we conducted two stages of qualitative research. The first included a qualitative questionnaire distributed to education students during their training; the second was a series of qualitative interviews focusing on experienced teachers and their dialogue inside their classrooms while using our model. Following are examples of how some experienced teachers describe the ways the use of model changes discourse in their classroom:

**Roni Gur, (Highschool Teacher, professional instructor, teaches art and visual culture, 23 years, Reut arts, Haifa, Israel):** *“The students learn to look deeply into the visual text, formulate their thoughts and opinions in an orderly and organized manner and know how to justify their claims well. The language in the classroom becomes richer, the sentences students say become longer, and the discussions in general become more fascinating ... An 11<sup>th</sup> grade student excitedly described how she analyzed a work of art she had never seen before, in front of a large audience, during a guided city tour ... The group guide was amazed at the depth of her knowledge and the richness of her language. She told her that she*

had never heard such a wonderful explanation about this statue, and that she was absolutely right in her analysis. 'This is thanks to you Roni, said the student. You taught me to observe what is in front of me, how to think about what I see and how to express what I feel, Think, and see.' I told her that this is exactly the goal of our curriculum, and my personal goal as a teacher. My students should neither recite me nor any textbook, rather walk the world confidently, knowing how to observe, think and articulate their thoughts independently and professionally”.

**Dganit Plishti, (Highschool Teacher, school leader, teaches history, civics, art and visual culture and Hebrew, 28 years, Gymnasia, Jerusalem, Israel):** “I see the use of the visual code in the classroom, first and foremost, as a tool that enables my students to experience success. Every answer is correct as long as it is reasoned in the context of what I see and how I see it. The students can express themselves without judgment from the teacher or other students, therefore active listening is created, the other students can either agree or disagree with what is said as long as they justify their thoughts relying on a deep observation of the visual text”.

**Orly Zimmerman, (Highschool Teacher, school leader and Profession coordinator, teaches art and visual culture, 23 years, Herzog high school, Gezer and Begin High school, Ramat-Gan, Israel):** “The discussions about culture in general and the visual code in particular, helps my students gain a deeper understanding of the forces acting on them and shaping their perceptions and reaction to reality. They learn to be critical observers and do not take any visual representation for granted. Discussions in class deepens and cover wider fields than before, according to the student's interests. In one case, when climate activists broke into a museum and vandalized a masterpiece, an interesting discussion was held regarding art's role in society and norms of behavior and protest. In a concluding conversation, a student said that she is thankful for finally understanding, through our discussion, what critical thinking means, an understanding that was missing in her studying years so far”.

In the past five years, the "visual code operation model" has mostly been adopted by teachers, students, and pupils involved in visual culture, including Visual Communication, Cinema, Photography, Art, and Design. Since visual literacy is deeply understood in this audience as a critical thinking skill, new methods of assimilation are always welcome. The quotes presented indicate that teachers who have used this method report deeper discussions and arousal of curiosity in their lessons. Currently, the model is not being institutionalized outside the educational framework described above. Assimilation among teachers and students from other, non-visual disciplines, has occurred several times during the past year as part of teacher training and academic courses given by the authors. With its taxonomic structure, the model allows differential training based on the needs of each discipline. More importantly, assimilation of critical discussion using visual texts on a regular basis will undoubtedly contribute greatly to improving classroom discourse and student's involvement within the subjects discussed. Though it is early to assess the success of this process, we believe that assimilation of such skills is essential in all fields, in order to form the basis for observation and critical reading of the reality for which schools prepare the students of the present-the teachers and citizens of tomorrow.

## References

- Barthes, R. (1977). The Photographic Message. In S. Sontag (Ed.), *A Barthes Reader* (pp. 194-210). Hill and Wang.
- Dikovitskay, M. (2005). *Visual Culture: The Study of the Visual After the Cultural Turn*. The MIT Press.
- Duchamp, M. (1975). The Creative Act. In M. Sanouillet, & E. Peterson (Eds.), *The Essential Writings of Marcel Duchamp* (pp. 138-140). Thames and Hudson.
- Heidegger, M. (1977). The Age of the World Picture. In Palgrave Macmillan UK eBooks (pp. 70–88). [https://doi.org/10.1007/978-1-349-25249-7\\_3](https://doi.org/10.1007/978-1-349-25249-7_3)
- Husserl, E. (2012). *Logical Investigations Volume 1*. In *Routledge eBooks*. <https://doi.org/10.4324/9780203879054>
- Jagodzinski, J. (2023). Visual Pedagogy in the Shadow of the Anthropocene. In S. Sturm (Ed.), *Visual Pedagogies, Methodologies & Educational Research, Vol.2* (pp. IX-XXIX). Brill.
- Mirzoeff, N. (1999). An Introduction to Visual Culture. In *Routledge eBooks*. <https://doi.org/10.4324/9780429280238>
- Newman, B. (1947, October). The First Man Was an Artist. *Tiger's Eye*, 1, 59-60.
- Tzezana, R. (2013). *The Guide to the Future*. Tezana Roey.
- Ventura, J., & Segal, K. (2019). *The short story of Design*. Yediot Books.
- Virilio, P., & Rose, J. M. (1994). *The Vision Machine*. <http://ci.nii.ac.jp/ncid/BA2402985X>

## LESSONS LEARNED FROM TEACHING DURING THE COVID-19 PANDEMIC: OPERATIONALIZING THE WHAT IF'S

**Kathy R. Fox, Tracy Y. Hargrove, & Kathleen Roney**  
*Watson College of Education, University of North Carolina Wilmington (USA)*

### Abstract

During the COVID-19 pandemic teachers were asked to quickly adapt to new instructional methods. School districts, principals and other school administrators provided a variety of guidelines and outreach methods. Teachers expressed a lack of continuity across schools, grade levels and regions. The study reported here surveyed approximately 1000 teachers across one southern U.S. state, capturing real time descriptions of instructional delivery methods, perceptions of student and parent engagement, and the effects on teachers' own well-being and livelihood. Analysis provided implications for professional development and teacher education programs to better prepare teachers to avoid the stress of training, changing evaluation methods and lack of consistency in accountability. Lessons learned on working with parents and caregivers from an additive approach will be included.

**Keywords:** *Teacher education, teacher mental health, teacher, parent-teacher engagement.*

---

### 1. Introduction

In 2020, teachers were expressing concerns in the immediacy of the first wave of COVID 19 pandemic's impact on schools, families, and communities. Data from a Kaiser 2020 study stated that 1.5 million, or about one in four, teachers in the United States, had high risk condition from the COVID-19 virus (Palosky, 2020). Rumors of a quick vaccination approval were beginning to surface. The numbers of fatalities due to the COVID-19 pandemic were still somewhat centralized into more densely populated and geographically specific areas. In other words,

As teacher educators we felt similar concerns. Not only were we experiencing the stress of the pandemic on our personal lives, but also felt concerned for our teacher education students, the public-school teachers with whom we worked and the children and families of the communities we served. In response, we designed a study of teachers across our state to gather immediate data from teachers on the effects of the COVID-19 pandemic. One of the most surprising findings from our study has been the consistency of responses across teachers' years of experience, geographic locations, grade level assignments and even socio-economic levels of the school populations. In 2023, as we sit with lingering questions about the policies and practices of the original school closings, we continue to feel the effects of the COVID-19 pandemic on teachers, schools, homes and communities. The challenge is to take the lessons learned about teacher stress, the readiness of teachers and families to transition to virtual learning, and the support systems within the school and home communities to support learning in both settings.

### 2. A survey of the literature prior to the COVID-19 pandemic

#### 2.1. Logistics

**Training:** Across studies on technology use and training showed that most teacher education programs offered courses in technology. Much of the assignments were teacher focused rather than child focused and addressed only a small subset of knowledge and skills (Hughes, 2013; Moore-Adams, Jones & Cohen, 2016). Preservice teachers were often asked to demonstrate knowledge of technology in multimedia projects but were less prepared to design lessons that would bridge school to in-home instruction (Duncan & Barnett, 2009). In teacher training programs, preservice teachers use of technology to address issues of equity and differentiation across cultures, languages, socio-economic differences, and technology ability were neglected (Resta and Leferrier, 2015).

**Accessibility:** The greater number of device types owned by a student, the greater the level of learning readiness (Estira, 2020). In a study by Fabito et al. (2020), data revealed that one significant barrier and challenge students encountered in online learning was a good internet connection. Other children lacked

laptops and desktop computers and had limited internet access (Cleofas & Rocha, 2021). Additional findings showed the use of mobile devices had the potential to be used and adapted for learning (Jin & Sabio, 2018). A study by Yra, et al, (2020), showed students' readiness for online classes yet burdened from computer and internet rentals in cafes.

## **2.2. Accountability**

School accountability: As virtual and blended schools in the United States continue to expand school accountability — or lack thereof — was an identified concern. Provisions varied across districts and states. Gaps in data made it difficult to assess the extent to which virtual and blended schools successfully met student needs. While some states reported data on individual measures to help parents make decisions about where to send their children to school, others failed to report any data on the measure (Molnar, et al., 2019).

## **2.3. Social-emotional effects on teachers**

One clear factor in children's resilience from adverse childhood experiences that result in stress, or ACES, is the presence of a consistent and caring adult. "The most important factor in restoring a sense of safety is a strong relationship with a competent, caring and positive adult" (Berson & Baggley, 2009, p 378). The responsibility of this work may be heavy. In climate-initiated, health related and other large events, such as political and social unrest, teachers likely experienced the same stress factors as children. Children take cues for how to react to situations from their caregivers, including teachers. As with children, teachers' reactions to stress will differ and may result in anxiety and/or health problems. Teachers may be in denial of importance of the event, or on the other hand, may be hyper vigilant with fear for children being out of their control (Berson & Baggerly, 2009, p. 376).

## **3. Methodology**

The purpose of this study was to better inform teacher educators of the challenges of school-home virtual instruction, particularly in a forced situation as experienced due to the COVID-19 pandemic. The study design gave us a chance to gather a wide range of data so that unidentified and unanticipated issues and events would emerge. Using a method of coding that revealed both trends and outliers, we anticipated a wide range of responses due to the rapid transition and the vast differences in the regional, geographic and economic demographics across the 100 counties in our state. Questions were designed to discover instructional tools and methods teachers used in both the onset and the continuation after six months of virtual instruction due to the pandemic. Questions asked teachers to state the amount of direction they were given and from whom, to describe the communication between school and home, and to describe concerns they had for children, parents and caregivers. As an overarching question, we asked teachers how they were feeling about the transition from traditional face -to -face teaching to a blend of models of virtual teaching. This question, "What are three words that best describe how you are feeling about your teaching today?" resulted in further inquiry into teacher stress and response to trauma

### **3.1. Design**

We chose phenomenology, a qualitative methodology, which has as its goal the description of a particular phenomenon from those who have first-hand experience of it. Being that change was occurring rapidly, with much of its new experiences for participants, this first-hand experience was important to examine.

Fraenkel, et al. (2012) point out that phenomenological research is one of the more difficult to conduct because the participant must relive the event as accurately as possible. We collected data from the participants early on, from April 2020 and again in November 2020, as they were experiencing the COVID-19 pandemic as they transitioned and then began to accept, make choices, and sharpen skills in virtual instruction. As explained by Neubauer, et al. (2019), we engaged an interpretive phenomenological analysis in that we as researchers played an active role in interpreting the data.

## **4. Findings**

Because of the timeliness of the data collection, limited to the three months just after the transition to virtual learning, survey results reflected the urgency of the moment. The data proved emotional and authentic, with participants thanking us for asking the questions. Teachers felt a need to be heard and counted in the tumultuousness of the time. Demographic analysis of participating teachers revealed a range of teacher years in experience, rank, grade levels and classroom designations. Other quantifiable questions addressed specific logistics of accessibility, training for technology and support for delivery and curriculum

design, concerns for training, changing demands and roles of teachers, job security, accountability for self and students, and overall health of the participants. Analysis across and inter-regions showed emerging patterns and outliers among respondents. The large data set showed consistency of concerns and issues, including from teachers across social-economic differences in school populations, in teachers of different grade levels from Kindergarten to high school, and with teachers whose level of education and ease with technology differed. In other words, concerns over the logistics of virtual instruction, accountability of children's learning during virtual instruction, and the social emotional effects on children, families and teachers were consistently expressed. Representative data are listed below that address each of these areas.

**Accountability: Concern for Children's Academic Accountability**

- I feel stressed about being asked to provide feedback to my students and hold them accountable when many cannot even do the work.
- Questioning my essential-ness to the profession as more than 70% of my students are not participating in my lessons causing me to question how my effort I put into my work, therefore maybe causing the quality of content to slip.

**Accountability: Concern for Evaluation of Teaching**

- I am receiving a summative [evaluation] and that scares me. I was out for 3 weeks with COVID-19 pandemic and then schools being closed the rest of the year. I am worried that my sickness will be counted against me because teachers are penalized in their summaries for their attendance...I hold myself to a high standard as an educator and I don't want to be marked down on things she didn't get to see this year... My district said I would be paid through the end of the year. That is all I know.
- The prolonged questioning of if I am earning my 8 hr day pay from someone's subjective judgement when in fact I'm doing everything I've been asked while maintaining a home and family as well.

**Logistics: Concern for meeting the needs of all students with limited Wi-Fi access and technology**

- Nearly half of our student body does not have internet access. Even if the state tried to say that a Google Meet is equivalent to a classroom setting, which it isn't, there is no way that a paper packet can be equivalent to a teacher.
- ...If a student participates in our Weekly Zoom, then that counts as a weekly communication. However, only about 20-25% show up for Zoom meetings. A phone message or an email sent does not count as a communication according to my administration. I must achieve a two-way communication with each family, each week. At the end of the week, I have to submit a report to my administrator with the names of students I failed to connect with. Last week, they added the requirement of doing a virtual walk-through evaluation of my peer's at-home learning "classroom." ...I'm already anxious about this Friday's staff meeting, wondering what new requirement administration will add to my plate.

**Social Emotional: Concern for Health of Teacher**

- My concerns are primarily for my own mental health. Sitting in front of a computer screen 8.5-9 hrs. a day to complete all of the work that is expected of me is not too great for my mental health.
- I am most concerned about a different kind of burn out. One not from long workdays, but from not being able to escape the job. Emails/turned in work after 11 pm are hard to ignore. Also, I'm a single mother, so I've been trying to balance out teaching my classes, helping my daughter with her own, in addition to just finding that "family" time.

## 5. Discussion

Analysis of results showed patterns across the state's one hundred counties in the data collection. With very little variation, the most frequent response to question describing their current status in 3 words, was "overwhelmed," followed by "tired." This overarching response was then explained in the qualitative responses regarding logistics, accountability and the social emotional status of participants.

When asked about professional concerns, with examples such as pay, job security and other, provided in the question stem, participants most frequently shared concerns over accountability measures to satisfy district and school administrators' changing demands. This was followed by concerns to meet the needs of children virtually as well as the children's ability to attend class and accomplish tasks in this new system. Their knowledge and effectiveness with new technologies as instructional methods was a concern it would now be used in evaluation.

Teachers showed concern for accountability for children's academic growth. This was often expressed as the lack of attendance and/or "logging in" or "showing up" in the virtual classroom.

They described frustration with their district’s lack of guidelines, consistency, and encouragement for grading. While this was generally attributed to variations in technology and connectivity in children’s homes, this logistical gap left teachers stressed about children’s progress. Because children and parents were told that grades would be on a Pass/Fail status, or, in some cases, not taken, teachers felt their work was devalued by both administrators and families.

Training logistics and the expanding job demands were described in detail, with similarities across the schools. Many reported long hours on the computer with children’s synchronous instruction and then mandatory phone calls to follow-ups with children who had not checked in. Mandatory training in technology and subsequent paperwork were described by multiple respondents, sometimes occurring on the teachers’ own time. An increase in workload was described in every region and across all grade levels, with many citing needs both to teach virtually and to prepare paper packets to be distributed to children without technology in the home.

## 6. Closing: implications for the *What Ifs*?

In writing this article we sit with hindsight not available when the study began. In March 2020 we were struck by the call for teachers, including our preservice education students, to quickly convert face-to-face instructional methods to a form of virtual instruction. As teacher educators we designed this study to better meet the needs of teachers in the event of the need for further school closings. Almost three years later we see the acceptance of virtual instruction as a method to provide schooling when traditional classroom instruction is not possible. In just the last half of the 2022-year, school districts have announced “No more snow days” as policy, virtual instruction when schools were shut down due to political unrest and violence, and continuing health concerns for COVID-19 pandemic closing schools on an intermittent basis.

We have observed our students and partnership teachers in the field expressing a desire to ignore the implications of school closings and return to pre-COVID-19 pandemic practices, often described as “getting back to normal.” In spite of Molnar, et al’s 2019 report, as well as numerous indicators of stress on teachers, children and families from the quick pivot to virtual teaching, a call for a change in teacher education programs is not prevalent. In our state, recent statistics show the teacher turnover was one of the highest in the country, with 16% of teachers leaving after the 2021-22 school year (Barnum, 2023). Logistics, accountability, and the social emotional health of teachers—that ultimately affect children and families—has driven us to now ask what we learned and what are the changes that need to occur.

Following are strategies from local, national and international reports on what worked, what we can have ready and what we now can be positive changes, with or without a sudden transition to virtual education.

- Free Wi-Fi access for public use across regions and economic conditions: One of the most revealing “aha moments” of the public’s awareness of the vast effects of the COVID-19 pandemic was discovering the discrepancies of internet access across the US and other so-called “first world countries.” As part of the Biden administration the Affordable Care Act was instated to provide \$30 a month to families to help cover costs of internet access, with a one-time discount of \$100 to cover the cost of a laptop (Get Internet, n.d.). This does not alleviate however the infrastructure necessary to deliver the access or to provide ongoing assistance in the case the ACA fades with the advent of political change.
- Professional development for teachers and administrators that focuses on building consistent accountability measures for virtual instruction—Development of guidelines for both parents and teachers is a first step. In Colorado, Senate Bill (**SB22-137**) Transition Back to K-12 Standard Accountability, was signed into law in 2022 in response to the need for transparency in student learning data. This will allow the state to target support and resources to the districts and schools that need it the most.
- Professional development and a refocus from teacher educators on a learner centered technology tools, to alleviate the stress of technology training while practicing. Tools and strategies that provide content and outreach to homes, compared to current technology focus on efficiency of lesson plans and presentations.
- Trauma informed counseling and interventions made available as a routine procedure for both teachers and administrators: little attention has been focused on resiliency factors needed to sustain qualified teachers in the profession. In a study of 163 teachers looking at “the trauma informed trenches,” researchers found a need for compassion and support for occupational well-being to sustain and maintain the teaching workforce (Christian-Brandt, Santacrosse, & Barnett, 2020).

## References

- Barnum, M. (2023). *Teacher turnover hits new highs across the U.S.* Retrieved March 11, 2023 from <https://www.chalkbeat.org/2023/3/6/23624340/teacher-turnover-leaving-the-profession-quitting-higher-rate>
- Berson, I. & Baggley, J. (2009). Building resilience to trauma. Creating a safe and supportive early childhood classroom. *Childhood Education*, 85(6), 375-379.
- Christian-Brandt, A., Santacrose, D., & Barnett, M. (2020). In the trauma-informed care trenches: Teacher compassion satisfaction, secondary traumatic stress, burnout, and intent to leave education within underserved elementary schools. *Child Abuse and Neglect*, 110(Pt 3), 104437. Retrieved June 5, 2020 from <https://pubmed.ncbi.nlm.nih.gov/32151429/>
- Cleofas, J. V., & Rocha, I. C. N. (2021). Demographic, gadget, and internet profiles as determinants of disease and consequence related COVID-19 anxiety among Filipino college students. *Education and Information Technologies*, 26(6), 6771-6786. <https://doi.org/10.1007/s10639-021-10529-9>
- Duncan, H. & Barnett, J. (2009). Learning to teach online: What works for pre-service teachers. *Journal of Educational Computing Research* 40(3). 357-376.
- Estira, K. L. A. (2020). Online distance learning readiness of business administration students in one state university in the Philippines. *Journal of Critical Reviews*, 7(12), 826-832. [http://dx.doi.org/10.31838/jcr.07.12.146\[16\]](http://dx.doi.org/10.31838/jcr.07.12.146[16])
- Fabito, B. S., Trillanes, A. O., & Sarmiento, J. R. (2020). Barriers and challenges of computing students in an online learning environment: Insights from one private university in the Philippines. *International Journal of Computing Sciences Research*, 5(1), 441-458. <https://doi.org/10.2514/ijcsr.2017.001.1.51>
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. (2012). *How to design and evaluate research in education* (8<sup>th</sup> Ed.). McGraw-Hill.
- Get Internet. (n.d.). Retrieved March 11, 2023 from <https://www.whitehouse.gov/getinternet/>
- Hughes, J. (2013). Descriptive indicators of future teachers' technology integration in the PK-12 classroom: Trends from a laptop-infused teacher education program. *Journal of Educational Computing Research*, 48(4), 491-516.
- Jin, W. & Sabio, C. J. (2018). Potential use of mobile devices in selected public senior high schools in the city of Manila Philippines. *International Journal of Learning, Teaching and Educational Research*, 17(4), 102-114, <https://doi.org/10.26803/ijlter17.4.7>
- Moore-Adams, B., Jones, W. & Cohen, J. (2016) Learning to teach online: a systematic review of the literature on K-12 teacher preparation for teaching online, *Distance Education*, 37:3, 333-348, DOI: 10.1080/01587919.2016.1232158
- Molnar, A., Miron, G., Elgeberi, N., Barbour, M. K., Huerta, L., Shafer, S. R., & Rice, J. K. (2019). *Virtual Schools in the U.S. 2019*. Boulder, CO: National Education Policy Center.
- Neubauer, B. E., Witkop, C. T., & Varpio, L. (2019). How phenomenology can help us learn from the experiences of others. *Perspectives in Medical Education*, 8(2), 90-97.
- Palosky, C. (2020). About 1.5 million teachers are at higher risk of serious illness from COVID-19. *Newsroom*. Retrieved March 11, 2023 from <https://www.kff.org/coronavirus-covid-19/press-release/about-1-5-million-teachers-are-at-higher-risk-of-serious-illness-from-covid-19/>.
- Resta, P., & Leferrier, T. (2015). Digital equity and intercultural education. *Education and Information Technologies*, 20(4), 743-756.
- Yra, J., Castillo, R., Bautista, R., Camayang, J., & Camayang, A. (2020). Students' online learning readiness and internet connectivity Customization of QSU e-Ara. *American Journal of Educational Research*, 11(8), 878-884.

## TOWARDS FUTURE EDUCATION: HOW DO TEACHERS AND STUDENTS PERCEIVE BLENDED EDUCATION?

Seyyed Kazem Banihashem<sup>1,2</sup>, Perry den Brok<sup>1</sup>, Omid Noroozi<sup>1</sup>, & Harm Biemans<sup>1</sup>

<sup>1</sup>*Education and Learning Sciences, Wageningen University and Research (The Netherlands)*

<sup>2</sup>*Online Learning and Instruction Department, Open Universiteit (The Netherlands)*

### Abstract

Amidst the Covid-19 pandemic, online education has demonstrated significant potential in providing flexible and easily accessible learning opportunities on a global scale. As a result of its numerous advantages, the landscape of education in the post-Covid era is anticipated to be a combination of online and face-to-face (F2F) instruction, with F2F education retaining its predominant role. Achieving such a blended model necessitates prompt attention towards blended education and a comprehensive exploration of how educators and students perceive it. Hence, the objective of this research is to delve into and examine the perceptions and emotions of teachers and students regarding blended education. To accomplish this, a total of 327 teachers and 547 students from a Dutch university participated and completed a survey. The collected data were analyzed by using SPSS. In terms of the findings concerning teachers, it was generally observed that a majority of them experienced a significant workload and stress levels in blended education. A considerable proportion of teachers did not indicate a strong sense of well-being within the blended education context. On the other hand, in terms of motivation, teachers displayed a relatively positive level of motivation. As for the outcomes related to students, a substantial number of students expressed perceiving a high workload in blended education. However, the majority reported low levels of stress. In regard to well-being, a significant proportion of students displayed neutral well-being. Nevertheless, students demonstrated motivation towards blended education. These results can guide the future design of education for the post-Covid time in higher education contexts.

**Keywords:** *Blended education, future education, higher education, teachers, students.*

### 1. Introduction

In the present day, technology assumes a vital role in education, particularly through its provision of online learning opportunities (Banihashem et al., 2022; Farrokhnia et al., 2023). Over the past three years, there has been a significant global increase in the utilization of online education, primarily due to the impact of the Covid-19 pandemic (Drachslar et al., 2021; Van der Spoel et al., 2020; Stevens et al., 2023). This transition from traditional F2F education to online education has had a profound impact on higher education, presenting both advantageous opportunities and potential risks (van Puffelen et al., 2022). The key benefits associated with online education include enhanced comfort, flexibility, and accessibility for learners (Mukhtar et al., 2020; Paudel et al., 2021). However, it is important to acknowledge the challenges that come with this shift, such as social isolation, decreased motivation, increased work pressure, difficulties in self-regulation, and delayed feedback (Aboagye et al., 2021; Rasheed et al., 2020).

Notwithstanding these obstacles, the benefits offered by online education during the pandemic cannot be easily dismissed. In other words, as online education has demonstrated its worth in the realm of higher education, there has been a noticeable increase in the number of institutions investing in online education (Shi, 2019; Zhao & Watterston, 2021), particularly in the post-Covid-19 era (Banihashem et al., 2023; Ratten et al., 2023). While it is predicted that F2F education will continue to be the primary mode of instruction in the post-pandemic era, there is a consensus that online education will remain an integral part of the educational landscape (Lockee, 2021). This argument calls for a reevaluation of higher education practices and the development of a carefully crafted new educational approach that combines flexibility with effectiveness in the post-pandemic era (Neuwirth et al., 2021). The importance of this need has gained increased attention, particularly following the successful implementation of vaccination programs in 2022 and the gradual return to normalcy in various aspects of life (e.g., Ratten et al., 2023).

According to the literature discussing the future of education in the post-pandemic era, blended education emerges as a promising approach that offers a balanced and flexible form of learning. It aims to address the difficulties posed by online education by combining F2F instruction with online components in the post-pandemic era (Banihashem et al., 2023; Sharma & Shree, 2023). Blended education is defined



as a design of learning where the elements of both F2F and online education are combined in a pedagogically thoughtful manner (Banihashem et al., 2014; Vo et al., 2020). There is a considerable pool of research that reported positive impacts of using blended education compared to F2F and online education such as improving engagement and performance (Deschacht & Goeman, 2015). Despite its benefits, challenges also are reported regarding the acceptance of blended education since its design and implementation seemingly is more complicated than fully F2F and fully online education and both teachers and students have fewer experiences with such education (Banihashem et al., 2023).

In the context of blended education in the post-pandemic era, our understanding of how teachers and students perceive this approach remains limited (Banihashem et al., 2023). Therefore, there is a crucial need to investigate teachers' and students' perspectives on blended education, as such research can provide valuable insights into the factors that contribute to its wider acceptance and effective implementation. The present study aims to explore teachers' and students' perceptions and emotions concerning blended education, specifically focusing on workload, stress, motivation, and well-being. To achieve this objective, the following research questions have been formulated.

- RQ1. How do teachers perceive their workload, stress, motivation, and well-being in blended education?
- RQ2. How do students perceive their workload, stress, motivation, and well-being in blended education?

## 2. Method

This exploratory study was conducted in a Dutch university specializing in life sciences in the academic year 2021-2022.

### 2.1. Participants

In this study, 327 teachers and 547 students participated. The distribution of participants in terms of gender was nearly equal, with male teachers comprising 46% (N=140) and female teachers making up 43% (N=133) of the total. A significant number of teachers held the position of course coordinator (N=191, 62%), and the majority of them were of Dutch nationality (N=214, 70%). Moving on to the student participants, the majority were female (N=328, 61%). However, there was a good balance between participants from both bachelor's level (N=253, 47%) and master's level (N=267, 50%). Similar to the teacher participants, the majority of students were of Dutch nationality (N=356, 67%). Considering the diversity of the participants in terms of gender and nationality, it can be inferred that the sample was representative of the university.

### 2.2. Measurements

Teachers' perceptions and emotions towards blended education were measured via four variables including workload, stress, well-being, and motivation, and it included 10 items for teachers. Teachers' workload was measured using three items (e.g., *teaching this course in a blended form increased the workload*). Teachers' stress included two items (e.g., *I experienced stress teaching this blended course*). Well-being was measured using two items (e.g., *I feel a sense of well-being when teaching in a blended form*). And the measurement of teachers' motivation consisted of three items (e.g., *I was motivated to teach this blended course*).

The same variables were used to measure students' perceptions and emotions towards blended education with 12 items. Three items for students' workload (e.g., *I experience a high workload in my current education*), three items for stress (e.g., *I feel stressed in the current blended courses*), four items for well-being (e.g., *I feel connected to my fellow students in my current education*), and two items for motivation (e.g., *I am motivated to follow blended courses*). All items for both teachers and students were designed based on a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree'.

### 2.3. Data analysis

A descriptive analysis was conducted to provide an overview of teachers' and students' perceptions and emotions regarding blended education,

## 3. Results

### 3.1. Results for RQ1

The findings about teachers' perceptions and emotions towards blended education revealed that, overall, a majority of teachers reported experiencing a high workload (N=220, 71%) and stress (N=213, 70%) in the blended education setting. Furthermore, a significant number of teachers did not demonstrate a strong sense of well-being in blended education (N=84, 27%). However, in terms of motivation, teachers were relatively found to be motivated (N=184, 60%) (Table 1).

Table 1. Teachers' perceptions and emotions towards blended education.

Item	Mean	SD	Agreement no. (%) <sup>b</sup>	Disagreement no. (%) <sup>c</sup>	Neutral no. (%)
<i>Workload</i>					
Teaching this course in a blended form increased the workload	4.36	0.99	255 (83%)	22 (7%)	30 (10%)
It was difficult to combine personal life at home with blended teaching	3.16	1.12	181 (59%)	81 (26%)	45 (15%)
I feel high mental effort teaching in a blended form	3.77	1.08	220 (71%)	47 (16%)	40 (13%)
Total	3.76	0.86	220 (71%)	47 (16%)	40 (13%)
<i>Stress</i>					
I experienced stress teaching this blended course	3.96	1.06	238 (78%)	38 (12%)	31 (10%)
I feel worried about teaching my course in a blended form	3.25	1.14	188 (61%)	78 (26%)	41 (13%)
Total	3.60	0.91	213 (70%)	58 (19%)	36 (11%)
<i>Well-being</i>					
I feel comfortable about my blended teaching	3.43	0.97	188 (61%)	60 (20%)	59 (19%)
I feel a sense of well-being when teaching in a blended form	2.68	0.97	26 (9%)	107 (34%)	174 (57%)
Total	3.05	0.86	107 (35%)	84 (27%)	116 (38%)
<i>Motivation</i>					
I like blended teaching	2.86	1.08	157 (51%)	116 (38%)	34 (11%)
I was motivated to teach this blended course	3.62	1.09	214 (70%)	57 (18%)	36 (12%)
I feel satisfied with my blended teaching	3.25	1.00	181 (59%)	74 (24%)	52 (17%)
Total	3.24	0.88	184 (60%)	82 (27%)	41 (13%)

<sup>a</sup>Based on a 5-point Likert scale (Strongly disagree, disagree, neutral, agree, and strongly agree)

<sup>b</sup>Agreement = Agree, and strongly agree; <sup>c</sup> Disagreement = Strongly disagree, disagree

### 3.2. Results for RQ2

The outcomes concerning students' perceptions and emotions towards blended education indicated that a significant proportion of students perceived a high workload (N=164, 31%) in the blended education context. However, the majority of students reported low levels of stress (N=388, 73%). In terms of well-being, a considerable number of students displayed a neutral well-being state (N=224, 42%). Nevertheless, students demonstrated motivation towards blended education (N=284, 46%) (Table 2).

Table 2. Students' perceptions and emotions towards blended education.

Item	Mean	SD	Agreement no. (%) <sup>b</sup>	Disagreement no. (%) <sup>c</sup>	Neutral no. (%)
<i>Workload</i>					
I experience a high workload in my current education	3.35	0.91	180 (34%)	80 (15%)	274 (51%)
I experience difficulty in combining the current form of education with my personal life	2.87	1.11	125 (23%)	166 (31%)	243 (46%)
I feel a high mental effort in learning in my current education	3.34	1.05	187 (35%)	104 (20%)	243 (45%)
Total	3.18	0.85	164 (31%)	117 (22%)	253 (47%)
<i>Stress</i>					
I feel worried about not passing a blended course	2.44	1.08	94 (18%)	378 (71%)	62 (11%)
I feel worried about the current blended courses	2.17	0.95	53 (10%)	410 (77%)	71 (13%)
I feel stressed in the current blended courses	2.42	1.04	77 (14%)	377 (71%)	80 (15%)
Total	2.34	0.88	75 (14%)	388 (73%)	71 (13%)
<i>Well-being</i>					
I feel connected to my fellow students in my current education	2.41	0.94	70 (13%)	369 (69%)	95 (18%)
I feel a sense of well-being in my	2.84	0.90	104 (20%)	145 (27%)	285 (53%)

current education					
I feel a sense of belongingness in my current education	2.72	0.97	102 (19%)	165 (31%)	267 (50%)
I feel part of a community at WUR in my current education	2.66	1.00	106 (20%)	180 (34%)	248 (46%)
Total	2.65	0.83	96 (18%)	215 (40%)	224 (42%)
<i>Motivation</i>					
I like following blended courses	3.28	1.04	252 (47%)	108 (20%)	174 (33%)
I am motivated to follow blended courses	3.19	1.05	244 (46%)	119 (22%)	171 (32%)
Total	3.23	0.99	248 (46%)	113 (21%)	173 (33%)

<sup>a</sup>Based on a 5-point Likert scale (Strongly disagree, disagree, neutral, agree, and strongly agree)

<sup>b</sup>Agreement = Agree, and strongly agree; <sup>c</sup> Disagreement = Strongly disagree, disagree

#### 4. Discussions

In this study, our findings indicate that both teachers and students perceived a high workload in blended education. However, their experiences with stress differed, as teachers reported high-stress levels while students reported low-stress levels. One plausible explanation for this disparity is that blended education is a relatively new instructional approach for many institutions, and teachers may lack sufficient experience in designing courses in this format (Sharma & Shree, 2023). Moreover, in blended education, online resources and tools play a crucial role in enhancing teaching and learning (Alammary et al., 2014). However, technical issues commonly associated with blended education can contribute to added stress and workload. Despite these challenges, both teachers and students did not demonstrate strong well-being in blended education. These findings align with previous studies reporting low well-being among teachers and students in online education during the Covid-19 pandemic (Panadero et al., 2022). One possible explanation for this is the novelty of the situation, which results in a higher workload for both teachers and students, negatively impacting their well-being. This argument finds support in previous studies that have reported a negative correlation between workload and well-being (Pace et al., 2021). Another possible explanation is that the transition from fully online education during the pandemic to a new form of education in the post-pandemic era posed challenges for teachers and students in striking a balance between personal and social interactions in online and remote teaching and learning. On the topic of motivation, both teachers and students demonstrated relatively high levels of motivation in blended education during the post-pandemic period. This can be attributed to the flexibility that blended education offers, as supported by previous studies (Wong et al., 2020).

#### 5. Conclusion

By examining the perceptions and emotions of teachers and students in blended education, this study offers a comprehensive understanding of various aspects such as workload, stress, well-being, and motivation. Consequently, it fills a void in the literature concerning post-pandemic education by shedding light on how teachers and students perceive blended education. Furthermore, this study not only contributes to and expands the existing body of knowledge on post-pandemic education but also carries significant implications for future education policies and practices.

#### References

- Aboagye, E., Yawson, J. A., & Appiah, K. N. (2021). COVID-19 and E-learning: The challenges of students in tertiary institutions. *Social Education Research*, 1-8. <https://doi.org/10.37256/ser.212021422>
- Alammary, A., Sheard, J., & Carbone, A. (2014). Blended learning in higher education: Three different design approaches. *Australasian Journal of Educational Technology*, 30(4), 440-454. <https://doi.org/10.14742/ajet.693>
- Badali, M., Hatami, J., Banihashem, S. K., Rahimi, E., Noroozi, O., & Eslami, Z. (2022). The role of motivation in MOOCs' retention rates: a systematic literature review. *Research and Practice in Technology Enhanced Learning*, 17(1), 1-20. <https://doi.org/10.1186/s41039-022-00181-3>
- Banihashem, S. K., Noroozi, O., den Brok, P., Biemans, H. J., & Kerman, N. T. (2023). Modeling teachers' and students' attitudes, emotions, and perceptions in blended education: Towards post-pandemic education. *The International Journal of Management Education*, 21(2), 100803. <https://doi.org/10.1016/j.ijme.2023.100803>

- Banihashem, S. K., Noroozi, O., van Ginkel, S., Macfadyen, L. P., & Biemans, H. J. (2022). A systematic review of the role of learning analytics in enhancing feedback practices in higher education. *Educational Research Review*, 100489. <https://doi.org/10.1016/j.edurev.2022.100489>
- Banihashem, S. K., Rezaei, J., Badali, M., & Dana, A. (2014). The Impact of Using Blended Learning on Students' Creativity. *Journal of Innovation and Creativity in Human Science*, 4(1), 113-128.
- Deschacht, N., & Goeman, K. (2015). The effect of blended learning on course persistence and performance of adult learners: A difference-in-differences analysis. *Computers & Education*, 87, 83-89. <https://doi.org/10.1016/j.compedu.2015.03.020>
- Drachler, H., Jansen, J., & Kirschner, P. A. (2021). Adoption of learning technologies in times of pandemic crisis. *Journal of Computer Assisted Learning*, 37(6), 1509-1512. <https://doi.org/10.1111/jcal.12626>
- Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*, 1-15. <https://doi.org/10.1080/14703297.2023.2195846>
- Lockee, B. B. (2021). Online education in the post-COVID era. *Nature Electronics*, 4(1), 5-6. <https://doi.org/10.1038/s41928-020-00534-0>
- Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. *Pakistan journal of medical sciences*, 36 (COVID19-S4), S27. <https://dx.doi.org/10.12669%2Fpjms.36.COVID19-S4.2785>
- Neuwirth, L. S., Jović, S., & Mukherji, B. R. (2021). Reimagining higher education during and post-COVID-19: Challenges and opportunities. *Journal of Adult and Continuing Education*, 27(2), 141-156. <https://doi.org/10.1177/147797142094773>
- Pace, F., D'Urso, G., Zappulla, C., & Pace, U. (2021). The relation between workload and personal well-being among university professors. *Current Psychology*, 40, 3417-3424. <https://doi.org/10.1007/s12144-019-00294-x>
- Panadero, E., Fraile, J., Pinedo, L., Rodríguez-Hernández, C., Balerdi, E., & Díez, F. (2022). Teachers' well-being, emotions, and motivation during emergency remote teaching due to COVID-19. *Frontiers in Psychology*, 13, 1-14. <https://doi.org/10.3389/fpsyg.2022.826828>
- Paudel, P. (2021). Online education: Benefits, challenges and strategies during and after COVID-19 in higher education. *International Journal on Studies in Education*, 3(2), 70-85. <https://www.ijonse.com/index.php/ijonse/article/view/32/pdf>
- Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, 144, 103701. <https://doi.org/10.1016/j.compedu.2019.103701>
- Ratten, V. (2023). The post COVID-19 pandemic era: Changes in teaching and learning methods for management educators. *International Journal of Management Education*, 100777. <https://doi.org/10.1016/j.ijme.2023.100777>
- Sharma, L., & Shree, S. (2023). Exploring the Online and Blended Modes of Learning for Post-COVID-19: A Study of Higher Education Institutions. *Education Sciences*, 13(2), 142-153. <https://doi.org/10.3390/educsci13020142>
- Shi, M. (2019). The effects of class size and instructional technology on student learning performance. *The International Journal of Management Education*, 17(1), 130-138. <https://doi.org/10.1016/j.ijme.2019.01.004>
- Stevens, T. M., den Brok, P. J., Noroozi, O., & Biemans, H. J. A. (2023). Teacher profiles in higher education: the move to online education during the COVID-19 crisis. *Learning Environments Research*, 1-26. <https://doi.org/10.1007/s10984-023-09458-w>
- Van der Spoel, I., Noroozi, O., Schuurink, E., & van Ginkel, S. (2020). Teachers' online teaching expectations and experiences during the Covid19-pandemic in the Netherlands. *European journal of teacher education*, 43(4), 623-638. <https://doi.org/10.1080/02619768.2020.1821185>
- van Puffelen, E. A. M., Stevens, T. M., Banihashem, S. K., Biemans, H. J. A., Noroozi, O., Raeven, N. S. M., & den Brok, P. J. (2022). Covid-19 forced remote teaching and university education after it. In *Proceedings of the 18th International CDIO Conference*.
- Vo, M. H., Zhu, C., & Diep, A. N. (2020). Students' performance in blended learning: disciplinary difference and instructional design factors. *Journal of Computers in Education*, 7(4), 487-510. <https://doi.org/10.1007/s40692-020-00164-7>
- Wong, K. T., Hwang, G. J., Choo Goh, P. S., & Mohd Arrif, S. K. (2020). Effects of blended learning pedagogical practices on students' motivation and autonomy for the teaching of short stories in upper secondary English. *Interactive Learning Environments*, 28(4), 512-525. <https://doi.org/10.1080/10494820.2018.1542318>
- Zhao, Y., & Watterston, J. (2021). The changes we need: Education post COVID-19. *Journal of Educational Change*, 22(1), 3-12. <https://doi.org/10.1007/s10833-021-09417-3>

## **PEDAGOGICAL MODEL FOR SOCIAL TRANSFORMATION WITH A COMMON GOOD PERSPECTIVE**

**Mariano Sánchez Cuevas**

*Vice presidency for academic affairs, UPAEP University (México)*

### **Abstract**

Education as a common good has as its distinctive feature- a renewed purpose for the formation of citizens in favor of integral human development and in a context of economic, social and environmental sustainability that favors it. For this purpose, the educational process must address the development of all the potentialities and capabilities of the individual, from a holistic and humanistic vision so that he/she may discover and fulfill his/her personal and professional vocation in order to address the main social challenges in a committed and supportive manner to contribute positively to social transformation. This new view of education goes beyond a utilitarian approach, as it integrates the multiple dimensions of human existence and considers the educational process as an inclusive and crucial factor to promote democracy and human rights, the formation of citizenship and the promotion of a culture of peace. As a proposal derived from this humanistic approach to education arises the pedagogical model called 'pedagogy of the common good', whose anthropological foundations are based on the centrality of the human person and the social values of respect for the dignity of the person, solidarity, subsidiarity, truth, freedom, justice, common good and love. In addition, this pedagogical model is based on four principles: integral experience, culture of encounter, transforming leadership and transcendence in the common good. The concretization of the model allows the generation of the following learning: learning to be integral, learning to live together, learning to transform and learning to transcend. The 'pedagogy of the common good' favors the development of meaningful experiences that facilitate the full development of the talents of the students in all their potential in an integral manner, so that they grow in a spirit of solidarity and become promoters of justice for all, care for the family, respect for the dignity of human life, protection of nature, the search for peace from the donation, otherness and mission.

**Keywords:** *Pedagogical model, common good, significant experiences, social transformation.*

---

### **1. Introduction**

The postulate of education as a common good emphasizes the objectives of education as a collective social effort and questions educational models based on utilitarian perspectives or those whose vision is limited to an education that produces labor forces. A perspective that has the common good as its horizon, favors the humanistic approach that places people and their connections with the community in a central place and entails the reinforcement of the cultural, social and relational dimensions of the educational process; it is concerned with the opportunity to make education more relevant to the specificity of different realities in a creative and integrative process of empowerment. This holistic and humanistic vision contributes to a new model of educational and social development and integrates the multiple dimensions of human existence, which also considers education as an inclusive and crucial factor to promote democracy and human rights, as well as to strengthen global citizenship and civic engagement. In this new perspective, educational institutions are seen as innovative and transformative entities, capable of improving quality and efficiency through empowerment and greater cooperation with the various actors of society that contribute to the educational ecosystem (Locatelli, 2018).

UNESCO (2015), in its document "Rethinking education towards a global common good?", the following approaches are made from a humanistic conception of education and development, based on respect for life and human dignity, equal rights, social justice, cultural diversity, international solidarity and shared responsibility for a sustainable future: The notion of education as a common good, reaffirms its collective dimension as a common social activity from a shared responsibility and commitment to solidarity, education is necessary for the realization of the fundamental rights of people, an authentic education is one that forms the human resources we need to be productive, keep learning, solve problems, be creative and live together and with nature in peace and harmony; a humanistic and holistic vision of education can and must contribute to achieving a new development model, in which economic growth

must be governed by respect for the environment and concern for peace, inclusion and social justice. The humanistic values that should constitute the foundations and purpose of education are: respect for life and human dignity, equal rights and social justice, cultural and social diversity, and a sense of human solidarity and shared responsibility for our common future.

## 2. Objective

Describe the structural components of a pedagogical model with a common good approach by describing its principles and pillars in order to assess its contribution to the transformation of individuals and society.

## 3. Methods

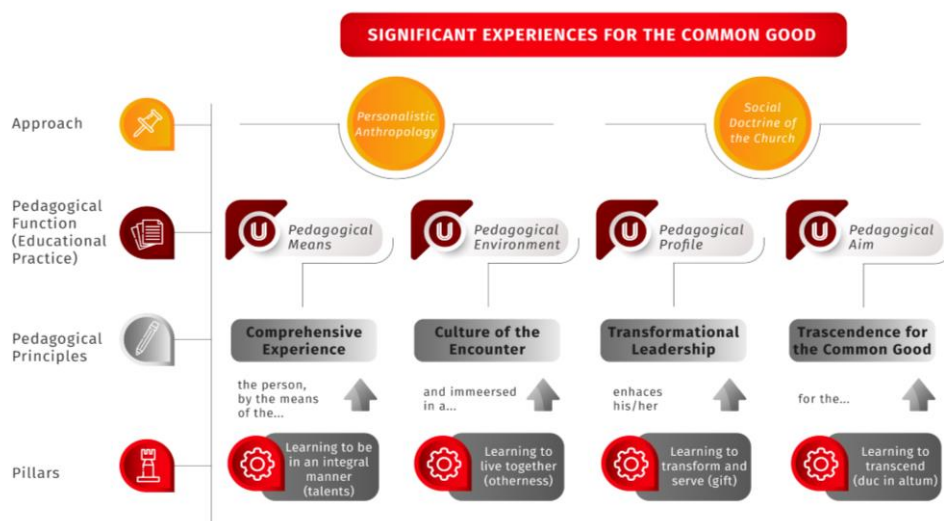
The methodological approach consisted of an exploratory study with a qualitative approach. The design of the pedagogical model was carried out through a documentary review of the historical, philosophical, anthropological and pedagogical sources that support the mission of the university and current educational trends. Its validation consisted of analysis and group discussion sessions for the sharing of the proposal with experts in the educational field, finally the validation of the principles was done through a qualitative method of interpretative descriptive type.

## 4. Discussion

The documentary analysis of the secondary sources for the construction of the pedagogical model corroborated the affirmation that education is the common good that an educational institution contributes to society. Affirming from this perspective that education is a space to cultivate values, knowledge and socialization of the person living in community. The educational process seeks to generate meaningful experiences that facilitate the full development of students in all their potential in an integral way, so that they grow in a spirit of solidarity and are promoters of justice for all, respect for the dignity of human life, protection of nature, the search for peace and political stability, poverty and migration, from the social values of solidarity and social charity. On the other hand, a second finding in relation to the common goods generated by education was the 'educational relationship' between the teacher and the student. Since this 'educational relationship' is a personal and unique relationship that unfolds throughout all the interrelations of the educational community, it is a complete and integral educational relationship that forms a dynamic interaction, constantly updated in a singular and unique way.

As for the pedagogical model, its construction was defined from two fundamental axes- firstly, the axis of a personalist anthropology from which it is affirmed that the educational process has its centrality in the student's person and the second axis consists in the incorporation in the formative process of the social values of justice, dignity of the person, solidarity, subsidiarity and common good. This pedagogical model, called 'pedagogy of the common good', is based on four principles: integral experience, culture of encounter, transforming leadership and transcendence in the common good (Figure 1).

Figure 1. Pedagogical model 'Pedagogy of the common good'.



The **integral experience** promotes that everything the student experiences in the educational institution is meaningful, transforms, enriches and enables him/her to act as a whole person who realizes his/her personal vocation as a competent professional. The intention of this principle lies in the conversion of learning experiences into meaningful experiences, which have the characteristic of being intentionally formative experiences that decisively modify the interiority of the student towards the truth and the good, achieving a significant learning by experiencing the common good, in such a way that he/she acquires and potentiates collective habits to act with and for others.

The **culture of encounter** in this pedagogical model is considered as the environment in which the formative process takes place, in this sense the common 'pedagogy of the good' recognizes the importance of listening to the student, of dialoguing with him, of liberating him and making him aware so that, in this way, he can transform himself and transform the world, that is, change his surrounding reality and the way he relates to it. This environment is based on dialogue, respect, openness and welcoming the student, thus turning the educational act into an act of hospitality. This culture of encounter is also characterized because it has its origin in the awareness of the value and dignity of each of those who participate in the educational process, thus generating environments of respect, appreciation, teamwork, community experiences, inclusion and social friendship.

The principle of **transformational leadership** is the pedagogical goal that promotes the 'pedagogy of the common good'. The characteristics of this style of leadership are the following: graduates characterized by a high academic preparation, a humanistic sense and an attitude of service; commitment to the promotion of the common good and driven by a transforming spirit. Transformational leadership tends to the genuine search for the good, hence it is considered necessary to reflect on the relevance of personal attitudes and decisions, as well as the moral implications of how the graduate's behavior influences the lives of others. To this end, the person must be trained in habits that strengthen the will and determination, while fostering a critical conscience that freely seeks what is good, noble and true.

As a last principle and very much in consonance with the previous one is the transcendence that gives to the student's life the constant search and construction of the common good. This sense of **transcendence in the common good**, favors that students are formed in a service mentality promoting the common good with their professional and civic actions, this because university students need to be responsible, have a healthy concern for the problems that affect others, have a generous spirit that leads them to face these problems, and to seek the best solution for them.

The 'pedagogy of the common good' is concretized in four pillars that refer to the types of learning that are developed in the context of this model, which are described below. **Learning to be integral** is a pillar that seeks the development of all the student's talents, knowing that everything has been given to them as gifts for their own fulfillment and that of others; **learning to live together** refers to respecting differences and valuing the dignity of each person, hence characteristic attitudes such as listening, respect and welcoming; **learning to transform** means learning that considers others as the recipients of the development of their own talents, to detonate an attitude of service that seeks to transform environments to make the student more human and hopeful. Finally, **learning to transcend**, as a driver to find the ultimate motivation of educational action from a transcendent sense of personal and professional vocation through the search and construction of the common good.

Based on the components of the pedagogical model and the vision of education as a common good, the 'pedagogy of the common good' was conceptualized as follows (Sánchez & Medina, 2021).

- 'Pedagogy of the common good' is understood as a series of principles and styles, convictions and goals that are at the basis of the educational work of an institution committed to social transformation and the extension of culture.
- The 'pedagogy of the common good' is considered as the habit that the student freely conquers when living a personal encounter with his teachers and classmates, in such a way that he acquires and refines human or disciplinary concepts, applies them to the resolution of problems in his immediate reality and assumes attitudes of service encountering the other, to know together the reality, re-signify it and transform it for the good of all. This encounter is the origin of the construction of the common good.
- The 'pedagogy of the common good' recognizes that two types of knowledge structure the educational relationship and for this reason it is called 'integral educational relationship'. On the one hand, 'know-how', that is, the specific knowledge of a profession, with its specific epistemology and its specific object. The knowledge that will qualify the student for a professional activity and that guarantees the seriousness of his work. On the other hand, a 'knowing how to be', i.e. a knowledge of the human, an introduction to the elements of *humanitas*.

## 5. Conclusions

The pedagogical model presented in this work favors the integral development of the student and considers them as a person constituted by the following dimensions: cognitive-intellectual, volitive, bodily-sensitive, affective-emotional and spiritual dimension.

The 'pedagogy of the common good' is considered an innovative pedagogical theory and generates the common good of education and integral relationship. This pedagogy has its philosophical basis in a personalist anthropology and a realistic epistemology.

This pedagogy also encompasses as part of its educational intention the preparation of students to work in the transformation of the realities of the world and to grow in them a spirit of humanity.

The social values and virtues that are experienced in living an education with a common good perspective are: solidarity, subsidiarity, respect for the dignity of the person, justice, magnanimity, sociability, fraternity, compassion, generosity, civic awareness and commitment, charity, gratitude, truthfulness, equity.

The 'pedagogy of the common good' is a formative proposal that promotes the recognition of otherness, encounter and dialogue. It is also a pedagogy with a human face, in which the relationship of the formator with his students is translated into an attitude of welcome, commitment, recognition and responsibility.

This pedagogy also implies training for the common good, which is concretized in the encounter between teacher and student in situated and collaborative learning environments, facilitated by active methodologies in a formative process that promotes meaningful experiences and the experience of social virtues. An educational experience is meaningful in this context when it is experiential and seeks to transform the interior of the person, thus giving way to a learning that is significant for the student, which makes him modify his inner attitude towards his reality and the one that surrounds him, acting accordingly for the transformation of that reality.

The significant experiences that are favored in the 'pedagogy of the common good' are generated from the intentionality of the teacher's facilitation and with the support of active methodologies used in didactics, among these methodologies are the following: experiential learning, learning based on challenges, research-action, project-based learning, problem-based learning, learning based on relationships.

In this way, every educational experience generated in the context of the 'pedagogy of the common good' throughout the student's formative trajectory involves training them for the common good so that, upon entering the world of work, family and civic life, it is common for them to work in teams, resolve conflicts, think critically to solve problems and possess an attitude of service to build the common good in the context where he or she is, in other words, to be a transforming leader.

## References

- Locatelli, R. (2018). La educación como bien público y común. *Perfiles educativos*, Vol. XI, 178-196.
- UNESCO (2015). *Rethinking education towards a global common good?*. París: UNESCO.
- Sánchez, M, & Medina, J. (Eds). (2021). *Pedagogía del bien común: principios y pilares*. México: UPAEP-UIC.



# CHALLENGES – TOWARDS CONTINUOUS PEER ASSESSMENT IN UNDERGRADUATE PROGRAMMING CLASSES

**Manfred Meyer**

*Department of Mechanical Engineering,  
Westfälische Hochschule - Westphalian University of Applied Sciences (Germany)*

## Abstract

This paper presents a pragmatic approach for stepwise introduction of peer assessment elements in undergraduate programming classes, discusses some lessons learned so far and directions for further work. Students are invited to challenge their peers with their own programming exercises to be submitted through Moodle and evaluated by other students according to a predefined rubric and supervised by teaching assistants. Preliminary results show an increased activation and motivation of students leading to a better performance in the final programming exams.

**Keywords:** *Continuous assessment, peer assessment, formative assessment, competency-oriented exams.*

---

## 1. Introduction and overview

Peer assessment has become quite popular as a means to empower students to take responsibility for and manage their own learning while also learning to assess and provide constructive feedback to peers (Cornell University, 2023). Besides enhancing the effectiveness of learning itself (“assessment for learning”), peer assessment can also serve for activating students as instructional resources for each other.

Computer programming can be regarded as an essential skill for the 21<sup>st</sup> century. Introductory programming courses are thus popular in higher education as part of the foundations of an information technology-related curriculum (Ng, 2012). However, as computer programming is a complex intellectual activity, programming classes are regarded as difficult resulting in often high dropout rates. Therefore, many researchers and practitioners have proposed various methodologies and tools to help students learn computer programming.

In this paper we first discuss the background of undergraduate computer programming classes in general and in our specific case, review some related work on using peer assessment in this context before we present our approach in detail concluded by a preliminary evaluation and a discussion of some directions for future work.

## 2. Background

The difficulties involved in learning how to program have various aspects ranging from the syntax of programming languages that have not been designed for novices to the need for abstraction when developing algorithms and the use of state-of-the-art tools for efficient and effective programming, a competency required in professional software development but rarely taught at university.

Therefore, more than a decade ago, we redesigned our first-year programming courses (GDP1 and GDP2 at our university, internationally often referred to as CS100/101 courses) in a stringent competency-oriented manner. We now strictly focus on the key competencies of (1) understanding a problem statement, (2) modelling the required data and deriving an algorithm to solve it, and (3) implementing and testing the resulting Java program using Eclipse as state-of-the-art Integrated Development Environment (IDE). Additionally, we introduced the social learning platform *Perusall* (Miller, Lukoff, King, & Mazur, 2018) in order to get students better prepared for the lectures, enforce social interaction between peers and leave more of the precious contact time for in-depth discussion of “hard topics” (as identified by Perusall’s “Confusion Report”) and the use of “Just-in-Time Teaching (JiTT)” methods (Camp, Middendorf, & Subiño Sullivan, 2010) like Peer Instruction (Mazur, 1997) or Flipped Classroom (Bergmann & Sams, 2012).

Consequently, in order to ensure the ‘constructive alignment’ of learning and assessment according to (Biggs & Tang, 2011), students are informed from the very beginning of their classes, that it is exactly this competency that is getting tested in the final exams. There are no questions like naming all

primitive data types in Java or transforming a for-loop in an equivalent while-loop, but knowledge about data types or loop-statements is nevertheless essential to solve the given programming exercise.

For the practical classes in the lab, we asked the students to work on the programming exercises in small teams of around four students sharing one table. We also motivated them to continue working in teams off campus and provided additional exercises to take home for training purposes between classes and over the weekends.

Having recognized that those students performed better in the final programming exams who have been learning/training in teams continuously asking for some more exercises or even defining their own training cases, we started investigating how to enforce this type of “peer challenging” more formally and facilitate constructive peer feedback. This we later developed further into a peer assessment approach rewarding bonus points for the final exam in order to activate students and motivate them to take part in this feedback culture.

### 3. Related work

While peer assessment has been successfully employed in a variety of academic disciplines and its use in the classroom in order to increase student engagement by actively involving them in the assessment process has been practiced and researched for decades, there is not much work yet on using peer assessment in programming classes.

Sitthiworachart and Joy (2004) already proposed a web-based peer assessment system in the context of an undergraduate computer programming course. Dolezal, Motschnig, and Pucher (2018) analyze the applicability of peer assessment to smaller exercises at secondary school level and makes recommendations for its use in computer science courses.

Alkhalifa and Devlin (2021) focus on the crucial role that students play in peer assessment, especially on programming students’ perspectives on such practices. They also discuss the students’ expectations and critical issues during development of the peer assessment system.

While in our approach we focus on feedback being given and assessment made by students themselves, Srikant and Aggarwal (2013) discuss the automatic evaluation of computer programs for their potential for large-scale impact. They present a machine learning framework to automatically grade computer programs and claim that it provides a better grading than a simple test-case-pass based grading which we also use in our approach but only as one of many aspects in the grading rubric.

### 4. Our approach

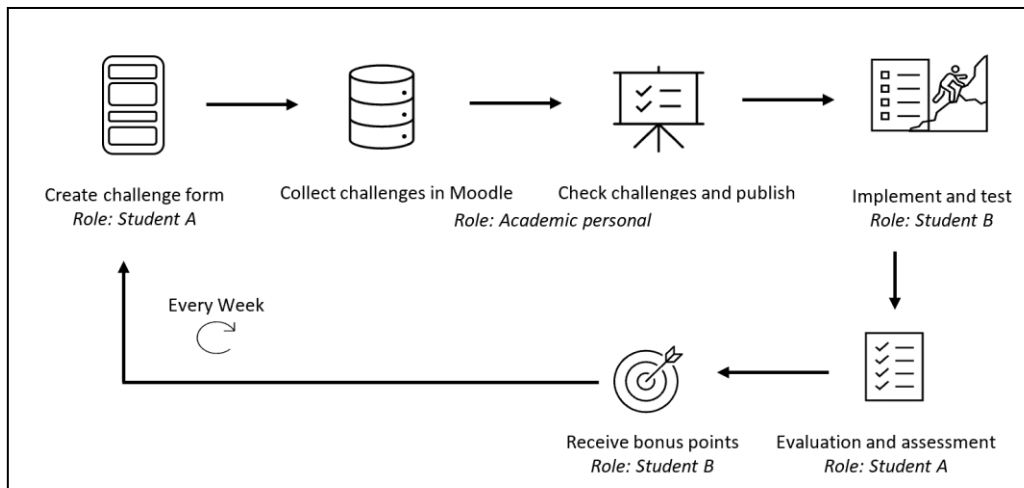
In our programming classes, we introduced weekly ‘challenges’: programming exercises submitted by students to be solved by their peers. They are currently used as continuous formative assessment throughout the lecturing period by which students can collect ‘bonus points’ (for both submitting and solving challenges) which can get credited up to 20% towards the summative assessment, thus reducing stress at the final exam.

As our programming courses have been designed as entirely competency-oriented and constructively aligned classes and exams (exam notebooks provided with IDE and state-of-the-art programming tools), continuously solving challenges provides a perfect training for the final exam. Moreover, by designing and submitting ‘good’ challenges, students demonstrate deeper understanding of the topic while balancing its complexity: a ‘good’ challenge is challenging enough to get solved by many but probably not all students.

The current implementation is integrated into the Moodle LMS where students can submit challenges through a form basically asking for the exercise statement (text) plus Java code template (optional) and test cases (input and expected output). Challenges are then checked by teaching assistants (TAs) for validity and understandability, and selected challenges get presented to all students on Moodle. With the use of the CodeRunner plugin, the provided test cases help students check the functionality of their solution while design aspects etc. are being assessed manually – by the authors of the respective challenge currently still being supervised by TAs for evaluation and ensuring assessment quality and fairness.

While our approach extends usual peer assessment by also asking students to design the assessment (‘challenge’) itself, its introduction in first programming classes also revealed several lessons learned: from student’s participation (acceptance), the need for clear rubrics and prior assessment training to technical issues with Moodle integration. Moreover, the ultimate goal of entirely substituting the final exam by continuous assessment throughout the lecturing period requires substantial changes to the examination regulations. However, preliminary feedback from students shows that the majority (but not all) like this approach both for continuous training for the exam and also for improving their marks by bonus points collected through challenges.

Figure 1. The Peer Challenges Process.



Students are invited to submit so-called “Challenges” in Moodle through a predefined form using the Test feature of Moodle. It comes with five questions (“Frage”) asking for the student’s ID and the estimated time needed for solving the challenge (Frage 1) followed by the detailed introduction to the given exercise and explanation what to do (as plain text, “Frage 2”), a Java code template (“Frage 3”), a sample solution (Java code, “Frage 4”) and concluded by a list of test cases, each consisting of a Java statement and its expected output (“Frage 5”).

Figure 2. Submitting a new Challenge (student’s view).

**Formular: Abgabe der Challenge Nr. 6**

Test Einstellungen Fragen Ergebnisse Fragensammlung Mehr

Student's name:

Status: Beendet

Verbrauchte Zeit: 24 Minuten 27 Sekunden

**Frage 1**  
Schreiben Sie bitte Ihre Matrikelnummer und die nötige Zeit für die Lösung der Aufgabe (in Stunden) (Text)

Student's number:

Lösungszeit:

**Frage 2**  
Schreiben Sie hier die Aufgabenstellung (Text)

Ein Bekannter von dir erzählt, dass er sehr von Pangrammen fasziniert ist. Jedoch stört es ihn, die Sätze die er konstruiert hat, zu überprüfen. Du als Programmierer möchtest ihm natürlich helfen, seine Arbeit zu automatisieren. Deine Aufgabe ist es eine Methode "isPangram" zu erstellen.

Hinweis: Ein Pangram ist ein Satz bei dem alle Buchstaben des Alphabets mindestens einmal vorkommen.

Beispiel: System.out.println(isPangram("The quick brown fox jumps over the lazy dog"));  
output: true;

**Frage 3**  
Hier schreiben Sie die Vorgabe wenn vorhanden (Java Code)

```

static boolean isPangram(String satz) {
}
    
```

**Frage 4**  
Hier schreiben Sie die Musterlösung (Java Code)

```

public static boolean isPangram(String satz) {
    Satz = Satz.toLowercase();
    boolean[] alphabet = new boolean[26];
    for (int i = 0; i < Satz.length(); i++) {
        char c = Satz.charAt(i);
        if (c >= 'a' && c <= 'z') {
            alphabet[c - 'a'] = true;
        }
    }
    for (boolean seen : alphabet) {
        if (!seen) {
            return false;
        }
    }
    return true;
}
    
```

**Frage 5**  
Hier geben Sie die fünf Tests ein

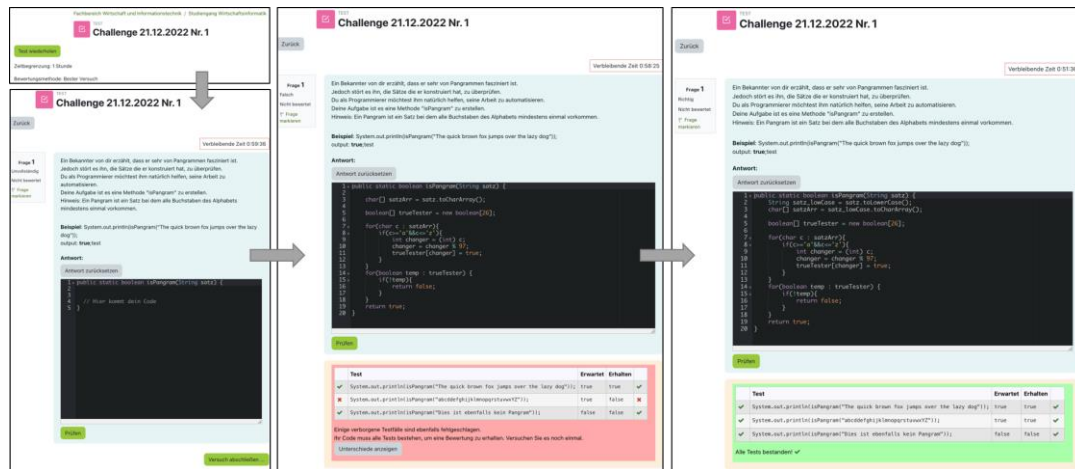
Tests	Input	Output
Test 1	System.out.println(isPangram("The quick brown fox jumps over the lazy dog"));	true
Test 2	System.out.println(isPangram("Das ist kein Pangram"));	false
Test 3	System.out.println(isPangram("The jay, pig, fox, zebra and my wolves quack"));	true
Test 4	System.out.println(isPangram("Dies ist ebenfalls kein Pangram"));	false

Once a challenge is submitted, it gets checked by TAs for correctness and completeness, understandability, appropriate test cases, difficulty and time estimate to solve it. If a challenge passes these checks, it gets published on Moodle, otherwise the student who submitted the challenge gets detailed feedback why it didn’t get published and how to improve for resubmission. Additionally, authors of challenges being published receive up to three bonus points towards the final programming exam.

All accepted challenges - plus some ready-prepared challenges in case there are not enough submissions from students - get published on Moodle on a weekly basis giving students one week to work on them. While students can use any external IDE to develop a solution (Java program), they can also directly use the built-in editor that comes with the CodeRunner plugin for Moodle where students can iteratively work on the code until all visible test cases are being passed and the solution can be

formally submitted. There is no time limit imposed and students may also work on challenges in teams, however solutions can only be submitted by individual students.

Figure 3. Solving a Challenge (student's view).



In the third phase, all submitted solutions to each challenge need to get evaluated. This is done also by students, normally by those who submitted the challenge (author). However, in rare cases students submitted a challenge but did not feel comfortable with also doing the assessment of their peers. In those rare cases, other students are invited to assess.

In order to ensure a fair assessment, a detailed rubric has been developed and all students doing assessments have been instructed beforehand how to apply this rubric to a given student's submission. However, especially in the beginning until students have developed some routine in using the rubric, they get supported by TAs. Table 1 shows the main criteria being addressed by the rubric. For each criterion, points are associated that get awarded to the respective student depending to what extent the criterion is being met.

Table 1. Criteria from the Peer Assessment Rubric.

- correctness (all tests being passed including some additional tests provided with each challenge which are not visible to the students when submitting their solution)
- proper documentation of classes and methods (using Javadoc),
- compliance with coding standards (naming, structure, indentation),
- simplicity and readability (keep it simple!),
- modularity (code structure, use of classes and methods),
- robustness (dealing with incorrect input, use of exception handling)
- efficiency and scalability of the underlying algorithm, if applicable

Thus, students can collect bonus points both by submitting challenges that get selected for publication on Moodle as well as by solving a given challenge and submitting their solution also through Moodle. However, the overall number of bonus points that can be credited towards the final programming exam is limited to 20% in total by our university's examination regulations.

## 5. Evaluation and future work

The peer assessment approach presented in this paper has been applied to first-year undergraduate programming classes (Introduction to Programming 1 and 2, GDP1 & GDP2) within the Business Informatics program at our university (Bocholt campus). At the beginning, we first introduced challenges developed by TAs as additional training exercises. This helped testing the implementation in Moodle using the CodeRunner plugin and also activating students and getting them familiar with the process of submitting solutions through Moodle. The awarded bonus points also helped to motivate students to take part in this experiment. Around mid-term we then started inviting students to also submit their own challenges once a sufficient number of students worked on the given challenges quite regularly.

As expected, students showed to be much more hesitant when it came to developing and designing their own challenges, so it took some weeks and also support from TAs until we received

challenges quite regularly such that most of the challenges presented to the students came from their peers. But still student submissions got evaluated and bonus points assigned by Tas.

It appeared that students didn't feel very comfortable in being involved in the evaluation process and thus it needed some time and clarification of the evaluation criteria and standards. Only towards the end of the term, we were able to complete our peer assessment approach by also having the students themselves doing the evaluation of their peers' submissions and giving constructive feedback.

However, after having overcome this restraint, we now observe a small but constant stream of challenges being submitted. Students have now accepted our approach as an additional means for training for the exams while also earning some bonus points already. As there are up to three times more bonus points awarded to submitting challenges and doing the assessment afterwards than for just solving a given challenge, more and more students do also participate in this core part of our approach focusing not only on the programming training and learning aspect but also on developing analytical and communication competencies when it comes to give constructive feedback to their peers.

Summarizing, the informally gathered feedback from the students is now quite positive and our challenges approach is being accepted by most of the students while some students still hesitate to participate. However, a more formal validation of our approach still needs to be done after the end of the first year. Based on the results we will then derive conclusions on how to improve the process and its implementation in the future.

### *Acknowledgements*

The work presented here is part of a Fellowship on Digital Examinations which the author got awarded by the initiative "Prüfung hoch 3" funded by the Stifterverband through the Friedrich-Alexander-University Erlangen-Nürnberg (project ID: H110 5114 5132 36447). The implementation in Moodle has been developed by Sihem Ould Mohand who also prepared the graphics for this paper.

### *References*

- Alkhalifa, A., & Devlin, M. (2021). Student Perspectives of Peer Assessment in Programming Courses. In *Proceedings of the 2021 Conference on United Kingdom & Ireland Computing Education Research (UKICER '21)*. 8, 1-7. New York: Association for Computing Machinery.
- Bergmann, J., & Sams, A. (2012). *Flip Your Classroom*. Washington, D.C.: International Society for Technology in Education.
- Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University*. Maidenhead: The Society for Research into Higher Education and Open University Press (McGraw Hill Education).
- Camp, M. E., Middendorf, J., & Subiño Sullivan, C. (2010). Using just-in-time teaching to motivate student learning. In S. Simkins, & M. H. Maier (Eds.), *Just-in-time teaching: Across the disciplines, across the academy* (pp. 25-38). Sterling, VA: Stylus Publishing.
- Cornell University, Center for Teaching Innovation (2023). *Peer assessment*. Retrieved March 20, 2023, from <https://teaching.cornell.edu/teaching-resources/assessment-evaluation/peer-assessment>
- Dolezal, D., Motschnig, R., & Pucher, R. (2018). Peer Review as a Tool for Person-Centered Learning: Computer Science Education at Secondary School Level. In M. Auer, D. Guralnick, & I. Simonics (Eds), *Teaching and Learning in a Digital World. Advances in Intelligent Systems and Computing*, 715. Springer.
- Mazur, E. (1997). *Peer Instruction: A User's Manual*. Prentice Hall.
- Miller, K., Lukoff, B., King, G., & Mazur, E. (2018). Use of a Social Annotation Platform for Pre-Class Reading Assignments in a Flipped Introductory Physics Class. *Frontiers in Education*, 3.
- Ng, W. (2012). The Impact of Peer Assessment and Feedback Strategy in Learning Computer Programming in Higher Education. *Issues in Informing Science and Information Technology*, 9.
- Sitthiworachart, J., & Joy, M. (2004) Effective peer assessment for learning computer programming. In *Proceedings of the 9th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education* (pp. 122-126).
- Srikant, S., & Aggarwal, V. (2013). Automatic Grading of Computer Programs: A Machine Learning Approach. In *Proceedings of the 12th International Conference on Machine Learning and Applications (ICMLA)* (pp. 85-92).

## **SYNERGY BETWEEN THE LESSON PLAN AND LESSON PRESENTATION: PRACTICE WHAT YOU PLAN!**

**Mokete Letuka, & Paseka Mollo**

*Department of Educational and Professional Studies, Faculty of Humanities,  
Central University of Technology, Free State (South Africa)*

### **Abstract**

The starting point of every lesson to be presented is a lesson plan. The lesson plan maps out the route that the teacher intends to take in the classroom. At teacher education institutions, student teachers are capacitated to master the skills of lesson planning and the skill of lesson presentation. The aim of this study was to investigate why there is no synergy between the student teachers' lesson plans and lesson presentations during teaching practice. Students map out their teaching on a lesson plan, but what they do in the classroom is not a reflection of the lesson plan itself. As a result, the researchers sought to investigate the reasons for this lack of synergy between the lesson plan and the actual lesson presentation. This qualitative research was conducted through semi-structured interviews. A sample of 20 B.Ed. degree student teachers who are in their third year of study were purposefully selected. The findings revealed that most students do not have high regard for lesson planning. The assessment rubric used to evaluate student teachers' teaching competence during teaching practice does not point out any aspects of the lesson plan. Again, student teachers are unsure of how to implement some of the aspects of the lesson plan template, among others identification of prior learning, values, and attitudes, assessment strategies, and expanded opportunities. The study highlighted the need to put more emphasis on the importance of the lesson plan and implementation thereof. It was also recommended that more marks be allocated for the lesson plan on the assessment rubric.

*Keywords: Lesson plan, correlation, lesson presentation, teaching practice.*

### **1. Introduction**

The Revised policy on the Minimum requirements for Teacher Education Qualifications (MRTEQ), 2015 is a policy that lays out a minimum set of agreed-upon competencies for initial teacher education (ITE) programmes in South Africa (Department of Higher education and Training, 2015). This policy sets minimum requirements for teacher education qualifications aimed at ensuring that the higher education system produces teachers of high quality, in line with the needs of the country. It describes clear, specific requirements for the development of learning programmes, as well as guidelines regarding practical and work-integrated learning (WIL) structure. In this paper, the researchers use the term teaching practice. Teaching practice constitutes an essential part of the BEd programme as is school-based work-integrated learning that is supervised and assessed. It is an approach that harmonizes academic and workplace practices for the mutual benefit of students and their intended workplaces, in most cases the school environment (Mudzielwana, Joubert & Phatudi, 2016). During this teaching practice period, student teachers are provided with opportunities to practice as a teacher, to develop desirable characteristics of a teacher and values in order to display appropriate professional behaviour (Mudzielwana, Joubert & Phatudi, 2016). Student teachers are also presented with a chance to learn different teaching skills and to effectively plan and present lessons that they were taught during lectures at the institutions of higher learning. This is an opportunity for self-evaluation and to discover their strengths and weaknesses through reflection. They are mostly guided by mentor teachers and their lecturers who are tasked to evaluate them and give them reflective feedback on their performances in the classroom (Lombard, 2015).

The effectiveness of a teacher within a classroom environment is realized through the ability to plan lessons correctly. The lesson plan is a guide for the presentation of the lesson, without which the teacher may go astray (Drake & Jackson, 2016). Good lesson planning is an important aspect where teacher expertise exists (Li & Zou, 2017). According to Du Toit (2016:140), there are five basic questions that need to be considered and these are "what I teach; who are my learners; why am I teaching this; how can I teach this and how successfully do I teach

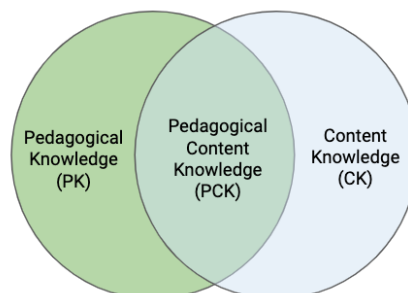
When training student teachers on lesson planning and lesson presentation teacher education institution should ensure that they have the knowledge and understanding of lesson aims and objectives. When formulating aims and objectives, student teachers should know that these should strive to develop the learners holistically. This can be achieved if aims and objectives can include the integration, interrelation, and interconnection between the cognitive domain, psychomotor domain, and affective domain (Drake & Jackson, 2016; Du Toit, 2016).

This is followed by the step on the identification of the major components of teaching and learning which are teacher presentation and learner practice (Drake & Jackson, 2016). Student teachers should know that during this phase they should display their knowledge of the content, the different skills of presenting the content, strategies for interacting with learners, and the ability to interact with different types of learners (Drake & Jackson, 2016; Rusznyak, 2011). The student should meticulously plan learner activities that are in line with the teacher's actions in order to achieve the required objectives. A dissimilarity should be made between guided practice and independent practice activities (Drake & Jackson, 2016). Guided practice activities are those activities that allow learners to demonstrate the application of the new content under the guidance of the student teacher. While independent practice activities are those activities that encourage learner-centered behavior. It allows learners to use the new concepts or skills in a relevant but new context (Drake & Jackson, 2016; Rusznyak, 2011).

## 2. Theoretical framework

The study is framed by Lee Shulman's Pedagogical Content Knowledge (PCK) model (Shulman, 1987). PCK was used because it emphasizes the importance of the three knowledge domains that teachers and student teachers must possess to present successful lessons. The three domains as proposed by Lee Shulman are presented in the diagram below and these are Content Knowledge (CK), Pedagogical Knowledge (PK), and Pedagogical Content Knowledge (PCK) (Shulman, 1987). The knowledge domains that student teachers must possess are explained as follows.

Figure 1. Lee Shulman's Pedagogical Content Knowledge (PCK) model (Shulman, 1987).



### 2.1. Content Knowledge (CK)

This domain refers to the outstanding knowledge of the subject matter that teachers must have to teach. A teacher must have a thorough understanding of the subject matter or content that they are going to teach (Shulman, 1986, 1987; Koehler, Mishra & Cain, 2013). The teacher must have expertise in the subject level that he/she will be teaching; for instance, the subject knowledge of mathematics at primary school, high school, and university differs. According to Shulman (1987: 6), the teacher's "content knowledge should embrace subject concepts, theories used in the subject, relevant philosophies, organizational frameworks, evidence, and proof, as well as reputable tactics and ways of developing such knowledge".

### 2.2. Pedagogical Knowledge (PK)

Pedagogical knowledge refers to a deepened understanding of strategies, methods, and processes that teachers should employ in the teaching and learning of their respective subject specializations (Shulman, 1986, 1987; Koehler, Mishra & Cain, 2013). It involves a thorough understanding of the aims and objectives of a subject, the educational purpose and values of the subject, and the ability to plan activities that will make the learning of the subject easy and making make the subject relevant and enjoyable to learners (Koehler, Mishra & Cain, 2013).

### 2.3. Pedagogical Content Knowledge (PCK)

PCK is about the knowledge and understanding of a subject matter taught, meaning the pedagogy of a specific subject. PCK relates to Shulman's (1986: 4) belief that "real teaching requires an understanding

of both content and pedagogy”. It does not require one to be just a content expert or just a pedagogy expert, but it requires teachers to have the expertise to match content with relevant pedagogy so that effective learning can take place (Koehler, Mishra & Cain, 2013). According to Koehler, Mishra & Cain, (2013,14), this knowledge domain “revolves around the teacher’s ability to properly teach, plan relevant activities for learning, understand the core and hidden curriculum, conduct assessment, and report results of a subject”.

### 3. Research methodology

This study sought to investigate the reasons why student teachers at a university of technology do not synergize their lesson plans with their lessons during teaching practice. A qualitative enquiry which, according to Denzin and Lincoln (2011) involves the study of anything in its consistent environment to attempt to make sense of it regarding the meanings people assign to it, using among others, observations, interviews, and personal experiences, was used to carry out this investigation.

#### 3.1. Data analysis

The explanatory nature of qualitative research is relatively lengthy and more descriptive and leads to the discovery and construction of new meanings, understandings, ideas, and deductions (Delpont and Fouché 2005). Deductions were made and new meanings of the ideas and opinions of the participants when analysing the collected data, were established regarding their challenges pertaining to presenting their lessons in accordance with their lesson plans during teaching practice. Analysis and description of student teachers’ responses were reported by means of rich and thick descriptive explanations which, according to Ponterotto (2006), have to do with lengthy elaborations and interpreting of meanings. The constant comparative method of analysis and interpretation of data was used.

#### 3.2. Data collection

Qualitative data collection techniques were used in this study using semi-structured focus group interviews. A focus group interview is a type of group interview where data emerge from the interaction among participants (Cohen et al 2007). Focus group interviews were conducted with student-teachers in their final year of study. According to Edwards and Hollands (2013), one of the core features of semi-structured interviews is the interactional exchange of dialogue between two or more participants. Dialogues were held with the student teachers to investigate the challenges they encounter during teaching practice, when they plan their lessons as well as present them as planned.

### 4. Results

After the student teachers’ lessons that they presented during teaching practice were observed and compared with their lesson plans, at the realization that there were aspects of the lesson plans that did not come out as outlined on the lesson plans, we decided to investigate the reasons why this was the case.

Students were asked two questions that were coined to bring about an understanding of the reasons for the lack of synergy between their lesson plans and the actual lessons they presented.

#### Question 1

Students were first asked about the extent to which they understand the aspects of the lesson plan, and if they could confidently complete the lesson plan template?

10 students claimed they understood all the concepts that are outlined in the lesson plan, however, some of their responses indicated that they had some misconceptions about some of the aspects of the lesson plan. Five of the students acknowledged that there were some aspects that they were not sure of.

Here are some of the responses by those who claimed to understand the lesson plan in its entirety:

- *“The lesson plan template is easy to fill in and it is understandable”*
- *“The lesson plan template helps me a lot because it makes me aware of all the activities that are expected of me as a teacher”*

Even though these students claim to understand all the lesson plan aspects, one of them, attempting to explain what “expanded opportunities” is, which is one of the aspects on the lesson plan, referred to it as a summary of the lesson where the teacher provides final explanations and remarks to the learners. We deduced from this explanation that students still have misconceptions about certain elements of the lesson plan.

The following are some of the responses from students who acknowledged that there are some elements of the lesson plan that they do not quite understand.

- *“I always struggle with the section that requires me to mention the skills, knowledge and attitudes”*



- “There are many teaching methods listed on the lesson plan template to choose from, but I always select question and answer because I am not even sure what scaffolding method is”.

#### **4.1. Discussion (question 1)**

Most student teachers view the lesson plan template as an understandable and uncomplicated document, and they do not struggle to complete it fully before their lessons. However, findings reveal that some of them have misconceptions about certain aspects of the template and thus do not complete it correctly. This provides evidence that student teachers lacking pedagogical knowledge (PK), as they have limited comprehension of a variety of teaching methods.

#### **5. Recommendations (question 1)**

Subject didactics lecturers must be sensitized about the misconceptions that students have about the lesson plan so that they spend time reinforcing a deeper understanding of the lesson plan.

Lecturers are also encouraged to spend more time facilitating and demonstrating various teaching methods that student teachers are expected to demonstrate competence in.

#### **Question 2**

What challenges are you confronted with during your lessons, that derail or cause you to deviate from what you have planned on the lesson plan template?

This question was coined to elicit responses regarding the actual reasons student teachers do not present lessons as they planned them. These are some of their responses:

- *“Learner discipline and classroom management are the challenges that I mostly face in the classroom during lesson presentation. As learners are the ones rotating, they come late to class and disrupt the ongoing lesson. When learners misbehave in the classroom, they delay the lesson and I end up skipping some points in the lesson due to time wasted”.*
- *“Time, class time is very short, and learners are unpredictable. Sometimes you must spend more time explaining one concept than you had planned, leading to not achieving some of the objectives you stated”.*
- *“Having to discover that the teaching strategies that you are using are not helping the learners to acquire the intended knowledge, now you have to use other strategies within the same period, which puts you under pressure because you won’t get extra time for these new adjustments. Also, sometimes gadgets are used to conduct a lesson and it happens that technical errors arise in the middle of the lesson, now you need to rearrange your lesson in such a way that you can still lead the learners to the objectives they need to acquire”.*

#### **6. Discussion (question 2)**

Most student teachers indicate that they deviate from their plan as outlined on the lesson plan template because of issues related to learner discipline and time constraints. Student teachers in their final year of study are expected to demonstrate high levels of time management as well as competence in classroom and discipline management, but this is not the case.

One of the students indicates that learners are uncooperative and do not participate in class, as well as pretend to understand what is being taught. This is a clear indication of the lack of pedagogic content knowledge (PCK) on the part of the student teachers. Final year student teachers as facilitators and mediators of learning are expected to possess the skills to get learners engaged or involved in the teaching and learning activities, but again, this does not seem to be the case.

#### **7. Recommendations (question 2)**

More intensive pedagogical training is requested to prepare students for both expected and unexpected situations that arise in the teaching and learning arena, such as the management of ill-discipline and the optimal use of time. Students must be intensively trained to become facilitators and mediators of learning equipped with skills to be able to get learners involved in their classroom activities.

## References

- Cohen, L. Manion, L. & Morrison, K. (2007). *Research methods in education*. London: Routledge.
- Denzin, K. N. & Lincoln, S. Y. (2003). *Collecting and interpreting qualitative materials*. London: SAGE.
- Delport, C. S. L. & Fouché, C. B. (2005). The qualitative research report. In A. S. de Vos, H. Strydom, C. B. Fouché and Delport, C. L. S. (Eds). *Research at grass roots: For the Social Sciences and Human Services Professions*. Pretoria: Van Schaik.
- Drake, M. & Jackson, M. (2016). *Lesson planning within a learning-centred context*. In: Okeke, C. Abongdia J, Adu E.O, Vn Wyk M, Wolhuter, C. (Eds). *Learn to teach: A handbook for teaching practice*. Cape Town: Oxford University Press.
- Edwards, R. & Holland, J. (2013). *What is Qualitative Interviewing?* ([http://eprints.ncrm.ac.uk/3276/1/complete\\_proofs.pdf](http://eprints.ncrm.ac.uk/3276/1/complete_proofs.pdf)). Retrieved on 23 August 2022.
- Koehler, M.J., Mishra, P. & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)?. *Journal of Education*, 193(3), 13-19.
- Li, W. & Zou, W. (2017). A study of EFL teacher expertise in lesson planning. *Teaching and Teacher Education*, 66(2017). 231-241
- Mudzielwana, N., Joubert, I. & Phatudi, N. (2016). *Teaching Practice – its purpose and implementation*. In: Okeke, C. Abongdia J, Adu E.O, Vn Wyk M, Wolhuter, C. (Eds). *Learn to teach: A handbook for teaching practice*. Cape Town: Oxford University Press.
- Ponterotto, J. G. (2006). *Brief Note on the Origins, Evolution, and Meaning of the Qualitative Research Concept “Thick Description”*. Fordham University, New York.
- Rusznayak, L. (2011). Learning to explain: How student teachers organize and present content knowledge in lessons they teach. *Education as Change*. 15(sup1), 95-109.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.
- Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-23.
- Temiz, N. 2019. A lesson plan model for character education in primary education. *Educational Research and Reviews*, 14(4). 130-139.

# ASSESSMENT FROM WITHIN – UNDERSTANDING THE KNOCK-ON EFFECT OF TEACHERS’ PRACTICES ON CLASSROOM SPEAKING ASSESSMENTS

**Rúben Constantino Correia**

*Centre for English, Translation and Anglo-Portuguese Studies – Languages, curriculum, and teacher education research strand (Portugal)*

## Abstract

Speaking has been increasingly promoted in language syllabuses and curriculums, both in Portugal and internationally, as one of the major aims of foreign language teaching. Naturally, the importance of oral skills has led to increasing research in this area, with the focus largely on the need to measure ability and the best way to do it. Unsurprisingly, considerable attention has been drawn both to assessment and the context in which it operates. However, the unique features of speaking make it the most challenging skill to assess. Bearing this in mind, and my role as both researcher and teacher with a vested interest in speaking, I spent almost a full school year at a Portuguese public school cluster doing classroom observation in an attempt to chart: a) – typical classroom interactions between learners / teachers and learners / learners, and b) – the general nature of most speaking events taking place in the classroom, including that of assessment. Findings seem to evidence that Portuguese EFL teachers seem to be at odds with designing suitable assessment procedures for monitoring students’ progress. There is a narrow view of assessment as synonymous with testing, and thus the grading function, which largely contributes to the dominance of summative assessment over formative assessment. As a result of such procedures, functions and structures regularly arise with atypical frequency, utterances are exceedingly short and exaggeratedly well-formed; backchannel responses, discourse markers and colloquial expressions are seldom used, and a shared knowledge of context is not assumed. To turn the tables on this state of affairs teachers need to assess with a learning-oriented frame of mind, i.e., to be the link between instruction and what is learned and to promote effective student learning. The vital point when discussing (speaking) assessment is making sure it reflects instruction (frequent opportunities to engage extensively with the language), supports learning, and is meaningful for learners.

**Keywords:** *English as a foreign language, speaking, assessment, learning, learning-oriented assessment.*

---

## 1. Introduction

Learning a foreign language, as a rule, is seen by experts (anthropologists, sociologists and professors/teachers) as a major asset for global understanding and the mobility of people. English is found at the top of the pyramid as the number one language to achieve these goals. Nowadays being able to express oneself proficiently and intelligibly in English is decisive for learner-users who want to thrive both academically and professionally.

The search for more effective ways of teaching English as a Foreign Language (EFL) gave rise to different teaching methods/approaches on both sides of the Atlantic over the past century. From those, the Communicative Language Teaching (CLT) approach emerged as the one adopted by most practitioners, marking “a major paradigm shift within language teaching in the twentieth century, one whose ramifications continue to be felt today” (Rodgers & Richards, 2001, p. 151). CLT argues for genuine communicative exchanges through activities designed to develop the students’ ability to use language appropriately and meaningfully. Naturally, the importance of oral skills in language syllabuses and curriculums grew and led to increasing research in this area, with the focus largely on the need to measure ability and the best way to do it. Considerable attention has, then, been drawn both to assessment and the context in which it operates.

### 1.1. Problem statement

Speaking has unique traits that make it the most distinctive and probably the most difficult skill to assess in classroom-based contexts. Unlike writing, speaking is done spontaneously, greatly restricting the possibility to plan one’s discourse before processing and producing it. Thus, the teacher/assessor has to

judge, in real-time, production and/or interaction related to several aspects of what is being said (range, pronunciation, accuracy, fluency, interaction, coherence). Furthermore, in Portugal the assessment of speaking proficiency faces a major challenge – the reluctance of Portuguese state schoolteachers to address it. Most students studying English at the lower levels (5<sup>th</sup> up to 9<sup>th</sup> graders) are overloaded with grammar instruction and exercises, usually done via course-books, quizzes or worksheets. Clearly, the emphasis given to linguistic competence outweighs that given to linguistic performance, which in turn hinders the students' speaking proficiency and the assessment process itself. Right from day one, Portuguese learner-users are faced with the strict grip of this type of assessment, that of diagnostic assessment, which is a common practice usually done via testing related to their past learning. Theoretically, it aims to ascertain the learner's strengths and weaknesses, although it is the latter that is acted upon by teachers. All their efforts seem to be directed at what the students cannot do. This type of assessment neither does what it is meant to do – identify strengths and weaknesses – nor is it designed as a diagnostic tool. Firstly, it hardly ever covers all the major skills, as speaking is usually omitted and secondly, it resembles an achievement test instead of a diagnostic one. As a result, students are not assessed to check what they can or cannot yet do, but instead are assessed on their understanding of language features from previous years with little or no valid feedback available for students or teachers. The effectiveness of diagnostic assessment is undermined and does not contribute as it should to successful learning.

The root of the problem may lie in the confused nature of diagnostic testing in past and recent literature. Very often diagnostic and placement tests are taken as transposable terms serving the same purposes, when in fact they are not. Brown implies they can be indistinguishable and a placement test can serve the same aim as a diagnostic test (2004, pp. 46, 47). As mentioned above, the latter is supposed to identify strong points and weaknesses, whereas the former is meant to help teachers place their students in a certain proficiency level appropriate to their abilities. Alderson (2007) notes how neglected diagnostic testing is in language testing research: “[...] there is virtually no description, much less discussion, of what the underlying constructs might be that should be operationalized in valid diagnostic tests” (p. 28). In addition to being limited, the information about diagnostic assessment is also rather unclear, leading to multiple interpretations and misconceptions. In the light of such lack of rationale, Blood (2011) suggests that “in the broadest sense, then, diagnostic second language (L2) assessment refers to any L2 assessment practice, whether in the form of a formal written test or informal teacher questioning, that yields diagnostic feedback” (p. 57).

## 2. Speaking's inherent character

Researchers have fairly recently started to dedicate similar attention to spoken language as they did to written language, only to realise that they differ significantly from each other. Unlike writing, where a shared spatio-temporal ground is by definition non-existent, speaking is done in real-time, narrowing greatly the possibility to plan, edit or revise one's discourse before processing and producing it. In addition, the speaker must master and mobilize an array of linguistic knowledge – vocabulary, sound system (segmental features), suprasegmental aspects like stress, intonation and rhythm and language functions – alongside with the kinesics usually related to spoken language, to avoid extensive hesitation or communicational breakdowns. Unsurprisingly, speaking seems to be more challenging than writing, or reading for that matter.

Speaking is broadly characterised by the use of incomplete sentences (known as ellipsis) to avoid unnecessary effort, connected or not with conjunctions, what Luoma (2004, p. 12) conceives of as idea units, short turns between interlocutors together with simple interrogative structures, manipulation of strategies to gain time to speak, such as fillers and hesitation markers, repetitions and rephrasings (to correct, alter or improve what has been said by the speaker who is taking the floor or by previous speakers), fixed conventional phrases and use of informal speech (simpler syntax to make improvisation easier) due to its spontaneity and purposes. These devices are employed to both facilitate speaking and compensate for difficulties that (may) arise. Indeed, disfluencies and consequent repairs are quite natural in spoken language. Spoken language is commonly less lexically dense and fragmented, resulting in a high frequency of pro-forms, incomplete clauses and a low frequency of information-carrying words. The fact that speaking is traditionally an interactional activity contrasts with the detached stance of most writing. While the writer embarks on a solo endeavour, and his/her audience is not present and often is not known, the speaker is directly involved with his/her listener(s), the subject matter and the context. This involvement is marked by the use of first-person pronouns, vocative forms and attention signalling. The set of features presented are intrinsic to the time-bound nature of speaking's processing conditions. The shape and nature of speaking is intimately connected to its socio-psychological processes, which clearly impact on language use and are responsible for most of the differences between spoken and written language.

### 3. Key concepts

Assessment has become a popular but “sometimes misunderstood term in current educational practice” (Brown H. D., 2004, p. 4) and for this reason a distinction between the terms assessment and testing, which are repeatedly used interchangeably, must be made.

Testing is an administrative product-oriented procedure, usually imposed by the teacher, that occurs at specific moments with the purpose of measuring second/foreign language knowledge for scoring and grading. Tests are often a norm-referenced instrument – scores are compared amongst students, used to determine individual ability or demonstrate mastery of a given skill, and offer limited information to identify areas for improvement because they tend to be “one-off” events of speaking proficiency. When a teacher gives a test, he/she is obtaining a narrow sample of the test-taker’s performance in a specific domain that does not account for the progress made (or not) based on that performance. On the other hand, assessment is an ongoing process-oriented approach that takes many different forms. One of these forms are tests. Thus, testing is a subset of assessment and should be seen as one of the many methods available for assessing students’ verbal performance. In view of the limited nature of tests, alternative assessment procedures such as self-assessment, peer-assessment, portfolios, performance assessment, observation, etc., have been advocated by some experts like Shohamy (1997) and Bachman (2002). I prefer to consider these methods, tests included, as simply assessment, preferably when used in an integrated fashion to help improve learners’ speaking skills. Assessment is often a criterion-referenced measurement – students’ performance being compared against a set of criteria, used in educational contexts to monitor students’ strengths and weaknesses. It is operated in a systematic way for the purpose of helping “teachers find out what students are learning in the classroom and how well they are learning it” (Angelo & Cross, 1993, p. 4). Assessments serve as tools to draw inferences that the teachers can rely on about the students’ achievements, and to make the necessary adjustments in the teaching-learning environment, i.e., using assessment results to change practices which in turn assist students to improve their speaking proficiency. In a nutshell, “assessment is the systematic collection, review, and use of information [...] undertaken for the purpose of improving student learning and development” (Banta & Palomba, 1999, p. 4), entailing careful planning, implementing, and acting upon the results. Assessment goes beyond the question how much the students have learned; instead, it asks how they learned and what can be done to improve their learning.

### 4. Assessing with a learning-oriented frame of mind

From the beginning of the twenty-first century, a new framework has steadily gained ground in the field of educational assessment, the learning-oriented assessment approach. This innovative view of pedagogy “holds that for all assessments, whether predominantly summative or formative in function, a key aim is for them to promote productive student learning” (Carless, 2009, p. 80). Hence, whatever form the assessment takes it must be a means of supporting learning and, simultaneously, to acknowledge its centrality. Implementing a learning-oriented assessment approach to speaking “involves the collection and interpretation of evidence about performance so that judgments can be made about further language development” (Purpura, 2004, p. 236) to promote knowledge. Analysing Purpura’s words carefully, we conclude that evidence is the core ingredient of learning-oriented assessments. After being collected from multiple sources, evidence helps teachers to monitor students’ progress, shows students’ acquisition (or otherwise) of what is being taught, and provides meaningful feedback for students and teachers. Carless (2009) summarizes learning-oriented assessment in three simple principles. Bearing these principles in mind, teachers will be able to engage learners in productive assessment activities. “Principle 1: Assessment tasks should be designed to stimulate productive learning practices amongst students; Principle 2: Assessment should involve students actively in engaging with criteria, quality, their own and/or peers’ performance [*sic*]; Principle 3: Feedback should be timely and forward-looking so as to support current and future student learning” (p. 83).

Learning-oriented approaches to speaking should not be concerned only with measuring ability, but also with actual learning of pronunciation (segmental and suprasegmental aspects), vocabulary, language functions, register, turn-taking and breakdowns compensation. Thus, teachers must make sure that learning/assessment tasks represent spontaneous, real-life spoken interaction and target the speaking aspects the learner-users are supposed to use.

### 5. Methodology

The study followed a qualitative approach. It involved observing four different 9<sup>th</sup> grade classes (once a week) for almost a full school year in a combination of an observation scheme supplemented by descriptive linguistics field notes. The observation scheme was adapted from Spada and Fröhlich (1995)

original COLT – Part A and Part B, therefore named COLT PT – Part A and COLT PT – Part B. Besides the scheme, I always took blank sheets of paper to each lesson, allowing abundant space to make various entries about the events taking place inside the classroom.

## 6. Data analysis and discussion

Most of the lessons observed (87%) were teacher-led, either teacher to learner or teacher to class, which also translated in learner's individual work performing the same activity. Only 9% of the lessons were fully learner-led, either learner to learner or learner to class. Yet, it must be stressed that in these occasions, learners were engaged in speaking assessment activities. All of them were asked to do the same activity, being organised once in groups and five times in pairs. Teacher-centred instruction clearly outweighs learner to learner interaction, either in pairs or groups, allowing for few opportunities to engage in sustained speech and thus restricting the learners' possible use of the language. However, I reinforce the term possible because some learners, either by anxiety or lack of proficiency, even if given the opportunity refuse to speak. As for language itself, a strong emphasis continues to be attributed to grammar. Language functions were coded in all lessons but their importance in accurately conveying and/or interpreting meaning was never discussed. In addition, learners spent most of the time restricted to topics, usually determined by the textbook, which apply to the classroom domain and/or their first-hand experiences instead of being prompted more regularly to engage with topics that go beyond their nearest environment (e.g., international events). It would seem that form outweighs meaning and within it grammar is the front runner.

Of special interest for the scope of the study was the category student modality. As it happens, speaking is the least practiced skill. Tellingly, not only is speaking the least coded skill in isolation but also the skill that systematically has a subordinate role when in combination with the rest of the skills. Only once was speaking given the spotlight in instruction. This state of affairs translates in an exceedingly small number of self-initiated turns by the learners and a sparing use of the target language. Although learners are sensitive to turn-taking, they are either left in response mode for most of the time or simply use their first language. When they do use English, learners move back and forth between ultraminimal (one or two words) and minimal (three or more words, long phrases and/or one or two main clauses) speech. Sometimes the difference in coding is truly small, minimal speech could easily become ultraminimal (e.g., "Yes teacher" vs. "I don't know"). Many learners do not go beyond five word stretches of spoken language. Sustained speech (at least three main clauses) was coded in as little as 11 lessons, of which 5 matched up with speaking assessments. I would say this may be the combined result of low proficiency, language-skill-specific anxiety (negative self-confidence and self-efficacy), and the teacher-centred nature of the class.

How exactly, then, do these typical daily lessons influence the general nature of most speaking assessment events taking place in the classroom. First and foremost, teachers seem to be letting themselves be negatively guided by the impact of washback and not by learning. Indeed, most activities carried out reflect summative assessment demands instead of catering to the learners' needs. Yet, it must be said that teachers should not carry all the blame. As a teacher myself, I am no stranger to the pressure of summative assessment, which results in pressure to achieve success percentages projected by school boards. Consequently, set up oral presentations, role-plays, and description tasks with a grading frame of mind instead of a formative one. Adding to the challenge, these often take after the printed word. Learners think and/or discuss amongst themselves, if it involves pairs, in Portuguese and write down their sentences/text in English. This uncharacteristic planning in advance for speaking is followed by plenty of memorisation and rehearsal. As could be expected, learners struggle with their speaking or even come to a halt when they forgot their lines and have to restart their script all over again. Although resorting to speaking, this behavioural pattern does not match the characteristics of spoken language but the printed word instead. In this vein, learners' speech sounds unnatural, bookish, and too formal.

## 7. Concluding thoughts

There is considerable evidence throughout the literature (Swain, 2000) (Oliver, 2009) (Correia, 2021) to demonstrate the significance of spoken production, yet in Portugal extensive speaking occurs mainly as the spin-off of assessment events. More often than not, scripted dialogues are used, which differ significantly from ordinary spoken language – functions and structures typically occur with unnatural frequency; utterances tend to be very short and overly well-formed; backchannel responses, discourse markers and colloquial expressions are seldom used; and a shared knowledge of context is not assumed. Everyday speech rarely generates continuous correct complete sentences, clearly articulated words, and a lack of stance by the interlocutors. Speaking seems to fall through the cracks of the Portuguese EFL

classroom. Complications arise from the preference of accuracy over fluency, form over meaning, and grammar rules over language in use. Naturally, the following question can be raised – how are students supposed to provide extensive chunks of spoken language for assessment purposes, or otherwise, if oral practice is not part of normal lessons? The starting point must, then, revolve around effective oral practice as part of normal lessons and from there to a properly functioning assessment system (learning-oriented assessment), which in turn implies the connection between learning aims (improved proficiency and intelligibility), teaching methods (moving from audiolingualistic pedagogy to CLT principles), and assessment (monitoring of learners' progress and language acquisition whilst providing timely feedback). Perhaps, some input both for pre- and in-service teacher training which takes into consideration the rationale offered should be adopted for improved learner outcomes.

### References

- Alderson, C. (2007). The Challenge of (Diagnostic) Testing: Do we Know what we are Measuring? In J. Fox, M. Wesche, D. Bayliss, L. Cheng, C. Turner, & C. Doe (Eds.), *Language Testing Reconsidered* (pp. 21-39). Ottawa: University of Ottawa Press.
- Angelo, T., & Cross, P. (1993). *Classroom Assessment Techniques: A Handbook for College Teachers*. San Francisco: Jossey-Bass Publishers.
- Bachman, L. (2002). Alternative Interpretations of Alternative Assessments: Some Validity Issues in Educational Performance Assessments. *Educational Measurement: Issues and Practice*, 21(3), 5-18. doi: <https://doi.org/10.1111/j.1745-3992.2002.tb00095.x>
- Banta, T., & Palomba, C. (1999). *Assessment Essentials: Planning, Implementing, and Improving Assessment in Higher Education*. San Francisco: Jossey-Bass Publishers.
- Blood, I. (2011). Diagnostic Second Language Assessment in the Classroom. *TESOL & Applied Linguistics*, 11(1), 57-58. Retrieved from [academiccommons.columbia.edu](http://academiccommons.columbia.edu)
- Brown, H. D. (2004). *Language Assessment Principles and Practices*. New York: Longman.
- Carless, D. (2009). Learning-Oriented Assessment: Principles, Practice and a Project. In L. Meyer, & et al. (Eds.), *Tertiary Assessment & Higher Education Student Outcomes: Policy, Practice & Research* (pp. 79-90). Wellington, New Zealand: Ako Aotearoa.
- Correia, R. C. (2021). *Can We Speak?: Approaching Oral Proficiency in the EFL Classroom*. Unpublished Doctoral Dissertation, NOVA FCSH - Faculty of Social Sciences and Humanities, Department of Languages, Cultures and Modern Literatures, Lisbon. doi: <http://hdl.handle.net/10362/125772>
- Luoma, S. (2004). *Assessing Speaking*. Cambridge: CUP.
- Oliver, R. (2009). How Young is too Young? Investigating Negotiation of Meaning and Feedback in Children Aged Five to Seven Years. In A. Mackey, & C. Polio (Eds.), *Multiple Perspectives on Interaction: Second Language Research in honor of Susan M. Gass* (pp. 135-156). London: Routledge.
- Purpura, J. (2004). *Assessing Grammar*. Cambridge: Cambridge UP.
- Rodgers, T., & Richards, J. (2001). *Approaches and Methods in Language Teaching*. Cambridge: CUP.
- Shohamy, E. (1997). Second Language Assessment. In R. Tucker, & D. Corson (Eds.), *Encyclopedia of Language and Education* (Vol. 4: Second Language Education, pp. 141-149). Dordrecht: Kluwer Academic Publishers.
- Spada, N., & Fröhlich, M. (1995). *Communicative Orientation of Language Teaching Observation Scheme: Coding Conventions and Applications*. Sydney: National Centre for English Language Teaching and Research.
- Swain, M. (2000). The Output Hypothesis and Beyond: Mediating Acquisition through Collaborative Dialogue. In J. Lantolf (Ed.), *Sociocultural Theory and Second Language Learning* (pp. 97-114). Oxford: OUP.

## THE EFFECTS OF THE MIDDLE LAYER ON CHINESE COLLEGE TEACHERS' COMPETENCE MODEL: A META-ANALYSIS

Lei You<sup>1</sup>, Pei-Hua Tsai<sup>2</sup>, & Lung-Hsing Kuo<sup>2</sup>

<sup>1</sup>*Department of Literature and Communication, Hengshui University (China)*

<sup>2</sup>*Center for General Education, National Kaohsiung Normal University, Taiwan (R.O.C)*

### Abstract

In this paper, based on the competence onion model theory, we conducted an integrated study of empirical data in the middle layer of the competence model of Chinese university teachers by means of meta-analysis. A total of 30 previous studies were included, resulting in a total sample size of 16,632 individuals. The result showed that the overall performance of male teachers was better than that of female teachers in the middle layer of the Chinese university teacher competence model, and the average effect size was significant. Furthermore, research showed that among the four dimensions of attitude, values, self-concept, and social role in the middle layer, only the dimension of social role had a significant effect size and indicated that the overall performance of male teachers in this dimension was better than that of female teachers, and the level of superiority was low. The results indicated that there were clear differences in the overall performance of male and female teachers in different regions. The overall performance of the female teachers in North China was significantly better than that of the male teachers, with lower and weaker levels of excellence, while the overall performance of the male teachers in South China was better than that of the female teachers, with lower levels of excellence. The findings provide future researcher with references on the university faculty competency model.

**Keywords:** *Competence, college teachers, middle layer, meta-analysis.*

---

### 1. Introduction

In the onion model of competence proposed by Boyatzis (1982), it was divided from the inside out into personality and motivation layers, attitude, values, self-concept and social role layers, and knowledge and skill layers. The middle layer is crucial in connecting the core and the outermost layers. Even if an individual has great qualifications and can easily learn knowledge and master skills, an individual will still not be qualified for a specific job if an individual does not have the right attitude and values or cannot properly recognize himself or herself and play potential in a team. In the competence onion model, the middle layer played a crucial role in connecting the core layer and the outermost layer. With China's rapid economic growth, a number of studies on the competence of university teachers has been investigated. Therefore, this purpose of this paper was to investigate the intermediate layers of the college teacher competence model in depth.

According to the analysis of the literature, the findings of the previous studies on the competence of mid-level faculty in colleges and universities were quite different. For example, Chen and Wang (2009) pointed out that there was no significant difference between male and female instructors in the three factors of professional attitude and quality, self-regulation, and extraversion. Xu (2011) believed that female teachers performed better than male teachers in the middle layer of the model. Peng (2016) research pointed out that male teachers are significantly higher than female teachers in management ability, agreeable personality, and total score of self-concept. Therefore, this research questions of this paper focused on the following issues:

1. In terms of the middle layer of the competence model for Chinese university teachers, which gender performs better in terms of competence, male teachers, or female teachers?
2. How do male and female teachers perform in the four dimensions of attitude, values, self-concept, and social role respectively?
3. In the analysis of gender differences in the middle layer of the competence model for Chinese university teachers, are the location and geographic division of teachers in China the moderating variables affecting them?



## 2. Literature review

The middle layer of the onion model Boyatzis (1982) includes four dimensions of attitude, values, self-concept, and social role, as the persistent and consistent mental state or personality tendency of individuals to all kinds of people, things, and objects in their work situation based on experience. However, scholars have used different names for these dimensions in their studies. For example, the names of attitude dimensions include career preference (Lin, 2018), work attitude (Meng & Xuan, 2021), service spirit (Qiao, 2019), etc. The dimensions of values include political accomplishment (Chen, 2010), social responsibility (Tian, 2015), work values (Liu, 2019), etc.; the dimensions of self-concept include: self-knowledge (Meng & Xuan, 2021), self-image (Chen, 2018), etc.; the dimensions of the social role are named as interpersonal interaction (Xu, 2011), harmony between teachers and students (Chen, 2010), and teamwork (Chen, 2011). This study first classified and categorized these competency dimensions according to their definitions and the competency characteristic elements they contain, and then extracted empirical research data for in-depth discussion.

## 3. Methodology

In the process of literature collection, the terms "competence" and "university", "university" and "higher vocational education" were put into the searching engine in academic databases of China National Knowledge Network (CNKI), Wanfang, and Baidu, respectively. At the same time, retrospective methods were also used to check the references of critical material to additionally find relevant content. The literature covers a period from June 2006 to July 2021, with a preliminary collection of 936 papers.

In this paper, Comprehensive Meta-analysis (CMA) integrated analysis software was used, and each piece of data information is counted as an "independent event" in the research process, and the "individual effect size" of each content is calculated in a standardized way. Then the individual effect volume as a unit of analysis, and finally the overall effect evaluation (Hedges, 1981). In literature screening, literature with different background data for the study subjects and comparative analysis were all selected, so the effective number of individual studies may be multiple. Chang (2014) believed that in the process of meta-analysis, if type I error  $\alpha = .05$  and type II error  $\beta = .8$  were used in the calculations, and the optimal number of articles to include in the meta-analysis would have been more than 24, with 27 articles eventually included in the present study.

From the literature discussion, the positions of university teachers were related to the competence study of Chinese university teachers and the cultivation of students and are mainly divided into three categories: full-time teachers, counselors and administrators. In terms of geographic division, China is divided into seven regions: North China, Northeast China, East China, Central China, South China, Southwest China, and Northwest China, based on historical and ethnic factors and related geographical division principles. If the included literature is nationally sampled, the relevant data will not be included in the discussion.

A total of 30 articles were included in this study. Quantitative data that met the requirements were selected based on demand, and a total of 57 data items were selected.

The Cochran Q test and  $I^2$  were used as criteria for the homogeneity test. When the Q value reaches the significance level, it indicates the presence of heterogeneity in the literature, which was characterized by the ease of achieving significance as the number of samples increased. Then  $I^2$  value was referred to. Higgins et al. (2003) have pointed out that  $I^2$  values of 25%, 50%, and 75% represent low, medium, and high levels of heterogeneity respectively. Hedges and Vevea (1998) pointed out that the fixed effect model should be adopted if the effect quantity is homogenous. A random effect model is used if heterogeneity is shown in the effect size. The results on the analysis of gender differences in the middle layer of the model, the Q ( $p < .01$ ) value to a statistically significant level,  $I^2$  was 80.684%, indicating that the observed variation was caused by the difference in the effect size, indicating the high heterogeneity of it. Therefore, the random utility model was adopted in this study.

The publication bias test was performed and analyzed with  $N_{f.s.}$  (Classic fail-safe N) values. Tests showed that  $N_{f.s.}$  value was  $198(5k+10)$ , k was the number of studies), which was slightly lower than the tolerance number 295 proposed by Rosenthal (1991). However, considering that the total number of empirical data related to the same type of study in China was already included, the results are within the acceptable range. It can be considered that the weighted average effect size  $g = .063$  was less affected by publication bias. A funnel plot was used to further check the distribution of effect quantity, and the results. Most of the effect quantity is located at the top of the funnel plot on both sides, the overall symmetry phenomenon, a few offsets on both sides of the periphery, and the bottom of the funnel have a small amount of effect quantity.

## 4. Results and discussions

### 4.1. Main effect analysis of gender difference in the middle layer of model

The results of the meta-analysis of gender differences in the middle layer were shown in Figure 2. There were 7,618 males and 9,014 females in the study sample, for a total of 16,632. Among the 57 data, 19 items showed significant individual effects, and 38 items showed no significant individual effect. The overall weighted average effect  $g$  value was .063 ( $p < .05$ ), 95% confidence interval was [.006-.12], excluding zero. The results showed that male teachers perform better than female teachers in terms of the middle of the model in the current research on college teachers' competence. According to Cohen's (1988) explanation of the effect size (if the size is less than .2, it means low effect size; about .5 is a medium effect level; above .8 is considered a high effect size), and the weighted average effect size obtained as a result belongs to the low and weak degree.

Based on the total effect analysis, the group analysis was conducted according to the four dimensions of attitude, values, self-concept, and social role contained in the middle layer. As shown in the table below, the competence performance of male and female teachers is significantly different among all dimensions ( $Q_B = 8.891$ ,  $p < .05$ ). Separately, the competence performance of males in the dimension of the social role is significantly better than that of females ( $r = .158$ ,  $p < .05$ ), and the degree of superiority was low and weak, while the other dimensions are not significant.

### 4.2. Moderator variables

**4.2.1. Teachers' position.** The variation between teachers' positions was not significant ( $Q_B = .441$ ,  $p > .05$ ), indicating that it was not the moderating variable that affects the analysis.

**4.2.2. Geographical Division of China.** There was a lack of data from Northeast China and South China in the literature collection, so it would not be discussed in this grouping analysis. Some data were sampled nationwide without detailed geographical division, so it would not be discussed in this grouping. The results showed that geographical division of China among groups was significant ( $Q_B = 11.641$ ,  $p < .05$ ), indicating that male and female teachers in the middle layer of the model have different performances in different geographical divisions, which also indicates that geographical division of China was the moderator variable affecting the analysis of teacher gender differences in the competence of college teachers. The results showed that the overall performance of female teachers in North China was significantly better than that of male teachers, and the superior level was lower and weak ( $r = -.062$ ,  $p < .05$ ); The overall performance of male teachers in Southwest China was significantly better than that of female teachers, and the superior level was low ( $r = .275$ ,  $p < .05$ ); And in East China, Central China and Northwest China, there was no significant difference between male and female teachers in the overall performance.

The results are close to those of Peng (2016), Zhang (2016), and Lv (2011). In the studies of other scholars, Chen and Wang (2009), Liang (2012), Li (2011), and Qiao (2019) believed that there was no significant difference in the performance of middle layer competence between genders, while Xu (2011), Su (2014), Chen (2015) et al. concluded that female performance was superior to male performance, which was different from the results of this study. In the process of further reference, it was found that although Jiang (2019), Chen Yan (2018), and other literature collected questionnaire data nationwide, the number of research samples were less, which was not in line with Sudman (1983) claimed that on the number of samples (the research object was nationwide, and the sampling number was 1500-2000 people was appropriate), it may affect the results.

## 5. Conclusions

The teachers' position and geographical division of China as the moderator variable to join the analysis can be known: First, teachers' position was not the moderating variable that affects the gender difference analysis in the middle layer of college teachers' competence model. Then, the overall performance of male teachers engaged in the post of counselors was significantly better than that of female teachers, and the superior level belongs to the low degree. As for the Regional division of China was the moderating variable affecting the analysis of gender difference in the middle layer of college teacher competence model. The overall performance of female teachers in North China was significantly better than that of male teachers, and the superior level was low and weak degree. The overall performance of male teachers in southwest China was significantly better than that of female teachers, and the superior level was low degree. In East China, Central China, and Northwest China, male teachers are not significantly better than female teachers, and the highest level of superiority was in Northwest China, which was only a low and weak degree.

## References

- Boyatzis, R. E. (1982). *The competent manager: a model for effective performance*. New York: Wiley Press.
- Chang, S. X. (2014). *Meta-analysis implementation: Using Excel and CMA program*. Taipei: Wunan Book Publishing Company.
- Chen, H. (2010). *Research on the Competence of ideological and Political Theory Teachers in Colleges and Universities* [Doctoral dissertation, Hebei University of Technology].
- Chen, J. (2015). Research on competence Model of Undergraduate counselors in Shaanxi Province. [Master's thesis, Xi 'an Shiyou University].
- Chen, J. W., & Wang, Z. H. (2009). An empirical study on the Competence characteristic structure model of college counselors. *Journal of Higher Education*, 30(1), 84-89.
- Chen, M. (2014). *Research on the relationship between competence characteristics and job Performance of Physical Education teachers in colleges and universities in Fujian Province* [Master's thesis, Fujian Normal University].
- Chen, Y. (2018). *A study on the influence of the Competence of private College counselors on Career Planning* [Master's thesis, Nanchang University].
- Chen, Y. S. (2011). *Research on Performance Evaluation of college counselors based on Competence* [Doctoral dissertation, Nanjing University of Aeronautics and Astronautics].
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2<sup>nd</sup> ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Hedges L. V., & Vevea, J. L. (1998). Fixed-and random-effects models in meta-analysis. *Psychological methods*, 3(4), 486-504.
- Hedges, L. V. (1981). Distribution Theory for Glass's Estimator of Effect Size and Related Estimators. *Journal of Educational Statistics*, 6(2), 107-128.
- Higgins, J., & Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ*, 327, 557-560.
- Jiang, X. L. (2019). Investigation and Reflection on the Competence of young teachers in Western Universities. *Chongqing Higher Education Research*, 7(1), 47-58.
- Li, X. M. (2011). Research on Competence Model of Teachers in Teaching and Research Universities [Master's thesis, Jiangsu University].
- Liang, T. (2012). *A study on the relationship between college counselors' competence-self-efficacy and job performance* [Doctoral dissertation, Wuhan University].
- Lin, H. X. (2018). *Research on the Influence of Performance Appraisal Orientation on the Competence of university teachers* [Master's Thesis, Dalian University of Technology].
- Liu, S. S. (2019). *Research on competence Model and Professional Development of new teachers in Research Universities in China* [Master thesis, Jilin University].
- Lv, C. (2011). *Construction and Application of Competence Model for College Counselors —Take XX University as an example* [Master's thesis, Nanchang University].
- Meng, F., & Xuan, B. (2021). Proactive personality and competence of college psychology commissioners: the mediating effect of autonomy. *Chinese Journal of Health Psychology*, 30(1), 152-156.
- Peng, M. R. (2016). *An empirical study on the competence of double-qualified teachers in Higher Vocational Colleges* [Master's thesis, Jiangxi Science and Technology Normal University].
- Qiao, X. (2019). *Research on construction and Application of competence Model for college counselors* [Master's thesis, Qingdao University].
- Rosenthal, R. (1991). *Meta-analytic procedures for social research*. Beverly Hills, CA: Sage.
- Sudman, S. (1983). Applied sampling. In P. H. Rossi, J. D. Wright, & A. B. Anderson (Eds.), *Handbook of Survey Research* (pp. 145-194).
- Tian, G., & Gao, X. (2015). Research on the Present Situation and Countermeasures of PE Teacher's competence in Colleges and Universities – Take Guizhou Province as an example. *Science and Technology of Sports*, 36(6), 117-118.
- Zhang, M.Z. (2016). *Research on the Competence improvement of university counselors based on team role Theory* (Doctoral dissertation, Southwest University).

# WHAT INFLUENCE DID A DESIGN THINKING, CREATIVE PROBLEM-SOLVING WORKSHOP HAVE ON BEGINNER STUDENT TEACHERS?

**Karen McGivern**

*Business Department, St Mary's University College (Northern Ireland)*

## Abstract

The marketisation of education, globalisation, and the requirement for continuous economic growth, have positioned creativity and innovation as essential components of 21st century education. Creative approaches to learning have been shown to support well-being and promote a culture of continuous improvement which in turn, support the development of prosperous and sustainable, digital economies (OECD, 2019). In terms of teacher education then, creativity and innovation are now regarded as core skills for all teachers (Henriksen et al., 2021). If these skills are seen as being fundamental to societal development, they must therefore be nurtured as a key component of professional learning for teachers. Using a mixed methods approach, this study aims to explore ways in which creative and innovative mindsets can be fostered in student teachers as part of their initial teacher education. Questionnaires and focus groups were used to collect data. Firstly, a first-year cohort of Primary and Post Primary student teachers (n=118) attended an introduction to design thinking and creative problem-solving, 3-hour workshop with the objective of enhancing their creative problem-solving and innovative skills in preparation for school placement. Secondly, a collaborative podcast project with students and lecturers was developed to enhance students' learning experiences and foster creativity. Thirdly, following their school placement, further data were collected to address the extent to which the participants implemented some of the workshop initiatives during their placement. Preliminary findings suggest that the revised approach to teaching and learning can encourage creative, critical thinking and increase student confidence as they develop their competence and practice as teachers. In addition, the data suggest that students favour the more andragogical approach employed in the workshops and podcast development as opposed to traditional, pedagogical modes of teaching and learning. The research provides a strong platform to embed a culture of critical thinking, creativity, collaboration and communication, and in doing so, establish and build collaborative partnerships between education, business and community.

**Keywords:** *Creativity, innovation, critical thinking, pedagogy.*

## 1. Introduction

The marketisation of education, globalisation, and the requirement for continuous economic growth, have positioned creativity and innovation as essential components of 21st century education. Creative approaches to learning have been shown to support well-being and promote a culture of continuous improvement which in turn, have been shown to support the development of prosperous and sustainable, digital economies (OECD, 2019). In terms of teacher education, creativity and innovation are now regarded as core skills for all teachers (Henriksen et al., 2021). If these skills are seen as being fundamental to societal development, they must therefore be nurtured as a key component of professional learning for teachers.

Despite the significant progress made by the economy of Northern Ireland (NI) in the past few decades, it continues to be economically weaker compared to other regions in the UK. Low productivity remains a major obstacle for the growth of income and economic expansion. Similarly, to the rest of the UK, NI has experienced minimal, if any, productivity growth in recent times. The situation was worsened by the financial crisis of 2008/2009, which affected NI more severely than other parts of the UK and has hindered its recovery. (Department of the Economy NI, 2023).

It is clear that the quality of teachers in any society, plays a significant role in economic development and the imperative to prepare young teachers with the necessary skills and creativity to drive innovation in pupils from an early age is crucial to the prosperity of the future of NI. However, anecdotal evidence shared by teacher educators concerning student teachers themselves, would indicate weakened ability to; think and plan creatively; participate in logical risk-taking; autonomously problem-solve; foster

creativity in their lesson planning and subsequently, own students, has compelled the aspiration for this study – what influence did a design thinking, creative problem-solving workshop have on beginner student teachers?

## 2. Literature review

There is a growing body of literature that recognises the importance of creativity and innovation in education. According to Andreas Schleicher, Director for Education and Skills (OECD 2019), tomorrow's schools must focus on developing skills such as critical thinking and collaboration in pupils, help pupils to think for themselves and work with others to cultivate their creativity and critical thinking and through meaningful reflection, transform their ideas into purposeful inquiries and innovative solutions. They must also help pupils understand the limitations of individual and collective action and encourage creative problem-solving. This requires nurturing creativity and encouraging pupils to view situations from various perspectives, to help pupils' transform their ideas into innovative solutions and reflect on their progress.

The OECD Learning Framework 2030 discusses the need for updated teaching approaches in education to meet the changing needs of pupils in the 21st century. This framework identifies three transformative competencies pupils need to thrive and shape the future: creating new value, reconciling tensions and dilemmas, and taking responsibility (OECD, 2019, p.16). This report emphasizes the importance of creativity in developing these skills and suggests that pupils need more opportunities to develop their creative abilities. It also highlights the three different types of skills, including cognitive and meta-cognitive; social and emotional; and practical and physical skills that pupils need to succeed in the modern world. Furthermore, the report discusses how traditional teaching methods often focus solely on cognitive skills such as memorization, neglecting the importance of social and emotional skills like communication and teamwork. It recommends that incorporating project-based learning and collaborative assignments can help pupils develop these crucial soft skills. Additionally, the report accentuates the need for pupils to learn practical and physical skills in addition to academic knowledge, such as coding, design thinking, and environmental sustainability, concluding by emphasizing the crucial role of teachers in adopting updated teaching approaches and creating a classroom environment that fosters creativity, collaboration, and innovation. Despite the emphasis placed on teaching skills that enable pupils to excel in an innovation-driven world, there is scant proof that this has resulted in changes in teaching and learning methods within the curriculum, which is a cause for concern (Vincent-Lancrin, Urgel, Kar & Jacotin, 2019).

The UK Innovation and Skills (BEIS, 2021) defines creativity as the ability to create new and potentially valuable ideas in any activity and defines innovation as the process of transforming these ideas into a commercial reality (i.e., testing, measuring, learning & sharing). Therefore, to secure the future of a small, advanced economy such as NI, it is vital that we enhance the education system to align with contemporary demands and adequately resource it to counter the dwindling investment in skills (Department of the Economy, 2021). From a positive perspective, the General Teacher Council of NI (GTCNI, 2007) has suggested that creativity should be at the heart of education and that the ability to think creatively is crucial for modern education systems aiming to increase the opportunities available to children and young people. Consequently, the Council developed a set of professional teaching competencies, designed to promote creative and innovative approaches to teaching, leading to the development of pupils' creative thinking abilities. This competence framework is used as the basis for all teacher education programmes provided in NI.

According to Tough (1985), an andragogical approach to learning recognizes that adult students have different needs and motivations compared to younger students. Andragogy is a teaching philosophy developed by Malcolm S. Knowles (1970), that is centered around facilitating learning for adults, who are self-directed, have a wealth of life experiences, and are motivated by their own goals and interests. This approach places the pupil at the center of the learning process and recognizes their individual needs and abilities. By doing so, it promotes independent thinking, critical reflection, and active engagement in the learning experience. Knowles' six assumptions of andragogy provide a framework for designing effective learning experiences for adults. These include the need for adults to be involved in the planning and evaluation of their learning, the importance of incorporating their life experiences into the learning process, and the need for self-directed and problem-centered learning. Additionally, andragogy recognizes that adult students are motivated by practical and immediate application of new knowledge and skills, rather than theoretical concept that may not have a clear connection to real-world experiences.

Furthermore, the subject of assessment continues to be a highly delicate and political topic within educational systems. According to Serdyukov (2017) some current assessment and testing methods are stifling creativity within the classroom. Particularly in the competitive secondary school culture that focuses on national examination results is making it difficult for teachers who wish to encourage group work and

innovative idea creation. These teachers are required to prioritize pushing students to do well in traditional national exams, which conflicts with more progressive formative assessment strategies such as peer assessment, self-assessment, and extended project work.

### 3. Methods

Given that the study focusses on the individual experience of beginner student teachers and the development of their thinking in terms of creativity, an interpretative design was employed using a mixed methods approach to the data collection. The study was conducted with Primary and Post Primary students (n=118) in the first year of a four-year Bachelor of Education (BEd) programme leading to qualified teacher status. The first stage of the study set out to consider the influence that a design thinking, creative problem-solving workshop have on beginner student teachers. The purpose of stage 1 was to: understand participants' level of confidence and attitudes to creative design thinking; explore the challenges experienced; understand the extent to which a design thinking, creative problem-solving workshop influences a beginner student teacher. The workshop was a three hour fast paced experiential introduction to design thinking and creative problem-solving processes. It provided the opportunity to rapidly step through the stages of a design thinking process, introducing students to the overall process using a scenario challenge from everyday life. It was team based, and students learned the process and experienced the mindsets required for creative problem solving by running through a full cycle with tight time constraints. Throughout the session students were introduced to several highly interactive, purposeful, quick energizers, which can easily be used in everyday classroom delivery.

The workshop allowed time for students to reflect on their own learning and consider how they might apply this in school. A brief outline of the key learning points were to: gain practical experience in the design thinking process; build curiosity and look past the obvious; build students' confidence in their own creative thinking ability; experiment and get things wrong, learn from mistakes; refine and build actionable solutions; reflection on the process and understand the value of empathy, clarity and creativity in the classroom. Following the workshop, an anonymous semi-structured questionnaire was developed with a range of questions in open, closed and Likert scale formats. The questionnaire was accessible via a QR code, taking the user to a Microsoft Forms survey and was distributed to all who attended the experiential introduction to design thinking and creative problem-solving workshop.

Stage two of the study was intended to explore the extent to which the participants implemented some of the workshop initiatives during their school experience. Following the school placement in February – March 2023, a further questionnaire, similarly designed to the first was sent to all participants. The purpose of this questionnaire was to address the extent to which the students implemented some of the workshop initiatives during school experience. In addition, data were also collected from three focus groups of participants. All students were invited to participate via email communication with 52% response. From this, a random selection was made to create focus groups of six participants each. The key areas for focus group discussion were: participants' level of confidence and attitudes to creative design thinking; challenges experienced; influence of a design thinking, creative problem-solving workshop on a beginner student teacher; impact of implementing some of the workshop initiatives during their school experience, if any. Data were analysed using inductive thematic analysis (Braun and Clarke, 2006; Yin, 2009) to identify the key themes which have resonance to the research question.

### 4. Findings

The first questionnaire was completed by 60 students, a response rate of 51%. Section one consisted of four questions to ascertain: if the participants were enrolled on primary or post primary programme of study; subject specialism studied; gender identification. Sixty-five % of participants were studying on the primary programme and 35% post primary. Seventy-two % of participants selected Female and 28% selected Male in the gender identity question. In Section two, eight questions were asked. Five were designed using a Likert scale to assess the attitudes and views of the participants; three were open ended; and two were multiple choice. The first and second questions were designed to gauge students' level of confidence in the following criteria: understanding the underlying concepts of how to be more creative; ability to apply creativity to their work; creativity in thinking, before and after the workshop. Comparing the two results, 40% of students felt slightly confident in their understanding of the underlying concepts of how to be more creative, 42% were fairly confident, with 13% completely confident. After the workshop, there was a positive shift in data, to 7% slightly confident, 52% fairly confident and 38% completely confident. Thirty-two % of students felt slightly confident in their ability to apply creativity to their work, 42% fairly confident, with 20% completely confident. After the workshop 5% felt slightly confident, 63% fairly confident and 28% completely confident. The third criteria intended to capture students' level of

confidence on how creative they are in their thinking. The results show a positive increase before and after the workshop: 42% felt slightly confident before the workshop, this decreased to 10% after the workshop; 38% felt fairly confident in their creative thinking before the workshop, rising to 70% after the workshop, with the option of completely confident, rising from 7% before the workshop to 15% after the workshop.

Leading on from this, students were asked to what extent during the workshop, did they agree or disagree: they were absorbed; prompted to generate new and varied ideas; worked easily with others; explore different ideas or outcomes; combine their existing knowledge with new insights; use ideas from the workshop in school experience. 83% of students agreed or strongly agreed that they were engaged and absorbed in the workshop, 90% agreed or strongly agreed that they were prompted to generate new and varied ideas, 80% agreed or strongly agreed that they will be able to use ideas from the workshop on school experience. When asked to give one aspect from the workshop that could be used on school experience, a flat coding frame was created to represent students results. Table 1 below highlights the most popular, responses show a high level of choice for the Energiser aspects of the workshop.

*Table 1. One aspect from the workshop you could use on school experience.*

Workshop Theme	% Student Response
Hands up technique - getting attention	3%
Energiser - Fail test - counting and clapping	13%
Energiser - Empty bottle	12%
Energiser - Barber Shop - 'Yes and' and 'Yes but' activity	12%
Empathise - Roleplay - Interviewer, interviewee, notetaker	11%
Energiser - Storytelling through picture cards	12%
Ideation- brainstorm - if I could change this I would...	12%
Prototyping - build a version of your concept to share with others - 3d model design	11%
Voting best ideas - using stickers	2%
Groupwork	10%

The most popular aspects of the workshop that students most enjoyed, was building the prototypes (29%), activities (18%) and working with others (15%). When asked which aspects of the workshop the students did not enjoy, the vast majority of students (58%) stated they enjoyed it all or non-applicable, 12% of respondents felt the workshop was too long and 8% felt uncomfortable interviewing/questioning others. 90% of students indicated that they would like to attend more workshops like this.

The focus of Stage 2 of this study was to understand the extent to which the participants implemented some of the workshop initiatives during their school experience and how participation in a collaborative podcast project influences a beginner student teacher's design thinking, problem-solving skills. There was a 49% response rate from Survey 2. The survey and the focus groups showed that 65% of students used some of the ideas from the workshop during school experience, with the most popular activities, energisers (65%) and prototyping (35%). Focus groups highlighted students desire for more of these workshops, the andragogical approach to learning and the challenges presented to students to learn how to be creative in their thinking.

## 5. Conclusion

The results of this study suggest that the revised approach to teaching and learning can encourage creative critical thinking and increase student confidence as they develop their competence and practice as teachers. In addition, students favor the more andragogical approach employed in the workshops as opposed to traditional, pedagogical modes of teaching and learning, this finding is similar to those reported by Tough (1985). Incorporating andragogical principles into higher education can have numerous benefits for adult students. By recognizing their unique needs and motivations, institutions can create learning experiences that are more relevant, engaging, and effective. Additionally, andragogical approaches to teaching can help adults develop critical thinking and problem-solving skills that can be applied to their personal and professional lives. Incorporating andragogical principles into higher education is an important step toward creating a more inclusive and effective learning environment for adult students. By recognizing their unique needs and motivations, institutions can help these students achieve their goals and aspirations, and ultimately contribute to a more educated and skilled workforce. The most obvious finding to emerge from this study was that a design thinking, creative problem-solving workshop did influence students in their ability to apply creativity and learn design thinking ideas to bring into the classroom, which is encouraging. The majority of students were able to implement ideas from the workshop on their school experience.

The research provides a strong platform to embed a culture of critical thinking, creativity and collaboration and communication to enhance student opportunities of project-based learning experiences, and in doing so, establish and build collaborative partnerships between education, business and community.

Even though GTCNI (2007), emphasises the importance of pupils to think creatively and its centrality in education, focus group findings suggest that the practicalities in the classroom do not seem to be reflecting this. There are several challenges presented, but a good starting point is for teacher educators to consider devoting additional attention to embedding creativity and innovation workshops/initiatives into the curriculum, providing beginner teachers with the skills and competencies to have the confidence to explore creativity and innovation leading to potential improvement in school experience practises, and as graduates. This is a challenging space for Initial Teacher Education providers, but the impact has the potential to be transformative. Teaching creative problem-solving and critical thinking in higher education is essential, but it can be challenging to do so effectively given the varying critical thinking skillsets needed in different disciplines. Nonetheless, all subjects should aim to teach students creativity, innovation and design thinking. Depending on the teaching style and course, different techniques and structures can be utilized in the classroom. Creativity is a key factor that plays a vital role in the development of critical thinking skills, academic achievement, and career readiness. Furthermore, creativity and innovation are critical skills that every beginner student teacher should develop to succeed in embedding a conducive learning environment, encouraging exploration and experimentation, and using teaching methods that support creativity and innovation. By doing so, teachers can prepare students for the challenges of the future and empower them to reach their full potential, it is essential to ensure that beginner student teachers are adequately prepared to become an integral part of the 21st-century workforce, which requires creativity and innovation.

### References

- Braun, V., & Clarke, V. (2012). Thematic Analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA Handbook of Research Methods in Psychology, Vol 2: Research Designs: Quantitative, Qualitative, Neuropsychological, and Biological*. (pp. 57-71). American Psychological Association. <https://doi.org/10.1037/13620-004>
- Department for Business, Energy and Industrial Strategy (2021, July). *UK Innovation Strategy Leading the future by creating it*. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1009577/uk-innovation-strategy.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009577/uk-innovation-strategy.pdf)
- Department of the Economy NI (2023, January 11). *Independent Review of Invest Northern Ireland*. <https://www.economy-ni.gov.uk/sites/default/files/publications/economy/independent-review-of-investni-report.pdf>
- Department of the Economy (2021, September 7). *Skills strategy for Northern Ireland – Skills for a 10x economy*. <https://www.economy-ni.gov.uk/consultations/skills-strategy-northern-ireland-skills-10x-economy>
- General Teaching Council for Northern Ireland [GTCNI] (2007) *Teaching: The Reflective Profession*. <https://gtcni.org.uk/professional-space/professional-competence/teaching-the-reflective-profession>.
- Henriksen, D., Creely, E., Henderson, M., & Mishra, P. (2021). Creativity and technology in teaching and learning: A literature review of the uneasy space of Implementation. *Educational Technology Research and Development*, 69(4), 2091-2108. Doi: 10.1007/s11423-020-09912-z
- OECD (2019). *Future of Education and Skills 2030. Conceptual learning framework: Learning Compass 2030*. [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/OECD\\_Learning\\_Compass\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/OECD_Learning_Compass_2030_concept_note.pdf)
- Serdyukov, P. (2017). Innovation in education: What works, what doesn't, and what to do about it? *Journal of Research in Innovative Teaching & Learning*, 10(1), 4-33. doi:10.1108/jrit-10-2016-0007
- Tough, A. (1985). Review of Andragogy in Action: Applying Modern Principles of Adult Learning, by M. S. Knowles. *The Journal of Higher Education*, 56(6), 707-709. <https://doi.org/10.2307/1981081>
- Vincent-Lancrin, S., Urgel, J., Kar, S., & Jacotin, G. (2019, March 5). *Measuring Innovation in Education 2019*. [https://www.oecd-ilibrary.org/education/measuring-innovation-in-education-2019\\_9789264311671-en](https://www.oecd-ilibrary.org/education/measuring-innovation-in-education-2019_9789264311671-en)



## TLM (THREE LAYERS METHODOLOGY) MODEL FACING MULTIDISCIPLINARY EDUCATION

**Limor Sahar-Inbar<sup>1</sup>, & Nava Shaked<sup>2</sup>**

<sup>1</sup>*Industrial Engineering and Technology Management, HIT Holon Institute of Technology (Israel)*

<sup>2</sup>*School of Multidisciplinary Studies, HIT Holon Institute of Technology (Israel)*

### Abstract

One of the main challenges in education today is the need to adapt processes to the multidisciplinary world in which cross-domain communication is essential. Therefore, in this setting, education has to bring teachers and students from various backgrounds to work together, to develop a mutual language and synergistic teamwork and clear added value. These important challenges have gained only little attention by scholars to date. In our School of Multidisciplinary Studies, students who attend classes are from different departments and speak different professional languages. To address these challenges, we have created and implemented the TLM- Three Layers Methodology model, guided by the research question: how to assess and enhance teaching and learning within a multidisciplinary framework. Or, in other words, what educational processes need to be improved, developed and evaluated. In this research, we present the TLM model as we put to practice in our Multidisciplinary School at our institution, in which the curriculum includes courses in technology, the humanities and social sciences, community-engaged learning and entrepreneurship. Furthermore, teaching methods range from lectures to project-based learning courses (PBLs), to workshops in design of technological Proof of Concept (POCs). The research presents a program aimed at initiating processes of connection between faculty teams and promoting the quality of teaching for students, from a multidisciplinary point of view. The program is based on a holistic, innovative process that includes three layers: Peer Learning, Peer Review and Teaching Evaluation. The TLM model is groundbreaking both from an academic practical perspective and from a research perspective, while creating synergy and mutual relationships between its layers. It highlights the changes in teaching and learning patterns, the introduction of new digital tools, and unique Generation Z approach. In this article, we will present the process conducted, the evaluation study and implications.

**Keywords:** *Multidisciplinary, active learning, peer review, peer learning, teaching evaluation.*

---

### 1. Introduction

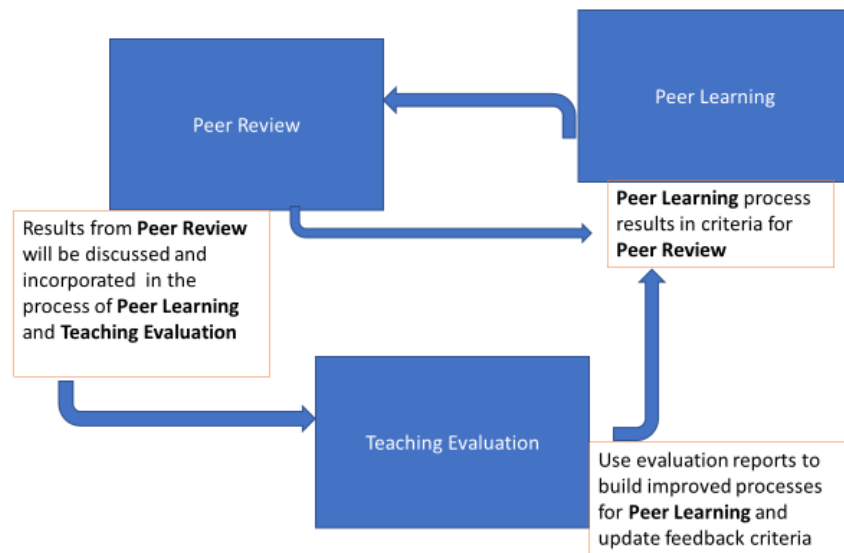
The School of Multidisciplinary Studies at the Holon Institute of Technology (HIT) was established in 2018 as a department and later developed into a school with an updated structure in 2021, providing a unique format in Israel higher education. This format enables the utilization of assets found in the academic institute and the knowledge and abilities of each faculty. The school empowers faculties and fills gaps needed for students' next steps in industry, performing cooperation at the international level with similar applied universities and institutions. The school aims to establish an ecosystem different from the landscape of higher education, with multidisciplinary discourse between lecturers and students. The school offers four different content components within the bachelor's degree curriculum, essential for every graduate of the institution, such as Humanities and Social Sciences, Integrated Technologies, Community-Engaged Courses, and Entrepreneurship and Innovation. The school developed an up-to-date teaching methodology with a diverse team of leading lecturers from different disciplines who collaborate in both teaching and research. Project-based courses that connect two fields of knowledge are taught, requiring entrepreneurial and multi-layer outside-the-box thinking. Teaching at the school integrates academia, industry, and society, requiring the construction of different quality control systems adapted to the study material, nature of the courses, and diverse mix of students and lecturers.

## 2. Motivation & rational of the model

The purpose of the program described in the article is to enhance and leverage the quality of teaching within a unique ecosystem of a multidisciplinary school. It is utilizing an innovative and distinctive methodology based on an integrated process. In response to the changes brought about by the COVID-19 pandemic in 2019, including digital and asynchronous advancements, the school successfully conducted a Peer Review process. The purpose is to monitor the quality of teaching under the new conditions of a unique and distinct study program, different from the students' core faculties. Based on this process, and accompanied by research, a set of recommendations was formulated to improve online teaching within a multidisciplinary framework, promoting interactive communication among students from diverse fields. This is how the "**Three Layers Methodology (TLM) Model**" was developed.

To clarify, this article aims to outline the conceptual framework of the model. In practice, more information and assessment tools were developed and used in an iterative process that resulted in several layers of finding, conclusions and feedback which could not be included in this article format. The work plan consists of three layers that complement each other methodologically and practically: **Peer Learning, Peer Review, and Teaching Evaluation**. Figure 1 shows the TLM model layers ecosystem.

Figure 1. The TLM models layers ecosystem.



The three levels of the TLM model are interdependent, creating a comprehensive model that highlights their mutual contribution to the advancement of teaching and learning. **Peer Learning** aims to synchronize different areas of knowledge, promoting mutual fertilization and cooperation. Based on the trust and dialogue developed during Peer Learning, we have developed a **Peer Review** process that improves teaching quality and enhances the students' learning experience. Through formative evaluation, we focus on real-time change through ongoing feedback provided by the teachers themselves, promoting personal development and best practices. Finally, to provide a comprehensive and conclusive picture, we conducted a **Teaching Evaluation** process using both external and internal assessment tools.

### 2.1. Peer learning

According to Topping (2005), Peer Learning can be defined as the process of acquiring knowledge and skills through active assistance and support among individuals who share equal status or are matched companions. In our case, Peer Learning occurs when a group of lecturers get together to discuss or study a common topic to develop their pedagogical and personal abilities. In addition, the goal of Peer Learning is to create synchronization between the various fields of knowledge for the purpose of mutual fertilization and cooperation both at the level of curricula and for research purposes, similar to peer review process (Shortland, 2010). Based on Topping (2001), several aspects need to be considered when planning peer learning. These aspects are applicable not only to students' peer learning as discussed in this article, but also in the context of teacher peer learning. These considerations include:

1. Identification of specific problems and opportunities that need to be addressed within the given context.
2. Clear definition of objectives, outlining what is hoped to be achieved through the peer learning process.
3. Determination of the participants who will be involved in the peer learning.
4. Selection of the appropriate method to be used for facilitating the peer learning.
5. Consideration of frequency, duration, and location of interactions that will take place during the peer learning process.
6. Identification of the necessary resources that will be required to support the peer learning activities.
7. Assessment of whether any training is necessary to enhance the effectiveness of the peer learning.
8. Definition of what will be assessed and the methodology to be used for the evaluation.

After carefully considering these aspects, we successfully planned and implemented our Peer Learning program. Here are examples of the activities conducted as part of the Peer Learning process:

- Round table open discussions where participants openly addressed common needs and issues.
- Brainstorm sessions to generate innovative solutions.
- Sharing and analyzing case studies to deepen understanding.
- Conducting workshops and joint training sessions focused on providing tools for enhanced teaching practices.

These activities facilitated an open dialogue among lecturers allowing speakers to articulate their thoughts, emotions, and opinions regarding various topics. The aim was to foster a collaborative and supportive environment that encouraged active engagement and knowledge sharing.

## **2.2. Peer review stage**

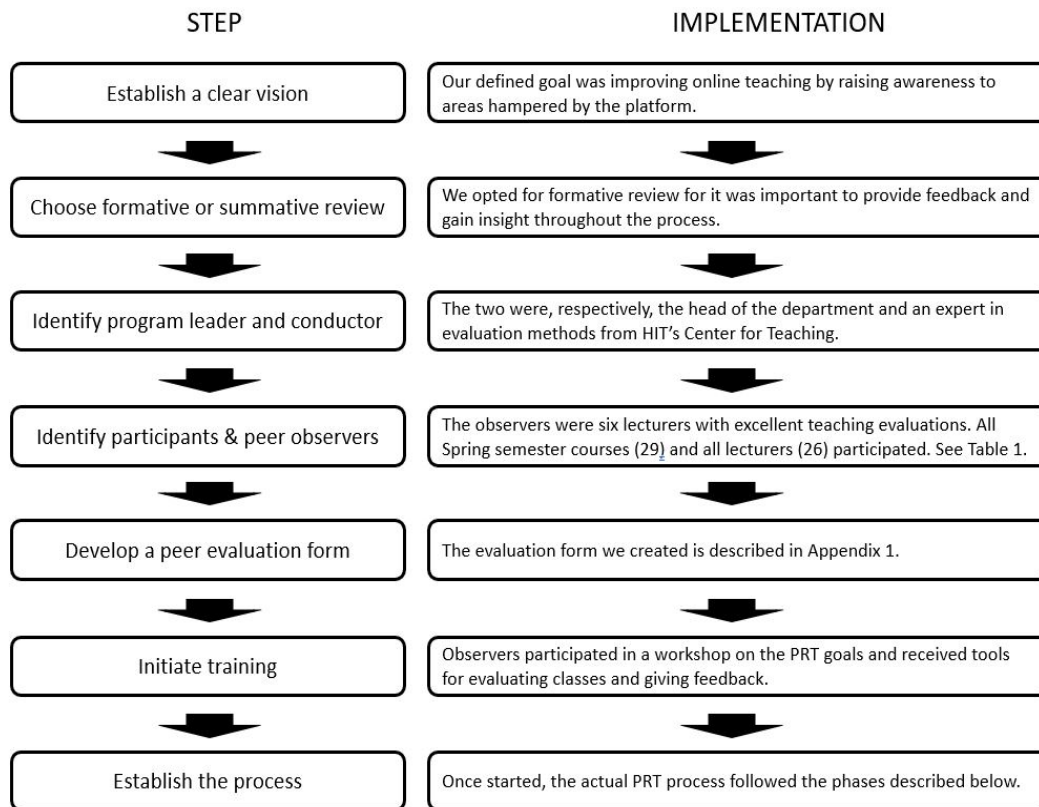
The Peer Review process is designed to improve the quality of teaching and enhance the learning experience of students through formative assessment. The focus is on improving processes through feedback in real time, with the aim of promoting development and improving quality. This approach is different from summative assessment, which mainly measures results (Shortland, 2004; Shortland, 2010). The Peer Review process was implemented during the COVID-19 restrictions period, and after drawing conclusions and insights, it was integrated into the overall TLM model to promote effective teaching, learning, and assessment.

**2.2.1. Planning & execution of peer review.** Guided by the aforementioned insights from the literature and an exploratory research, we consulted several approaches to the implementation of a peer review process. According to the literature, a meaningful peer review of teaching (PRT) should include concrete review experience, reflection and recommendation (Donnelly, 2007; Drew & Klopper, 2014). In this sense, a peer review is a flexible process whose success is not achieved solely by the actual observation by colleagues. For it to succeed it requires analysis of observed classes under criteria that observers may elaborate, and most importantly, by the communication between the observer and the observed peers, which would encourage an effective implementation of the review. Webb and McEnerney (1997) developed a set of steps to a successful formation of PRT that gave us conceptual foundations. In formulating our own PRT we mainly followed Torbeck and Dunnington (2021), who offered a shorter sequence of steps, adjusting them to the specific circumstances of a multidisciplinary ecosystem. Figure 2 describes our implemented sequence of the Peer Review of Teaching (PRT) formation, as designed for a multidisciplinary context.

These preparatory steps laid the ground for the actual Peer Review process conducted in three cycles. The population of participating observers in all cycles was a total of 44 (26 male, 18 female) and the total observed lecturers in all cycles was a total of 16 (7 male, 9 female).

Establishing the peer review process in practice was carefully designed procedure making sure that Lecturers' consent was obtained through enrolment and explanation of the process. The school courses were assigned to observers and each observer watched and evaluated classes using an evaluation form and then gave individual feedback to each participant. Observers reported their overall assessment, and summarized their experience which allowed them to generalize from their accumulated experience, and thus to provide useful input on common challenges and flaw. The head of the project analyzed the data and conclusions were shared with all staff.

Figure 2. PRT Formation Sequence.



**2.2.2. Assessment of the peer review feedback.** To fully assess the efficacy of the entire process, it was important for us to understand the perspective of the lecturers observed. We formed an online reflection questionnaire to be filled out by the observed lecturers in which they could voice their experience of being reviewed by peers. The reflection questionnaire, which was both quantitative and qualitative, was conducted about a month after all individual reviews between peers – an observer and an observed lecturer – had been communicated. This time period gave lecturers sufficient time for reflection on the review process and its efficacy, as the feedback they received could raise awareness to weaknesses and strengths, enabling them to put into practice suggestions for improvement of their online teaching.

**2.2.3. Discussion and evaluation.** Following the implementation of the methodology along its three steps, the data collected allowed us to better understand the pros and cons of online teaching in the school. We learned about each lecturer's shortcomings that required improvement, as much as their skills and strengths. Furthermore, we could gain a general picture of common challenges that lecturers are confronting, both technical and pedagogical, based on the data analysis.

In light of the common themes that emerged from the analysis, we formulated a set of recommendations for enhancing teaching in a multidisciplinary setting, which were communicated to the academic staff of the department.

### 2.3. Teaching evaluation

The evaluation process encompassed both external and internal control tools, providing a comprehensive summative evaluation aimed at delivering feedback at the end of the learning process. The objective was to assess the students' satisfaction of the learning processes. The aim was to provide a comprehensive overview of the learning experience, covering both the achievements of the students and the quality of the teaching and feedback provided.

A dedicated teaching evaluation questionnaire was created based on the institutional evaluation questionnaire, which contains parameters based on the dimensions of good teaching (SET), such as lesson organization, clarity, interest, attitude towards students, student involvement, and general satisfaction with teaching. This questionnaire can predict the effectiveness of teaching, as shown by Marsh (2007). The next stage is to include other relevant dimensions related to non-verbal behavior of lecturers, such as eye contact, movement in space, monotonous speech, and gestures. These dimensions have been shown to

be relevant and predict satisfaction with teaching, as demonstrated by Babad, Sahar-Inbar, Hammer, Turgeman-Lupo, & Nessim (2021). They are particularly relevant the Multidisciplinary courses. Different types of questionnaires will be built according to the different variety of existing courses and different teaching methodology. In addition, external teaching evaluation tools will be used. The teaching evaluation questionnaire, based on SET indicators, is delivered every semester by the institution. This questionnaire will provide a control and feedback tool for the peer learning and peer review process.

### 3. Discussion & conclusion

We consider the TLM model to be of great significance and believe that it can have a positive impact on the teaching, learning, and evaluation process not only in our institute but also in other faculties and academic institutions facing similar challenges. This methodology can be particularly relevant to programs where multidisciplinary studies are encouraged or required, whether within departments or between different faculties. Furthermore, our approach can serve as a model for implementing a peer review process in various settings, such as K-12 schools and the corporate world. Additionally, the quality control program has the added benefit of fostering dialogue between researchers from different fields, strengthening the academic vision, and enhancing the relationship between faculty members.

In conclusion, this program was developed with the understanding that assessing teaching is a crucial element in academic teaching today, particularly in light of the changes occurring in teaching and learning, the introduction of new digital tools, and unique teaching methods. The unique feature of our model is that, despite the diversity and differences in courses in our multidisciplinary ecosystem, clear criteria for quality and success can be applied while still allowing room for creative thinking and academic freedom. Finally, beyond addressing the challenges, we have also benefited from unintended outcomes, such as fostering dialogue between scholars from diverse disciplines and improving interconnectedness among faculty members. Thus, this program is groundbreaking both in the practical academic sense and in the research sense.

### References

- Babad, E., Sahar-Inbar, L., Hammer, R., Turgeman-Lupo, K., & Nessim, S. (2021). Student evaluations fast and slow: it's time to integrate teachers' nonverbal behavior in evaluations of teaching effectiveness. *Journal of Nonverbal Behavior*, 45, 321-338.
- Donnelly, R. (2007). Perceived impact of peer observation of teaching in higher education. *International journal of teaching and learning in higher education*, 19(2), 117-129.
- Drew, S., & Klopper, C. (2014). Evaluating faculty pedagogic practices to inform strategic academic professional development: A case of cases. *Higher education*, 67, 349-367.
- Marsh, H. W. (2007). Students' evaluations of university teaching: Dimensionality, reliability, validity, potential biases and usefulness. In R. P. Perry, & J. C. Smart (Eds), *The scholarship of teaching and learning in higher education: An evidence-based perspective* (pp. 319-383). Springer Dordrecht.
- Shortland, S. (2004). Observing Teaching in HE: A case study of classroom observation within peer observation. *International Journal of Management Education*, 4(2), 3-15.
- Shortland, S. (2010). Feedback within peer observation: Continuing professional development and unexpected consequences. *Innovations in Education and Teaching International*, 47(3), 295-304.
- Torbeck, L., & Dunnington, G. (2021). Development of a peer review of operative teaching process and assessment tool. *The American Journal of Surgery*, 221(2), 263-269.
- Topping, K. J. (2001). *Peer assisted learning: A practical guide for teachers*. Cambridge, MA: Brookline Books.
- Topping, K. J. (2005). Trends in peer learning. *Educational psychology*, 25(6), 631-645.
- Webb, J., & McEnerney, K. (1997). Implementing peer review programs: A twelve step model. *To improve the academy*, 16(1), 295-316.

# QUALITY OF ONLINE BIODIVERSITY SUMMATIVE ASSESSMENTS ADMINISTERED TO STUDENT TEACHERS AT A SOUTH AFRICAN UNIVERSITY

**Kholofelo Makgopa, & Monde Kazeni**

*Department of Science and Technology Education, University of the Witwatersrand (South Africa)*

## Abstract

Summative assessments are often used to make high stake decisions about students' academic success, which have long-term implications for both students and their respective institutions. Therefore, these assessments need to be of high quality to ensure that they yield accurate, objective and dependable results, upon which valid decisions could be made. The use of online assessments, where most lecturers have little experience and students have control of the assessment environment could compromise the quality of summative assessments. This is particularly true for Biodiversity assessments, which are complex. There is dearth of literature on the quality of online Biodiversity summative assessments in the South African context. This qualitative case study was conducted to determine the quality of online Biodiversity summative assessments administered at a South African university. The LINQED Quality Assurance Framework for Student assessment guided this study, which involved a review of eight online Biodiversity summative assessments administered to student teachers. Quality was measured by determining the content validity, authenticity, alignment with course objectives and the cognitive levels at which the assessments were pitched. The reviewed assessments were found to have high content validity and alignment to course objectives, but had poor coverage of the content and course objectives. In addition, the assessments were pitched at low cognitive levels and they had low to moderate authenticity. While these findings are based on a small sample, they could signify a global phenomenon. We therefore recommend further research, involving a bigger sample, to determine the recurrence of the findings from this study.

**Keywords:** *Summative, assessments, Biodiversity, online, student teachers.*

---

## 1. Introduction

Educational institutions have a mandate to educate, transform and train students in their respective fields of study (Shukla & Dungsungnoen, 2016). In this regard, assessments play a major role of collecting evidence about students' competencies and learning progress. Assessment, in the context of this study refers to the process of tracking students' learning progress, grading and providing students with feedback (Oyinloye & Imenda, 2019). Summative assessments are used to evaluate students' learning progress, skills acquisition, and academic achievement at the end of a defined instructional period. This type of assessment often takes the form of examinations, assignments, projects, or end of block tests, which are often used to make high stakes decisions about students.

Despite the high-stake decisions associated with summative assessments, literature (States, Detrich & Keyworth, 2018) shows that most summative assessments do not provide accurate and dependable results for making important decisions about students' lives, because of the way they are designed. This is particularly true for assessments in the Life Sciences topic of Biodiversity, which is difficult to assess (Sadler et al, 2013). This difficulty was exacerbated in South Africa in 2020 and 2021, when learning institutions were abruptly forced to administer assessments online, due to the COVID-19 pandemic. At this time, online teaching and assessment were relatively new to most educational practitioners in South Africa. Therefore, assessors might have simply developed online summative assessments that were easy to design and grade, such as items that only measure factual knowledge (Junus et al, 2021), hence lowering the quality of assessments.

Low quality online summative assessments are predisposed to cheating by students, who can easily copy answers from the internet, textbooks, class notes, or by consulting knowledgeable others (Junus et al., 2021). This implies that online summative assessments might not assess students'

competencies accurately, and these students would progress to the next educational level or to the corporate world with inadequate knowledge and skills. The purpose of this study was therefore to establish the quality of online Biodiversity summative assessments administered to student teachers at lower (first-year) and higher (Honours) educational levels at a South African university. Student teachers are students who train to become teachers. The study question was: What is the quality of online Biodiversity summative assessments administered to first-year and Honours student teachers at a South African university?

## **2. Conceptual framework**

The quality of assessment is measured using different parameters, but this study focused on the measurements of content validity, authenticity, alignment with course objectives and of the cognitive levels at which assessments are pitched. The selection of these quality measures was guided by the LINQED Quality Assurance Framework for Student assessment (Educational network LINQED, 2011), which include fitness for Purpose (alignment with course objectives and content), authenticity and cognitive complexity. These assessment quality measures have been used in many studies (Gareis & Grant, 2015; Kabombwe, Machila, & Sikayomya, 2021). Measurement of assessment alignment with course objectives involves relating assessment items to the objectives specified for the course under review, while measurement of content validity involves matching assessment items with course content (Gareis & Grant, 2015). The revised Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001) has been used extensively to determine the cognitive levels at which assessment items are pitched (Kabombwe, Machila, & Sikayomya, 2021; Anees, 2017). The measurement of assessment authenticity, which denotes an assessment's applicability to real-life situations has often involved the use of Wiggins' framework for authentic assessment (Wiggins, 1990). These measurement methods were employed in this study.

## **3. Methodology**

The study was a qualitative case study involving the review of eight Biodiversity examination papers, comprising of four main and four deferred examination papers, administered to first-year and Honours student teachers in 2020 and 2021, at a South African university. Main and deferred examination papers were reviewed per year and per level of study to triangulate the results of the review. Moreover, assessments from two educational levels (1<sup>st</sup> year and Honours) were reviewed to determine whether there was a difference in the quality of Biodiversity assessments administered at lower and higher educational levels.

During the review, each assessment item was examined by three raters independently, to determine its alignment with the stated assessment quality measures. Raters then determined the frequency of each assessment quality measure, in each examination paper. To analyse the collected data, average frequencies (from the three raters) of each assessment quality measure per assessment paper were determined. These frequencies were computed into percentages and presented on tables.

Data collection schedules were developed by the researchers and were independently reviewed by two Life Sciences lecturers. The schedules were piloted using summative assessment papers that were not part of the main study. This was to ensure that the schedules captured the intended information. Furthermore, the study was approved by the participating institutions' ethics committee.

## **4. Results**

As alluded to earlier, assessment quality was determined by measuring the assessment papers' content validity, alignment with course objectives, cognitive levels of the items, and their authenticity.

### **4.1. Content validity of online Biodiversity summative assessments**

The content validity of the summative assessments was determined to find out whether the assessments had a good representation of all the Biodiversity constructs prescribed for the courses (Webb, Katz & Decker, 2006). To determine the content validity of the assessments, prescribed topics for both first-year and Honours Biodiversity courses were listed, and items from the respective summative assessment were matched against these topics. The assessment items were then categorized as either 'based on' or 'not based' on the stipulated topics. Percentages of items that were 'based on' the prescribed topics were determined and converted into content validity indices (CVI). The results of these computations are presented on Table 1 below.

Table 1. Content validity of online Biodiversity summative assessments.

Year	Assessment type	First-year				Honours					
		*T 1 (%)	T 2 (%)	*NA (%)	CVI*	T 1 (%)	T 2 (%)	T 3 (%)	T 4 (%)	NA (%)	CVI*
2020	Main	49	48	3	<b>0.97</b>	87	0	0	0	13	<b>0.87</b>
	Deferred	39	47	14	<b>0.86</b>	100	0	0	0	0	<b>1</b>
2021	Main	69	25	6	<b>0.94</b>	75	17	0	8	0	<b>1</b>
	Deferred	69	21	10	<b>0.9</b>	75	0	0	0	25	<b>0.75</b>

\*CVI - represents Content Validity Index \*T - represents Topic \*NA - represents 'Not aligned' to any topic

The results on Table 1 show that all the online Biodiversity summative assessments were content valid, as they had CVIs of more than 0.7, which is considered to be high (Polit & Beck, 2006). However, the Honours assessments did not have a good coverage of the prescribed topics, as the assessment items were mainly based on one topic out of four: Biodiversity and climate change.

#### 4.2. Alignment of online Biodiversity summative assessments with course objectives

The alignment of summative assessment items with the course objectives was determined by listing the Biodiversity course objectives at first-year and Honours levels. Coincidentally, both courses had the same number of course objectives, but differed in focus. Each assessment item was assigned to respective course objectives. However, some assessment items aligned with more than one objective, and such items were counted more than once, when computing alignment percentages. The results are displayed on Table 2 below.

Table 2. Alignment of online Biodiversity summative assessments with course objectives.

Educational level		First-year						Honours						
Year	Examination Type	*O1	O2	O3	O4	O5	O7	O1	O2	O3	O4	O5	O6	O7
2020	Main	60	20	20	0	0	0	56	33	0	0	0	0	0
	Deferred	60	20	20	0	0	0	63	25	12	0	0	0	0
2021	Main	80	16	2	2	0	0	50	17	0	17	0	8	8
	Deferred	83	24	0	0	0	0	25	0	0	50	0	25	0

\*O - represents Objective

Table 2 shows that first-year assessments were related to three objectives out of seven. These three objectives required students to recall learnt information. Honours assessments focused mainly on objectives 1 and 2, which required students to describe and to explain the importance of Biodiversity concepts.

#### 4.3. Cognitive levels of online Biodiversity summative assessment items

The revised Bloom's cognitive levels of remember, understand, apply, analyse, evaluate, and create (Anderson & Krathwohl, 2001), were used as the framework for determining the cognitive levels of the reviewed assessments. Demonstrative verbs suggested for each cognitive level by Anderson and Krathwohl (2001) were used to identify the cognitive levels of the assessment items. Items which related to more than one cognitive level were counted more than once, when computing the percentages of items pitched at a particular cognitive level. The results are presented in Table 3.

Table 3. Cognitive levels of online Biodiversity Summative assessments.

Year	Exam type	Remember (%)		Understand (%)		Apply (%)		Analyse (%)		Evaluate (%)		Create (%)	
		Hons	1 <sup>st</sup> year	Hons	1 <sup>st</sup> year	Hons	1 <sup>st</sup> year	Hons	1 <sup>st</sup> year	Hons	1 <sup>st</sup> year	Hons	1 <sup>st</sup> year
2020	Main	57	87	43	13	0	0	0	0	0	0	0	0
	Deferred	29	100	57	0	0	0	14	0	0	0	0	0
2021	Main	61	87	31	13	0	0	8	0	0	0	0	0
	Deferred	76	75	8	25	0	0	8	0	0	0	8	0

The results show an almost consistent pattern of assessing the lower order thinking skills of remembering and understanding, at both first-year and Honours levels of study. Only a few assessment



items were pitched at analysis (8% and 14%) and creation (8%) cognitive levels, in the Honours summative assessments.

#### 4.4. Authenticity of online Biodiversity summative assessment items

Wiggin's 1998 framework for authentic assessments was used to categorize assessment items as either authentic or non-authentic. For an assessment to be classified as authentic, more than 50% of its items had to be authentic (Frey, et al., 2012), based on the authenticity indicators of Wiggin's framework (Wiggins, 1990). Each item in the different assessment papers was analysed to determine whether it had indicators of authenticity or not. The percentages of assessment items classified as authentic were determined and are presented in Table 4.

Table 4. Authenticity of online Biodiversity summative assessments.

Year	2020		2021	
Exam type	Main	Deferred	Main	deferred
1 <sup>st</sup> year	6	0	0	0
Honours	88	71	75	75

The results of the review show that all first-year assessments had low or no elements of authenticity, while all Honours assessments were moderately authentic (average of 77% authenticity).

## 5. Discussion

The study reported in this paper investigated the quality of online Biodiversity summative assessments administered to first-year and Honours student teachers at a South African university. The first finding of the study was that all the reviewed summative assessments were of high content validity, as they had CVIs of more than 0.7, which is an indication of high content validity. However, there was poor coverage of all the prescribed topics for Honours course. Similarly, a study conducted by Gareis and Grant (2015) to determine the content validity of educator made assessments in Malaysian found that even though assessments had high CVIs, assessment items were not evenly distributed across the prescribed content. This is particularly common in assessments of a topic such as Biodiversity, which is complex (Sadler et al, 2013). This means that students might pass a course without fully understanding the entire course content. Lack of time and expertise by assessors could account for the uneven distribution of summative assessments items across prescribed content (Webb, Katz & Decker, 2005).

The second finding was that both first-year and Honours summative assessments were highly aligned to course objectives. Nonetheless, assessment items were mostly aligned to three objectives out of seven, for first-year assessments, and to two objectives out of seven, for Honours assessments. A study conducted by Smith (2012) found that most online assessments were not aligned to course objectives. The reason for the misalignment of assessment items with course objectives could be that some objectives require assessment items to be pitched at higher order thinking levels, and it might be difficult for some assessors to design such items. Moreover, some assessors might ignore course objectives when designing assessments because it takes time to align assessment tasks to courses objectives.

The third finding relates to the cognitive levels of the reviewed summative assessments, which showed that the assessments were mostly pitched at lower cognitive levels of blooms' taxonomy; 'remembering' and 'understanding' levels (Anderson & Krathwohl, 2001). Similar findings have been found in several studies (Kabombwe et al, 2021; Shukla & Dungsungnoen, 2016). This finding is concerning because it implies that the quality of assessments is compromised (Anees, 2017), in the sense that students could achieve high scores from summative assessments but lack higher order thinking skills, which are essential for solving problems and making rational decisions in society and in workplace (Junus, et al., 2021). Shukla and Dungsungnoen (2016) suggested that most lecturers understand the importance of higher order thinking skills, but they do not know what they entail or how to integrate them in assessments. Low order thinking assessments administered online could be prone to cheating by students because they do not require individual engagement (Junus, et al., 2021).

The fourth finding revealed varying trends in the authenticity of first-year and the Honours assessments, in that first-year assessments had very low authenticity, while Honours assessments had moderate authenticity. The implication of this finding is that online Biodiversity summative assessments administered to first-year did not prompt students to apply knowledge to real-life situations. This shortcoming could be a result of assessors' lack of understanding of authentic assessment (Frey, et al., 2012), which could prevent them from planning for authentic assessments consistently. Furthermore, authentic assessments are usually open-ended questions that require higher order thinking ability, which some lecturers find difficult to assess (Shukla & Dungsungnoen, 2016).

## 6. Conclusion and recommendations

The study was set out to answer the question: What is the quality of online Biodiversity summative assessments administered to student teachers at a South African university? The findings showed that the reviewed online summative assessments had high content validity and alignment to course objectives, with poor coverage of the content and course objectives respectively. In addition, the assessments were pitched at low cognitive levels and they had low to moderate authenticity. Based on these findings, it could be concluded that the reviewed online Biodiversity summative assessments were of moderate quality. This finding is concerning because online summative assessments are prone to cheating because they are usually not invigilated and it is easy for students to access sources of information, such as the internet and other learning resources during the assessment (Junus, et al., 2021). Moderate quality Biodiversity assessments could adversely affect the Quality of Life Sciences graduates and subsequently the efficiency of the labor force in life sciences related professions. We recommend further studies to establish the recurrence of the findings from this study. We further recommend that lecturers in higher learning institutions need to revisit their assessments practices to ensure that they develop assessments that have good coverage of prescribed course content, course objectives, are pitched at higher cognitive levels, and that they are authentic.

### References

- Anderson, L. W, & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives* (Complete Ed.). New York: Longman.
- Anees, S. (2017). *Analysis of Assessment Levels of Students' Learning according to Cognitive Domain of Bloom's Taxonomy* (ED586762). Institute of Agricultural Extension and Rural Development. ERIC. <https://files.eric.ed.gov/fulltext/ED586762.pdf>
- Frey, B. B., Schmitt, V. L., & Allen, J. P. (2012). Defining authentic classroom assessment. *Practical Assessment, Research, and Evaluation*, 17(2), 1-18.
- Gareis, C. R, & Grant, L. W. (2015). *Teacher-made assessments: How to connect curriculum, instruction, and Student Learning*. (2<sup>nd</sup> Ed.). UK: Routledge. <http://dx.doi.org/10.4324/9781315855240>
- Educational network LINQED. (2011). *Quality assurance framework for student assessment – Guidelines for the design and implementation of effective student assessment*. Retrieved, July 13 2022 from: [http://www.linqed.net/media/18640/quality-assurance-framework-for-student-assessment-english-proofed-reading\\_final.pdf](http://www.linqed.net/media/18640/quality-assurance-framework-for-student-assessment-english-proofed-reading_final.pdf)
- Junus, K., Santoso, H. B., Putra, P. O. H., Gandhi, A., & Siswantining, T. (2021). Lecturer readiness for online classes during the pandemic: A survey research. *Education sciences*, 11(3), 1-14.
- Kabombwe, Y., Machila, N., & Sikayomya, P. (2021). A Comparative Analysis of the Zambian Senior Secondary History Examination between the Old and Revised Curriculum using Blooms Taxonomy. *Yesterday & Today*, 25, 1-25. DOI: <http://dx.doi.org/10.17159/2223-0386/2021/n25a2>
- Oyinloye, O. M., & Imenda, S. N. (2019). The Impact of Assessment for Learning on Learner Performance in Life Science. *Eurasia Journal of Mathematics, Science and Technology Education*, 15(11), 1-8. <https://doi.org/10.29333/ejmste/108689>
- Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing and Health*, 29(5), 489-97.
- Sadler, P. M., Coyle, H., Smith, N. C., Miller, J., Mintzes, J., Tanner, K., & Murray, J. (2013). Assessing the life science knowledge of students and teachers represented by the K–8 national science standards. *CBE — Life Sciences Education*, 12(3), 553-575.
- Shukla, D., & Dungsungnoen, A. P. (2016). Students' Perceived Level and Teachers' Teaching Strategies of Higher Order Thinking Skills: A Study on Higher Educational Institutions in Thailand. *Journal of education and Practice*, 7(12), 211-219.
- Smith, R. J. (2012). *Alignment of intended learning outcomes, curriculum and assessment in a middle school science program* [Master's thesis, Edith Cowan University]. <https://ro.ecu.edu.au/theses/489>
- States, J., Detrich, R., & Keyworth, R. (2018). *Overview of Summative Assessment*. Oakland, CA: The Wing Institute.
- Webb, V. J., Katz, C. M., & Decker, S. H. (2006). Assessing the Validity of Self-Reports by Gang Members: Results from the Arrestee Drug Abuse Monitoring Program. *Crime & Delinquency*, 52(2), 232-252. <https://doi.org/10.1177/0011128705277972>
- Wiggins, G. (1990). The case for authentic assessment. *Practical Assessment, Research & Evaluation*, 2(2), 1-3. <https://doi.org/10.7275/ffb1-mm19>

# EXPLORING THE INTEGRATION LEVEL OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) BY SETSWANA STUDENT TEACHERS AT A UNIVERSITY OF TECHNOLOGY IN SOUTH AFRICA

**Bridget Kesaobaka Mangwegape, & Paseka Patric Mollo**

*Dr., Central University of Technology, Free State, Bloemfontein 9300 (South Africa)*

## Abstract

The use of ICT has become an indispensable component of education in modern times. Recently, most teachers, including indigenous language teachers, have been involved in integrating technology into their classroom practices. But there is a lack of research on integrating ICT by Setswana student teachers at higher education institutions. This study aims to investigate the competency levels of Setswana student teachers in using ICT in their classrooms. A total of 20 student teachers were purposively selected to participate in this study. Data was collected using classroom observations and interviews. The SAMR model was used as a data analysis tool to determine the extent to which Setswana student teachers can integrate ICT in their classrooms. The results of this study indicate that the student teachers' competence to use ICT was still at a lower level. They predominantly only have basic computer literacy skills, such as word processors, PowerPoint, and other digital resources. The study revealed that the student teachers' ICT integration levels were still at the substitution and augmentation levels.

**Keywords:** *SAMR model, Setswana language, Information and Communication Technology, teacher education, integration.*

---

## 1. Introduction

Technology's evolution and application play a role in every aspect of modern life. In education, to enhance learning outcomes, most higher learning institutions have been investing in providing students and teachers with access to technology and enhanced learning through various types of computer technology, ranging from personal computers (PCs) in the "conventional" form of desktops and laptops to the relatively more portable form of tablet PCs. Setswana students are now better positioned to integrate technology into classrooms than in the old education system.

The use of technology provides Setswana student teachers with many opportunities to practice the Setswana language and involve themselves in authentic environments of language use (Kramsch & Thorne, 2020). Tseng (2019) has identified some language learning areas in which technology holds great promise, including phonetics, grammar, vocabulary, reading, writing, translation, auditory comprehension, literature appreciation, and testing. Mello (1996) has stated that Setswana vocabulary learning through technology can be flexible and effective. Internet-based technology has increasingly developed for years, by using the Internet of Things (IoT) for learning Setswana vocabulary has become more common than before. Turgut and Irgin (2009) reiterate, "The internet has opened up a world of possibilities for improving the vocabularies of students". It is observed that although many students are born in a technologically rich world, they might not be skilful users of technology (Bennett, Maton & Kervin, 2008). In the context of the higher education institution, student teachers could learn Setswana mainly using smartphones, computers, or laptops; however, they could not use such tools for their Setswana language learning in general and particularly learning Setswana vocabulary, indicating that Setswana students struggle in employing appropriate strategies for vocabulary learning strategies (VLS) through technological tools.

## 2. Literature review

TELL refers to using computers as a technological innovation to display multimedia to complement teaching methods (Patel, 2014). The main objective is to determine ways to use all kinds of technology, including computers, hardware, software, and the internet, to develop and improve language learning. Research studies have affirmed that technology and technological devices could be used to engage Setswana vocabulary learning in developing skills (Kramsch & Thorne, 2002). Groot (2000) maintained that TELL tools could be effective in helping students to learn a considerable number of words in a short period. Furthermore, Song and Fox (2008) stated that using mobile devices could motivate students to learn and remind them to work on the entailed learning vocabulary tasks.

However, TELL provides more learning, as it promotes learner autonomy and independence to Setswana student teachers who control the pace of progress and the materials presented to them. Additionally, it increases students' engagement and motivation while facilitating communication and meaningful interactions in which technology-related tasks approach more real contexts (Lamy & Goodfellow, 1999; Ortega, 1997) point out that technology provides an equal opportunity to Setswana students.

### 2.1. Theoretical framework

The theoretical importance of enhancing the integration level of Information and Communication Technology (ICT) by Setswana student teachers is justified by Substitution, Augmentation, Modification, and Redefinition (SAMR) model. Dr Ruben Puentedura (2006) developed the SAMR model that divides classroom technology integration into four levels. Substitution, Augmentation, Modification, and Redefinition are abbreviated as "SAMR". To help teachers personalize learning and aid pupils in visualizing challenging topics, the SAMR model was developed. When integrated classroom technology makes teaching and learning for both teachers and students smoother, such as during remote and blended learning, the SAMR Model can be particularly effective. Puentedura (2006, 2013) was used as the framework to evaluate technology integration. The SAMR model was developed to examine how technology is infused into teaching and learning activities. Furthermore, it is to encourage Setswana student teachers to augment instructional activities by using technology.

At the **Substitution** stage, technology is directly substituted for a more traditional teaching tool or method. It is a simple, bare-bones, direct replacement (Puentedura, 2006, 2013, 2014). With the **Augmentation** stage, the technology is again directly substituted for a traditional tool or method, significantly enhancing the student experience (Puentedura, 2006, 2013, 2014). Using the SAMR Model, you are starting from enhancement to transformation at the **Modification** step; this is a real modification to the lesson's design and learning objectives, not a replacement or addition. "Does the technology significantly alter the learning task?" is the crucial query here (Puentedura, 2006, 2013, 2014). The SAMR model's final stage, **Redefinition**, illustrates how integrating technology in the classroom can improve the student experience. In this situation, the question is whether teachers' use of technological tools enables them to reimagine a conventional learning assignment in a way that would not be feasible without technology, producing a novel experience (Puentedura, 2006, 2013, 2014).

The SAMR model was employed as the framework of the study to translate the purposes. 2006 Puentedura developed the SAMR Model, which contains Substitution, Augmentation, Modification, and Redefinition. Then, in 2013, Puentedura categorized the Substitution and Augmentation levels into Enhancement and the Modification and Redefinition levels into Transformation. At the Substitution level, digital technology is substituted for analogue technology. For example, in a Setswana teaching and learning classroom, the student teacher chooses to substitute a set of hard copy test review questions for digital versions. At the Augmentation level, technology is exchanged, and the function of the task or tool positively changes in some way. However, a student teacher may describe and accurately interpret and apply the SAMR model Puentedura (2014) shared Mueller and Oppenheimer's (2014) comparative study of student teachers taking digital or longhand notes. In his presentation materials, Puentedura focused on the change in the task (i.e., typing on a computer versus writing longhand on paper); this substitution negatively impacted Setswana student teachers.

### 3. Research methodology

The research design was qualitative and focused on classroom observation and focus group interviews. The researchers immersed themselves in the Setswana II subject spending approximately six (6) months in the classroom. ICT, for example, Laptops and cell phones were used to take notes during the classroom observation sessions, and a checklist was used with the following categories: Substitution, Augmentation, Modification, and Redefinition. The second phase was the focus group interviews conducted with second-year student teachers who have registered Setswana II.

#### 3.1. Aim of the study and research questions

This study aims to investigate the competency levels of Setswana student teachers in using ICT in their classrooms using the integration of technology categorized into each SAMR level. That is Substitution, Augmentation, Modification, and Redefinition.

The study sought to answer the following research questions:

1. What problems do Setswana student teachers experience when integrating ICT in their classrooms?
2. What are the students' perceptions regarding using laptops, projectors, smartphones, and tablets in the classroom?
3. Does the SAMR model assist student teachers in improving their involvement in integrating technology into their classroom practices?

#### 3.2. Sample

The population of this study comprised 20 second-year students registered at the University of Technology in Setswana I. In both phases of the study, purposive sampling is used in this research (Maree,2007). The second-year students who participated in the study were divided into groups for the first and second phases of the study, and a checklist was used as a guide for observations.

#### 3.3. Data analysis

Data were analysed using content analysis, and the responses were grouped into themes and later into subthemes according to research questions.

#### 3.4. Findings

Integration of ICT by Setswana students:

*Table 1. Levels of SAMR model.*

	Percentages
<b>Substitution</b>	15%
<b>Augmentation</b>	15%
<b>Modification</b>	35%
<b>Redefinition</b>	35%

From the table above, the Setswana student teachers preferred learning without functional change. Only forty-eight per cent (48%) of the respondents of Setswana student teachers refer to technology to substitute other learning activities.

Only twenty-eight per cent (28%) of the respondents of Setswana student teachers refer to the technology used to replace other learning activities but with additional functions.

Only twelve per cent (12%) of the respondents of Setswana student teachers refer to technology to redesign learning activities.

Only 10 per cent (10%) of the respondents of Setswana student teachers refer to the technology used to create tasks.

#### 4. Discussion and conclusion

The Setswana student teachers have infused varied types of technology into instructional activities. The technology integration has undertaken the enhancement (Substitution and Augmentation) and Transformation (Modification and Redefinition) stages. It implies that technology, which falls into Modification and Redefinition levels, enables Setswana student teachers to transform learning for students. On the part of the Setswana student teachers, it can be inferred that the use of technology may widen Setswana student teachers' knowledge and skills of Setswana. Technology integration could encourage students to be more creative and autonomous learners. The use of technology is expected to enhance Setswana student teachers learning effective teaching.

#### References

- Bennett, S., Maton, K., & Kervin, L. (2008). The 'Digital Natives' debate: A critical review of the evidence. *British Journal of Educational Technology*, 39(5), 775-786.
- Groot, P. J. M. (2000). Computer-assisted second language vocabulary acquisition. *Language Learning and Technology Journal*, 4(1), 60-81.
- Kramsch, C., & Thorne, S. L. (2002). Foreign language learning as global communicative practice. In D. Block & D. Cameron (Eds.), *Globalization and Language Teaching* (pp. 83-100). Routledge.
- Lamy, M. N., & Goodfellow, R. (1999). 'Reflective conversation' in the virtual language classroom. *Language Learning & Technology*, 2(2), 43-61.
- Mello, A. (1996). State of the Mac: Welcome to the age of digital expression. *Macworld*, 23-24.
- Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: advantages of longhand over laptop note taking. *Psychological Science*, 25, 1159-1168. <https://doi.org/10.1177/0956797614524581>
- Ortega, L. (1997). Processes and outcomes in networked classroom interaction: Defining the research agenda for L2 computer-assisted classroom discussion. *Language Learning & Technology*, 1, 82-93.
- Patel, D. S. (2014). Significance of technology-enhanced language learning (TELL) in language classes. *Journal of Technology For ELT*, 4(2), 1
- Puentedura, R. R. (2006). *Transformation, technology, and education* [Blog post]. <http://hippasus.com/resources/tte/>
- Puentedura, R. R. (2013). SAMR: Moving from Enhancement to Transformation. <http://www.hippasus.com/rrpweblog/archives/2013/05/29/SAMREnhancementToTransformation.pdf>
- Puentedura, R. R. (2014). SAMR and Bloom's taxonomy: Assembling the puzzle. [www.common-sense.org/education/blog/samr-and-blooms-taxonomy-assembling-the-puzzle](http://www.common-sense.org/education/blog/samr-and-blooms-taxonomy-assembling-the-puzzle)
- Song, Y., & Fox, R. (2008). Using PDA for undergraduate student incidental vocabulary testing. *ReCALL*, 20(3), 290-314.
- Tseng, S. (2019). Technology and learning English. *International Journal of Liberal Arts and Social Science*, 7(1), 14-29.
- Turgut, Y., & Irgin, P. (2009). Young learners' language learning via computer games. *Procedia – Social and Behavioral Sciences*, 1(1), 760-764.

# THE DECISION TREE ANALYSIS MODEL ON A REMOTE POPULAR SCIENCE LEARNING SYSTEM FOR IN-SERVICES EDUCATION OF TEACHERS

Lung-Hsing Kuo<sup>1</sup>, Pei-Hua Tsai<sup>1</sup>, Tzuchau Yeh<sup>2</sup>, Chenyu Chiang<sup>3</sup>, & Kuo-Ming Tu<sup>3</sup>

<sup>1</sup>Center for General Education, National Kaohsiung Normal University, Taiwan (R.O.C.)

<sup>2</sup>Penghu County Jiang Jun Elementary School, Taiwan (R.O.C.)

<sup>3</sup>National Center for High-performance Computing (NCHC) of NAR Labs, Taiwan (R.O.C.)

## Abstract

The in-service training learning system for primary and secondary school teachers in Taiwan breaks through the time and space limitations and uses a distance learning method to promote primary and secondary school and kindergarten teachers on understanding the scientific development, cultivating scientific knowledge literacy and life-long learning habits, and then giving feedback to students, making popular science knowledge activities a part of teachers' in-service training and social rational cultural activities. Nowadays, Taiwan's largest teachers' in-service education distance science learning website is "Knowledge Lecture Hall" (<https://knowledge.colife.org.tw/>), which was built by the Co-Life team of National Center for High-performance Computing (NCHC) of NAR Labs. The purpose of this study was to establish a data repository based on the in-service training data of 5,291 teachers participating in distance science education learning in the past five years (2018-2022) collected by the Knowledge Lecture website. The data contains 16 domains of variables, including basic information about teachers and the schools they work for, online viewing time, and information about teachers' in-service training courses. In the process of knowledge discovery in the database, the decision tree algorithm C5.0 was used for modeling, the AUC value was used to evaluate the predictive ability, and the concept of tree branch was used as the decision model. According to the class and relationship of variables, the explanation model of good prediction results was found, and the following research objectives were achieved as follows: First, analyze the preferences and trends of in-service teachers' participation in learning courses during the past five years (2018-2022). Second, explore the decision tree model of the key predictors of in-service faculty participation in learning courses in the Knowledge Forum over the past five years (2018-2022). Finally, recommendations for improvement based on the findings are provided as a reference for future management of in-service distance learning courses on the Knowledge Lecture website and for future research by future researchers.

**Keywords:** *Decision tree, remote education, teacher in-service training.*

---

## 1. Introduction

Improvements in distance learning systems are an excellent way to improve the professional development of teachers. Online popular science course learning can promote the popularization of science more quickly, so as to break through the space-time dilemma of learning, promote the understanding of scientific development of primary and secondary school teachers and kindergarten teachers, cultivate scientific knowledge literacy and lifelong learning habits, and give back to students. In this study, the Co-Life team of the NCHC together with the National Science Council and other academic institutions, built a "Knowledge Lecture Hall". In addition to providing teacher learning certification courses through the speaker portal, the site also records in-service learning information for teachers participating in digital learning activities. This study will be used as a reference for the Knowledge Lecture Hall website for advance distance learning courses for in-service teachers, and for additional discussions for future researchers.

With the advent of the big data era, besides relying on continuous advances in information devices, it is even more critical to obtain valuable information and transform it into knowledge through the exploration of massive data. With data mining models, we can discover hidden knowledge in the collected data. The key, however, is not the amount of data, but the goal and direction of first defining the problem and then following the process of knowledge discovery, etc. Additionally, discover the key knowledge (Liao & Wen, 2019).

## 2. Literature review

### 2.1. Remote education

Remote education is a form of remote teaching and learning that breaks through the formalities of time and space. This mode of learning with the help of networks continues to flourish around the world. With a growing variety of curriculum topics available online, the range of flexible and affordable educational options is growing. In fact, distance learning is full of numerous advantages over traditional modes of teaching. At this time, the domain of distance learning and distance education lacks such a precise vocabulary. King et al. (2001) hopes to start the movement toward a common vocabulary by offering precise definitions of distance learning and distance education, and their interrelationship. Both are treated in this study as tele-education.

Yueh & Liang (2015) pointed out that the development of ICT makes teaching and learning increasingly diversified, and the application of technology in digital learning, mobile and ubiquitous learning, cloud or open course is all aimed at facilitating the realization of supporting specific teaching implementation and providing different oriented learning resources.

As public administration programs extend their online education offerings to reach more time- and place-bound students, and as accredited institutions become interested in documenting teaching and learning effectiveness, the degree to which online students are successful as compared to their classroom counterparts is of interest to teaching faculty and others charged with assessment (Ni, 2013).

### 2.2. Decision Tree

From one or more predictor variables, the decision tree aimed to predict class-dependent variables and predict relationships between cases or objects. The goal of the decision tree is to predict or explain the results of category dependent variables (Liao & Wen, 2012). Decision trees are a common technique for data exploration, which is easy to understand and implement. It mainly uses the concept of tree branches as a decision model. There are two types of models, one is classification trees, which are mainly used to predict classification results. Regression trees are also used to predict the mean value of each classification. The decision tree will display a series of nodes as a tree structure, and the middle nodes of the tree (non-leaf nodes) represent their test attributes. The branches of the tree represent the classification of attributes; leaf nodes of a tree represent results obtained after classification (Tsai et al., 2021). Decision tree is a widely used classification and prediction tool at present. In the construction of the decision tree, it is based on the amount of information that is beneficial. Its advantage is that it can be simple, fast and accurate with fewer parameters set (Tsai et al., 2022).

There are numerous different algorithms for decision trees, including ID3, C4.5, C5.0, CART, CHAID, QUEST, etc. The main difference between these algorithms is that they use different attribute indices for classification. Common attribute indexes are Information Gain, Gini index and Chi square independence test (Tseng & Huang, 2017). The main indicator of ID3, C4.5 and C5.0 is information profit. The main indicator of CART is the Gini value, while the index of CHAID is Chi-square independent test (Pandya & Pandya, 2015). In this study, the C5.0 algorithm was used because the attributes of the analyzed data are categorical variables, node branches can have multiple branches, and the attribute index used information gain to determine each branch of the decision tree. Each decision was made to maximize the message gain.

### 2.3. Aim of the study

- Discuss recent five years (2018-2022) in the knowledge lecture hall in-service teachers to participate in seminar C5.0 model of important indicators.
- According to the results put forward suggestions for improvement, as a reference for in-service teachers' distance study course, and future researchers.

## 3. Study design

### 3.1. Definition of terms

- Attributes of the curriculum: Humanities, arts and philosophy (Attribute 1), Nature and life science and technology (Attribute 2), Social science (Attribute 3), Healthcare (Attribute 4).
- Educational background: college/university, Master, Ph.D.
- Time for surfing the Internet (week): from Sunday to Monday.
- School district: Northern group(1\_N), Central group(2\_M), Southern group(3\_S), Eastern and offshore islands group(4\_R)
- Remote area attribute: Non-remote area, Highly remote area, Remote area.



### 3.2. Data analysis

The decision tree will generate a tree based on the training data and predict new samples based on the trained rule. In this study, C5.0 was used as the decision tree algorithm, as shown in Table 1. The C5.0 model of in-service teachers participating in the learning course of knowledge lecture Hall in recent five years (2018-2022) was shown in Figure 1.

Table 1. Prediction effect of C5.0 Decision tree data exploration algorithm (2018-2022).

Algorithm	Accuracy	Errors	Adjusted propensity score	Boosting	Cross-validation
C5.0	59.95%	0.341	0.227	0.760	0.716

## 4. Results

### 4.1. The result of C5.0 decision tree course attribute type modeling

Model 2 was used to model the sample in this study. Table 2 and Figure 1 showed the decision tree model of in-service teachers participating in the course C5.0 in the recent five years (2018-2022) in Model 2. In-service teachers participated in Curriculum Model 2, where weekly online viewing time was 0.5200, school district was 0.2100, remote area attributes were 0.1400 and educational background was 0.1300.

Table 2. Parameter results of C5.0 decision tree modeling.

parameter	Model 1	Model 2	Model 3	Model 4
Boosting	10	10	10	10
Cross-validation	10	10	10	10
Deletion importance	75	75	75	75
Minimum record for each branch	1	2	3	4
Accuracy	55.70%	59.95%	57.01%	56.26%
Training area AUC	0.621	0.721	0.511	0.653
Testing area AUC	0.671	0.842	0.755	0.759
Importance of prediction				
Time for surfing the Internet(week)	0.1254	0.5200	0.3523	0.4822
School district	0.2195	0.2100	0.1823	0.1658
Remote area attribute	0.1223	0.1400	0.1725	0.0621
Educational background	0.1217	0.1300	0.1605	0.0648

According to Figure 1, this study predicted that curriculum attributes are the most important decision metrics. During the online viewing period of teachers' participation in the knowledge Lecture Hall website, 82.650% (4,373 people) watched the Internet on weekdays, Tuesdays, Thursdays, Fridays and weekends. The largest number of in-service teachers (60.348%) (2,639) viewed "Nature and Life technology" online. However, 17.350% (918) of the teachers participated in online training on weekdays and Wednesdays, and the "science and technology of nature and life" accounted for 46.187% (424), followed by the "social science" teachers, accounting for 46.078% (423).

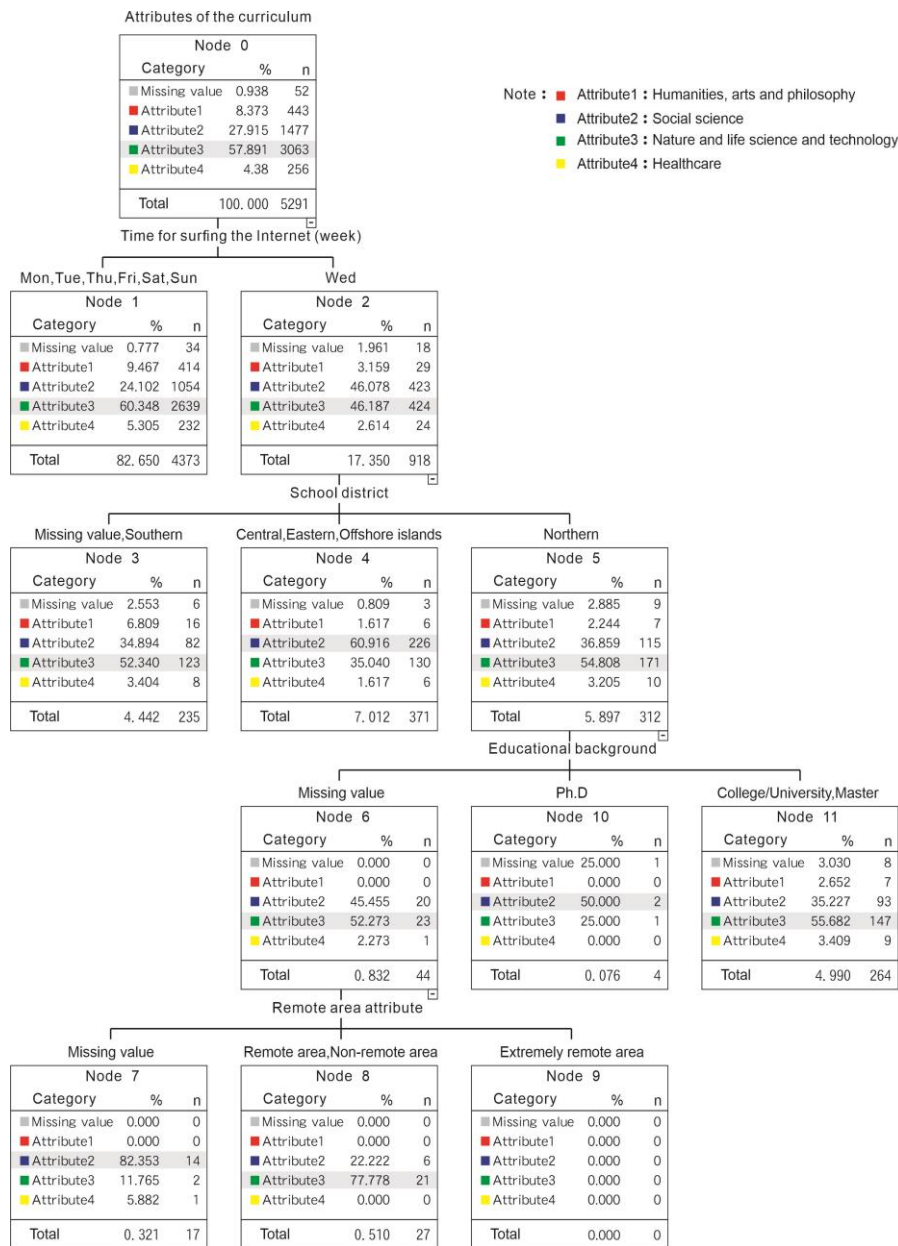
In addition, 4.442% (235) of the teachers in the southern district and 52.340% (123) of the teachers in the southern district studied remote teachers on Wednesday, while 52.340% (123) of the teachers in the southern district watched "Nature and life technology" on the Internet. 7.012% of the respondents said their school districts were located in central, Eastern and outlying islands, and 60.916% (226) said social science. 5.897 percent (312) of the respondents said their school is located in Buk-gu, and 54.808 percent (171) said science and technology in nature and life. So on Wednesday, go online to view the Nature and Life Technology category, School Districts in the North, Sustainable Forecasting for the distant Science Education Learning System C5.0 analytical model for the subsequent secondary indicators.

The proportion of in-service teachers with a doctor's degree was 0.076% (4 people), 50% (2 people), 4.990% (264 people) of in-service teachers with a university or master's degree, and 55.682% (147 people) of in-service teachers with a science and life science degree. If in-service teachers are eligible to participate in the online viewing period of the Knowledge Lecture Hall website on weekdays on Wednesdays and the school district is located in the North district, the proportion of online viewing of the course attributes of the in-service teachers is different according to their educational background. Among them, 0.832% (44) of in-service teachers whose educational background was omitted, and

52.273% (23) of them watched science and technology on the Internet. So, on Wednesday, I went online and looked up nature and life science and technology. the school district is located in the north. education background is a secondary index. missing value sustainable prediction of the distant science education learning system C5.0 analysis model.

If the online viewing time of in-service teachers participating in the Knowledge Lecture Hall website is weekdays on Wednesdays, the school area is located in the North district, the educational background is missing value, and the remote area is classified as remote or non-remote area, only 0.510% (27 people), 77.778% (21 people) watched "nature and life technology" online. 0.321% (17 people) of in-service learning teachers participated in the knowledge lecture hall website, and the remote area attribute was also omitted. 82.353% (14 people) of in-service learning teachers watched social science online. So on Wednesdays, watch nature and life science and technology classes online, with the school district to the north. Educational background is the missing value for sustainable prediction of remote science education learning system C5.0 analytical model for secondary index remote area attributes.

Figure 1. C5.0 model of in-service teachers participating in the curriculum (2018- 2022).



## 5. Conclusions and discussions

Online viewing time for teacher in-service training and participation in the Knowledge Lecture Hall Web site study was an important predictor in the C5.0 analysis model of the distance science education learning system.

In the C5.0 analysis model of the distance science education learning system, it was pointed out that the attributes of school area, educational background and remote area were secondary predictors, and they were also consistent with the preferences and trends of in-service teachers to participate in the course.

Regardless of whether the service school was located in a remote or non-remote area, the properties of the distance learning curricula of the in-service teachers also indicated that the teacher's concept of mobile technology learning was diverse, including the acquisition and development of concepts in natural and life technology and social sciences.

### *Acknowledgements*

We would like to thank the NARLabs (Taiwan) Co-Life team of the National Center for High-Performance Computing (NCHC) for providing valuable information for this study.

### *References*

- King, F. B., Young, M. F., Drivere-Richmond, K., & Schrader, P. G. (2001). Defining Distance Learning and Distance Education. *AACE Review (formerly AACE Journal)*, 9(1), 1-14. Norfolk, VA: Association for the Advancement of Computing in Education (AACE). May 4, 2023 Retrieved from <https://www.learntechlib.org/primary/p/17786/>
- Liao, S., & Wen, C. (2019). *Data Mining: In Case of SPSS Modeler*. DrMaster Press.
- Ni, A. Y. (2013). Comparing the Effectiveness of Classroom and Online Learning: Teaching Research Methods. *Journal of Public Affairs Education*, 19(2), 199-215.
- Pandya, R., & Pandya, J. (2015). C5. 0 algorithm to improved decision tree with feature selection and reduced error pruning. *International Journal of Computer Applications*, 117(16), 18-21. <https://doi.org/10.5120/20639-3318>
- Tsai, H., Wei, H., & Kuo, L. (2021). Data Mining Technique for Predicting the Model of In-service Teachers' Bilingual Instruction Training. *Journal of Sciences & Humanities*, 2021, 9(1), 14-29. [https://doi.org/10.6535/JSH.202111\\_9\(1\).0002](https://doi.org/10.6535/JSH.202111_9(1).0002)
- Tsai, H., Wei, H., & Kuo, L. (2022). Data Mining Technique for Constructing the Prediction Model of University Teachers' Evaluation of Schools. *Journal of Sciences & Humanities*, 9(2), 24-38. [https://doi.org/10.6535/JSH.202202\\_9\(2\).0002](https://doi.org/10.6535/JSH.202202_9(2).0002)
- Tseng, S., & Huang, S. (2017). The Application of Big Data on the Impact between Workplace Educational Training and Employees' Background - in case of Hotel Industry. *Yu Da Academic Journal*, 45, 33-49.
- Yueh, H., & Liang, C. (2015). Integrating Considerations of Students, Teachers, and Instructional Contexts in a Predictive Model of Distance Education. *Journal of Educational Media & Library Sciences*, 52(1), 33-57.

# INNOVATIVE WORK-BASED LEARNING AND EMPLOYABILITY SKILLS TRAINING FOR LEARNERS WITH SPECIAL NEEDS

**Dalun Zhang**

*Texas A&M University (USA)*

## Abstract

Employment has been identified as a critical need for individuals with disabilities (IWDs), given that it is an essential component of quality of adult life (Rogan, Grossi, & Gajewski, 2002). Nevertheless, despite the extensive support by federal legislation, public policy, federal initiatives and programs, the employment outcomes for IWDs are still disappointing and they continue to encounter employment problems such as lower employment rates and lower annual earnings. For example, people with disabilities have experienced significantly lower employment rates than those without a disability. According to findings from the NLTS2 (Newman, Wagner, Knokey, Marder, Nagle, Shaver, & Wei, 2011), the approximate rate of employment, at the time of the study, for individuals with disabilities ages 18-24 was 63% and was impacted heavily by the identified disability label and level of training/education. The Bureau of Labor Statistics (2022) reports 19.1% of people with disabilities were employed compared to 63.7% of their peers without a disability. Research has shown that long-term career outcomes for individuals with disabilities can drop to a rate as long as 17.2% (Baker, Lowrey, & Wennerlind, 2018). Research on evidence-based practices indicated that early employment experiences, supported internships, and collaboration are effective in preparing and supporting IWDs for their transition to employment (Bellman, Burgstahler, & Ladner, 2014; Lee & Carter, 2012). Longitudinal data demonstrates that schools can improve employment outcomes for youth with disabilities through job readiness instruction (Park, Bouck, & Duenas, 2020).

**Keywords:** *Employment, employability, disabilities.*

---

## 1. Providing work-based learning opportunities

One of the ways that schools can provide employment readiness instruction is through work-based learning (WBL) models. Work-based learning (WBL) is a type of educational approach that integrates classroom instruction with real-world work experience. It is designed to provide students with the skills, knowledge, and practical experience they need to succeed in the workforce. Some common examples of WBL are internships/cooperative education, apprenticeships, and school-based enterprise. These programs can be found in a variety of industries, including healthcare, finance, technology, and manufacturing. Work-based learning is often seen as an effective way to prepare students for careers, as it allows them to gain valuable work experience, develop professional skills, and make connections with potential employers.

## 2. Offering employability skills instruction

Another way in preparing students with disabilities for employment is to teach high school students with disabilities employability skills. This can be done by offering an elective course that teach basic and essential employability skills. Employability skills refer to genetic skills, competencies, knowledge, and personal attributes that enable a person to pursue career success at all levels and types of employment. These skills are not job specific or technical, however, are fundamental to fulfilling all jobs. For students with disabilities, developing employability skills can be particularly important as they may face additional challenges in finding and maintaining employment. By developing employability skills, students with disabilities can become more competitive in the job market, increase their chances of finding and keeping employment, and improve their overall quality of life. For students with disabilities, the following skills are particularly important. (1) Communication: Effective communication skills are critical for success in any job. Individuals with disabilities may need to develop alternative communication strategies or use assistive technology to communicate effectively. (2) Problem-solving: The ability to identify and solve

problems is highly valued in the workplace. Individuals with disabilities may need to be creative in finding solutions that work for them. (3) Time management: The ability to manage time effectively is essential for meeting deadlines and completing tasks. Individuals with disabilities may need to develop strategies to manage their time and energy levels. (4) Teamwork: The ability to work collaboratively with others is important in many jobs. Individuals with disabilities may need to develop communication and social skills to work effectively in a team. (5) Adaptability: The ability to adapt to change and handle unexpected situations is critical in today's fast-paced work environment. Individuals with disabilities may need to be flexible and adaptable to accommodate their needs. (6) Self-advocacy: The ability to self-advocate and communicate their needs is important for individuals with disabilities in the workplace. They may need to educate their colleagues and employers about their disability and the accommodations they require. (7) Technology: In today's digital age, technology skills are essential for many jobs. Individuals with disabilities may need to develop proficiency in using assistive technology to perform their job duties. (8) Positive attitude: A positive attitude and a willingness to learn and improve are highly valued in the workplace. Individuals with disabilities may need to develop resilience and a positive mindset to overcome challenges and achieve their goals.

### 3. Texas A&M University's projects

**TAMU Work-Based Learning Project.** The Work-Based Learning Project is a collaborative effort between Texas A&M University and the state-level Vocational Rehabilitation Services. The project aims to provide schools with financial and technical supports to develop new WBL models or enhance existing WBL models that lead to student employment. It offers work-based learning (WBL) opportunities for students and improve teaching practices that lead to employment for high school students with disabilities in Texas. Through a competitive application process, project staff selects high schools to receive training, technical assistance, and funds up to 10,000 U.S. dollars to implement a WBL model that provides job readiness instruction and employment practice. This collaborative effort between Texas A&M University's Center on Disability and Development (CDD) and the state-level Vocational Rehabilitation (VR) increases the number of good-quality WBL models and improves the knowledgebase of schools implementing models across the state. Participants in the project include schools without WBL experience and schools with some experience but want to expand or improve their current model(s). During the application process, project staff provides training opportunities and supports schools in developing a WBL model plan that leads to sustainability and employment outcomes. After schools receive the funds for their WBL model, project staff connects monthly with the schools to identify training and further support needs. The WBL models must include community collaboration, student evaluation, sustainability efforts, and utilizing best-practice pedagogy.

Each year, up to 25 schools with varied WBL experience will benefit from the TAMU Work-Based Learning Project. The schools receive funds, technical support, and training from experts in the field that leads to evidence-based WBL models. Throughout the multi-year project, project staff will collect data on model efficacy, viability within school structures, sustainability, and student employment outcomes. Outcomes include: Increasing the number of schools with WBL models and improving the quality of existing WBL models will strengthen Texas schools' ability to improve employment outcomes for youth with disabilities. The data gathered from the TAMU Work-Based Learning Project will inform best-practice for schools to create or enhance existing WBL models and inform evidence-based knowledge concerning WBL.

In its first two years, the project has supported the development of 50 work-based learning projects. These projects have included schools in all six TWC service regions and 12 of TEA's 20 regional education service centers. Participating schools serve urban, suburban, and rural areas, as well as low-income, immigrant, and majority-minority districts. Students range from 14 to 22 years-old, including students on 504 plans and IEPs. While most projects are hosted by public schools, one charter school is participating and the project staff continues to reach out to private and charter schools, as well as underserved regions of the state. Projects cover a range of industries. While custom printing and food service remain the most popular sectors, projects have become more diverse during the 2022-2023 school year. The project's training and technical assistance components also build the schools' capacity to develop and implement high-quality, sustainable work-based learning experiences. This allows them to expand and replicate their projects after the initial funding period, enabling them to provide more diverse work experiences and reach a broader range of students. Figure 1 illustrates the types of industry covered by the 50 WBL programs. Feedback from participating schools is overwhelmingly positive, and teachers report building stronger relationships with their VR Counselors, enrolling more students in Summer Earn and Learn and paid work experience, and increased partnerships for parent outreach and Pre-ETS services.

#### 4. Basic Employability Skills Training (BEST) curriculum development

*Rationales.* Employability skills are important for job search and retention. Ju and colleagues (2012) developed a survey to investigate employers' expectations on employability skills for entry-level employees with and without disabilities. They identified five domains of employability skills, including: Basic Skills, Higher Order Thinking Skills, Basic Work Skills, Social Skills, and Personal Traits that were considered as essential for entry-level employees. These researchers recommend that any efforts toward promoting employment outcomes for people with disabilities should target these basic employability skills. Other research also shows that employers like to hire individuals who have adequate employability skills. On the other hand, inadequate work skills, poor attendance, abusive behaviors, refusal of instructions, tardiness, appearance, and safety issues have led job loss to many individuals with disabilities (Chadsey & Beyer, 2001; Olson, Cioffi, Yovanoff, & Mank, 2001).

*Goal.* The goal of the project is to develop Basic Employability Skills Training (BEST), an innovative curriculum for employability skills training based on research evidences. The curriculum can be used in Texas high schools for teaching employability skills to high school juniors and seniors who are eligible for pre-ETS services with the potential to gain employment. The curriculum can be a Pre-ETS Elective Course. Some major objectives include: (a) identify from the literature and our own research important employability skills for students with disabilities, (b) identify curriculum components that help students develop employability skills, (c) develop lessons of the Basic Employability Skills Training (BEST), (d) gather feedback from stakeholders and subsequent revisions, (e) field-test the Basic Employability Skills Training (BEST) and subsequent revisions, and (f) finalize the Basic Employability Skills Training (BEST).

*The Skills.* The BEST curriculum addresses four areas of employability skills, including basic skills (read with understanding and ability to follow instructions), higher order thinking skills (ability to make sound decisions and ability to solve problems), basic work skills (ability to follow schedules and ability to stay with a task until finished), and personal traits (ability to evaluate and monitor own performance and ability to be assertive). The lessons cover specific skills that reflect research findings, required in Texas Essential Knowledge and Skills (TEKS), and in Council for Exceptional Children's (CEC) list of skills. Figure 2 shows the skills and their relationship to the BEST curriculum, TEKS, and CEC standards.

#### 5. Conclusions and recommendations

Schools play an important role in training students with disabilities employability skills to prepare them for gaining and maintaining employment after finishing their education. High schools can take several steps to provide employability skill training to students with disabilities, including:

- (a) provide vocational training programs: Schools can offer vocational training programs that are specifically designed for students with disabilities. These programs can help students acquire skills in various fields and prepare them for future employment.
- (b) collaborate with employers: Schools can collaborate with local employers to create work-based learning opportunities for students with disabilities. These opportunities can provide students with real-world work experience and help them develop employability skills.
- (c) offer internships and job shadowing: Schools can provide students with disabilities the opportunity to participate in internships and job shadowing programs. These programs can help students gain hands-on experience in their desired field and learn about the expectations and responsibilities of the workplace.
- (d) provide individualized support: Schools can provide individualized support to students with disabilities to help them develop employability skills. This support can include assistance with job searching, resume building, interview preparation, and workplace communication.
- (e) create inclusive learning environments: Schools can create inclusive learning environments that foster the development of employability skills for all students, including those with disabilities. This can include the use of universal design for learning, assistive technology, and accommodations to support students' learning needs.

Schools can take several steps to provide work-based learning opportunities to students with disabilities.

1. Collaborate with local businesses: Schools can work with local businesses to create internships, apprenticeships, or job shadowing opportunities for students with disabilities. They can identify businesses that have experience working with individuals with disabilities and are willing to provide work-based learning opportunities.
2. Identify and assess student needs: Schools should identify students with disabilities who may benefit from work-based learning opportunities and assess their needs. This assessment should consider the student's strengths, interests, and career goals.
3. Provide accommodations: Schools should provide accommodations that students with disabilities may need in order to participate in work-based learning opportunities. This could include assistive technology, accessible transportation, or job coaching.
4. Develop individualized learning plans: Schools should work with each student to develop an individualized learning plan that outlines their goals, skills, and the specific work-based learning opportunities they will participate in.
5. Provide training and support: Schools should provide training and support to students with disabilities before they begin work-based learning opportunities. This could include training on workplace safety, social skills, and job-specific skills.
6. Monitor progress and provide feedback: Schools should monitor students' progress during work-based learning opportunities and provide feedback to help them improve their skills and performance.
7. Evaluate the effectiveness of the program: Schools should evaluate the effectiveness of their work-based learning program for students with disabilities. This evaluation should consider the impact on student outcomes, the quality of the work-based learning opportunities, and the satisfaction of both students and employers.

## References

- Baker, J. N., Lowrey, K. L., & Wennerlind, K. R. (2018). Building an inclusive post-secondary education program for young adults with intellectual developmental disability. *Physical Disabilities: Education and Related Services*, 37(2), 3-33.
- Bellman, S., Burgstahler, S., & Ladner, R. (2014). Work-based learning experiences help students with disabilities transition to careers: A case study of University of Washington projects. *Work*, 48(3), 399-405.
- Chadsey, J., & Beyer, S. (2001). Social relationships in the workplace. *Mental Retardation and Developmental Disabilities Research Reviews*, 7, 128-133.
- Department of Labor (2022). Persons with a Disability: Labor Force Characteristics – 2021. Retrieved from: <https://www.bls.gov/news.release/pdf/disabl.pdf>
- Lee, G. K., & Carter, E. W. (2012). Preparing transition-age students with high-functioning autism spectrum disorders for meaningful work. *Psychology in the Schools*, 49(10), 988-1000.
- Newman, L., Wagner, M., Knokey, A., Marder, C., Nagle, K., Shaver, D., & Wei, X. (2011). *The post-high school outcomes of young adults with disabilities up to 8 years after high school: A report from the National Longitudinal Transition Study-2 (NLTS2)*. Retrieved January 20, 2023, from <https://ies.ed.gov/ncser/pubs/20113005/pdf/20113005.pdf>
- Olson, D., Cioffi, A., Yovanoff, P., & Mank, D. (2001). Employers' perceptions of employees with mental retardation. *Journal of Vocational Rehabilitation*, 16(2), 125-133.
- Park, J., Bouck, E. C., & Duenas, A. (2020). Using video modeling to teach social skills for employment to youth with intellectual disability. *Career Development and Transition for Exceptional Individuals*, 43, 40-52.
- Rogan, P., Grossi, T. A., & Gajewski, R. (2002). Vocational and career assessment. In C. L. Sax & C. A. Thoma (Eds.), *Transition assessment: Wise practices for quality lives* (pp. 103-117). Baltimore, MD: Paul H. Brookes.

# DEVELOPMENT OF A NEW METACOGNITIVE SELF-REGULATED MODEL OF COMPETENCY

**Margarita Auli Giraldo, & Jean-François Herold**  
*ADEF Laboratory, Aix-Marseille University (France)*

## Abstract

Since 2017, the University of Aix-Marseille (AMU) has engaged in a pedagogical transformation towards a Competency-Based Approach (CBA). Nevertheless, the evaluation of competencies is not yet operational. The transition to a CBA implies a pedagogical paradigm shift: what is evaluated here is not only students' performance (the result of their activity) but also their ability to achieve this result (the mental processes that lead to performance). In order to make CBA operational, it is essential to go beyond traditional evaluation systems since these systems focus almost exclusively on the productive character of competence (performance). Indeed, some conceptions of CBA are still influenced by an empiricist and behaviourist approach and tend to reduce competence to its observable manifestations, leaving aside its constructive character. The difficulty of creating new tools to assess competencies lies in the lack of socio-constructivist models that give their rights due to the learner's cognitive activity and social acceptability. The present model aims to anchor CBA in the Self-Regulated Learning (SRL) theories and, more specifically, to define competency through the metacognitive approach. Metacognitive analysis, judgments, and controls are necessary for students to plan and regulate their activity according to what is asked of them in a specific situation. To be competent, students must be performative and consciously explain the mental processes that lead them to acceptable performance. Also, for a student to be competent, a third party must validate their knowledge and abilities. Competence is certificative. Competency is a conscious mental ability that translates into socially acceptable behaviour. This model aims to present competence through a fuller scope, including its productive, constructive, and social characteristics. The practical use of this model would allow for the implementation of new and more robust competency assessment tools.

**Keywords:** *College assessment, competency, metacognition, models (theoretical), self-regulated learning.*

---

## 1. Introduction

By 2024, French Universities must transition to CBA to meet governmental standards. Each university department has to establish a competency-based structure program as a first step and then implement new assessment methods ensuring competency evaluation beyond knowledge checking. Nevertheless, other than the use of portfolios, there are few guidelines on how to assess competencies. Portfolios are great assessment tools because they focus not only on students' performance but also on the mental process that leads them to their final activity (Tardif, 2017; Coulet, 2011; Poumay & Georges, 2017). However, to properly use portfolios, there needs to be pedagogical alignment (teachers have a clear understanding of the specific goals and objectives of the program as a whole, not only for a specific course), plus students' reflexive activity needs to be supported (Buckley et al., 2012). In other words, to progress in the CBA, assessment needs to evolve into portfolios but to use portfolios, the CBA needs to be well advanced. Teachers are expected to make profound changes in their evaluations, but few options are given to them. This paper proposes to present a new take on the assessment of competencies by presenting a model of competency development based on the theories of Self-Regulated Learning (SRL) and metacognition. Embedding the competency notion into a fuller theoretical framework could lead to creating and implementing new assessment tools.



## 2. Competency and the socio-constructivist framework

Competency may be understood as “a complex know-act based on the effective mobilization and combination of a variety of internal and external resources within a family of situations” (Tardif, Fortier, & Préfontaine, 2006, p.22). Several french-speaking researchers base their definition of competency on Tardif’s work, and even though they might differ, they usually maintain his 3-components-structure: Competency has constructive and productive characteristics, and it is always situated. Competency is constructive in the sense that it is combinatorial by nature; it integrates resources of different kinds (e.g., psychological, contextual). Students must follow a cognitive process to achieve (construct) a specific action by combining different resources. Competency is also productive because it supposes a finalised action, it leads to a result. The productive character of competency is its observable manifestation, also known as performance. Finally, competency takes place in a specific and real context. It is always situated. (Boutin, 2004; Chauvigné & Coulet, 2010; Coulet, 2011; Crahay, 2006; Goudreau & Boyer, 2017; Jonnaert, 2009; Tardif, 2017).

Mottier-Lopez (2017) adds another important component to this structure: competency can only be inferred. Competency is certificative, to be valid, it needs to be socially assessed by experts (e.g., teachers). Usually, teachers infer competency (so assess it) by its productive character, performance. To be competent, students need to perform well, but even chance could explain good performance in a given context (Rey, 2012). Competency is the person’s ability to find solutions to complex problems in a specific context, whereas performance is the solution itself (Boutin, 2004; Chauvigné & Coulet, 2010; Coulet, 2011; Crahay, 2006; Jonnaert, 2009; Kahn & Rey, 2017; Tardif, 2017). When assessing competency, its constructive character is often put aside, which leads to undermining the complexity of the notion. A clue to understanding this paradox could be that competency is not embedded in a theoretical framework emphasising its double dynamic (Coulet, 2011; Crahay, 2006; Jonnaert, 2009). There is a gap between theory and practice: researchers have a rather socio-constructivist definition (e.g., taking into account the relationship between the learner and the environment, seeing competency as dynamic and situated), but what is actually assessed remains within a behaviourist framework, what is taken into account is the productive aspect, performance.

## 3. Self-Regulated Learning (SRL) and metacognition

To overcome this conceptual lack, the present proposition is to anchor the notion of competency in the robust theoretical framework of SRL. SRL refers to people's cognitive and metacognitive activity of altering process-information strategies that conduct to learning outcomes in terms of knowledge, understanding, and competency (Dignath & Büttner, 2008; Panadero, 2017). SRL pedagogical interventions have the particularity of focusing on both learning development processes and learning outcomes. In this sense, one may argue that CBA is a type of intervention that falls within the SRL framework. In fact, competency development is a learning process that largely requires self-regulation (Boutin, 2004; Chauvigné & Coulet, 2010; Coulet, 2011; Goudreau & Boyer, 2017; Tardif, 2017).

In their meta-analysis, Dignath and Büttner (2008) studied the effect of pedagogical interventions promoting SRL in primary and secondary schools. Results show that older students benefit better from prioritizing the metacognitive aspects of learning. Indeed, high cognitive demanding tasks require the use of more specific self-regulation strategies to achieve acceptable performance. Thus, basing SRL pedagogical interventions in metacognitive models is recommended (Panadero, 2017).

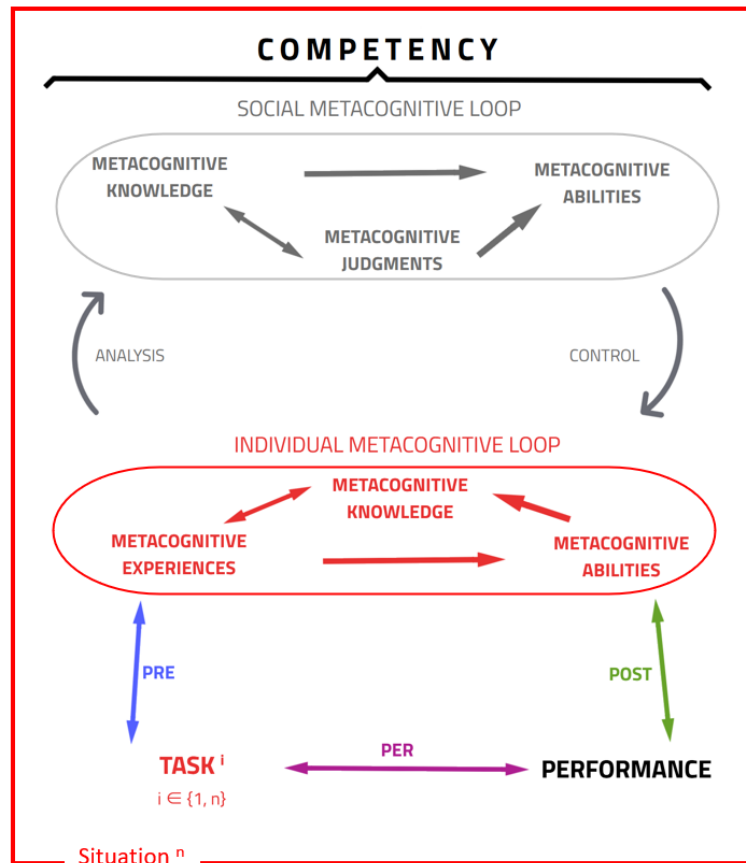
Metacognition may be described as monitoring and controlling activities that a person has over their cognition (Efklides, 2008; Quiles, 2014). Metacognitive activity echoes competency’s constructive characteristic: the cognitive processes leading to action. Even so, in the metacognitive theory, the difference and the link between the cognitive processes and performance (competency’s productive characteristic) is well understood. E.g., Leclercq and Poumay (2004) define metacognition as “the conscious or unconscious judgments, analyses, and regulations (but which must be made explicit, observable and conscious) made by the apprentice on their own performances (processes or products), in situations of PRE, PER or POST performance”.

Based on these associations, the present proposition is to anchor the notion of competency on the SRL metacognitive theoretical framework. Whereas CBA lacks a detailed analysis of the processes organising the mobilisation and the regulation of the activity it deploys, both metacognition and SRL have been vastly modelled. The creation of the metacognitive self-regulated model of competency (MSRMC) is an attempt to root competency into a broader scope.

#### 4. Metacognitive self-regulated model of competency (MSRMC)

In our model, we understand competency as the conscious ability to self-regulate one's activity according to a specific context and leading to effective performance.

Figure 1. The metacognitive self-regulated model of competency.



The red rectangle represents situation  $n$  ( $n$  meaning it could be an infinite number of situations). Competency is not only being able to complete task  $i$  at time  $t$  in a situation  $n$  but rather people's capacity to identify the situation and interpret it correctly. By identifying the situation, they can choose and implement the knowledge and abilities at their disposal, needed to successfully achieve their activity (Coulet, 2010, 2011; Kahn & Rey, 2017; Masciotra et al., 2004). Here, we define the capacity to situate oneself as a metacognitive self-regulatory activity in accordance with the demanded tasks and performance. As competency is contextual and socially constructed, both the Individual Metacognitive Loop (IML) and the Social Metacognitive Loop (SML) give place to metacognitive activity through iterative monitoring and regulation (Efklides, 2008).

While there is an ongoing discussion on the degree of consciousness involved in the IML and its components (Efklides, 2008; Quiles, 2014), competency is intrinsically conscious (Masciotra, 2005; Rey, 2012) in the sense that it must be socially certified (Coulet, 2011; Goudreau & Boyer, 2017; Tardif, 2017; Tardif & Dubois, 2013). E.g., when using a portfolio, a competent person must be able to explain to their evaluators the mental process that led them to their final action in order to guarantee that their performance is coherent with the prescribed task (and not only for a specific task but for all the tasks  $i$  that can be included in the same situation  $n$ ) (Buckley et al., 2012; Tardif & Dubois, 2013). Based on the IML, competency can be analysed. The analysis is the learner's conscious explanation and justification of the quality of their activity, including performance and the cognitive processes that led them to it (Leclercq & Poumay, 2004). The evaluator must take into account the learner's analysis (constructive characteristic of competency) plus the actual result of their activity (productive characteristic of competency) to define the level of development the learner has achieved and thus certify competency (Coulet, 2011; Tardif, 2017; Tardif & Dubois, 2013).

A person's analysis becomes a shared space between individuals (arrow from IML to SML), e.g., a student and their peers during the learning phase or a student and their teacher during an assessment. The conscious exchange between different people leads to the deliberate control of individual cognition and, consequently, controlling their productive activity (arrow from SML to IML). In other words, the results of the SML become meta-metacognitive information that each person has to consider to activate their IML and lead to acceptable performance (Efklides, 2008).

The SML comprises three components: Metacognitive Knowledge (MK), Metacognitive Judgments (MJ), and metacognitive Abilities (MA). MK refers to individuals' representations of the situation (contextual knowledge including the task demands) and themselves (knowledge and abilities they have at their disposal to complete the prescribed task). MJ are a shared assessment made by both parties regarding the degree of quality they attribute to the individual activity being analysed. MJ are made between both actors based on their individual MK (double arrow from MK to MJ). According to the result of the MJ, both actors activate their individual MA to regulate (initiate, stop or modify) the use of cognitive strategies (memory strategies, attentional focus, reasoning, planning, evaluation, etc.) to deliberately control their cognition (arrow from MJ to MA) (Efklides, 2008; Leclercq & Poumay, 2004; Masciotra et al., 2004; Panadero, 2017; Quiles, 2014). E.g., during the assessment, students will share the analysis of their own competency with their teacher. Together, they will make a MJ on the students' competency and, from the results of this explicit and conscious judgment and their individual MK, they will activate their MA to control their activity (arrow from MK to MA) through their IML.

The IML's role is to allow people to situate themselves according to context and act coherently. The IML and the task are in red because they are both necessary for self-regulation in accordance with the situation (also in red). E.g., learners must differentiate between what is expected of them and what they are actually able to do. In a learning and evaluation situation, they must recognise the prescribed task(s) by the teacher and, through metacognition, carry out the said task(s) to achieve acceptable performance. Performance is the concrete result of the activity, a finalised action measured by the prescribed task (Chauvigné & Coulet, 2010; Coulet, 2011; Efklides, 2008; Tricot, 2017).

To situate themselves through the IML, students use Metacognitive Experiences (ME), MK, and MA. MK is being continuously updated by integrating information from ME and MA (arrows from ME and MA to MK). ME reflects the ongoing cognitive and metacognitive process that individuals undertake to monitor their activity while performing a task (awareness of the state of cognitive processing and the production of possible conflicts or errors). The ME is an evaluation of the degree of accuracy and/or degree of satisfaction that the learner attributes to their ongoing activity. First, individuals understand their activity through MK, and then they evaluate their performance (or future performance) according to the prescribed task (arrow from MK to ME). Based on the results of the ME, students use their MA to regulate the use of cognitive strategies to regulate their cognition and achieve adequate performance (arrow from ME to MA) (Efklides, 2008; Leclercq & Poumay, 2004; Masciotra et al., 2004; Panadero, 2017; Quiles, 2014). The difference between ME and MJ from the MSL is that MJ are necessarily conscious because they are a shared judgment between two people. In contrast, individuals are not imperatively aware of their ME.

As for the relationship between the SRL process and productive activity, metacognition is a function of performance. First, the IML is used to situate the task before passing into action (PRE performance), regulation and control regard only the prescribed task (double arrow from IML to Task). Then it is used while performing (PER), regulation and control regard the relation between the prescribed task and ongoing performance (double arrow from Task to Performance). Finally, the IML is used after the action is completed in a tangible result, regulation and control regard the finalised performance (POST) (double arrow from Performance to IML) (Efklides, 2008; Leclercq & Poumay, 2004).

To sum up, competency supposes not only good performance (successful handling of the demanded task(s) through metacognition) but also a conscious and socially acceptable understanding of the self-regulatory process allowing for it (Jonnaert, 2009; Tardif, 2017).

## 5. Future research

The MSRMC aims to be a theoretical backbone to the development of competency assessment tools. To this day, there is an ongoing experiment at AMU where teachers and students are testing a new tool called "Reflexive questions". Students must answer metacognitive questions (including MK, ME, and MA items) at the class's beginning, middle, and end (PRE, PER, POST performance). Answering these questions has a double aim: supporting students' reflexive activity and offering teachers a new tool to assess competency that can be complementary to the evaluation of performance.

## References

- Boutin, G. (2004). L'approche par compétences en éducation: Un amalgame paradigmatique. *Connexions*, 81(1), 25-41.
- Buckley, S., Coleman, J., Davison, I. S., Khan, K., Zamora, J., Malick, S., Morley, D., Pollard, D., Ashcroft, T., Popovic, C., & Sayers, J. (2012). Les effets éducatifs des portfolios sur l'apprentissage des étudiants pendant le cursus prégradué: Une revue systématique de la collaboration Best Evidence Medical Education (BEME). Guide BEME N° 11. *Pédagogie Médicale*, 13(2), 115-145.
- Chauvigné, C., & Coulet, J.-C. (2010). L'approche par compétences: Un nouveau paradigme pour la pédagogie universitaire? *Revue française de pédagogie*, 172, 15-28.
- Coulet, J.-C. (2011). La notion de compétence: Un modèle pour décrire, évaluer et développer les compétences. *Le travail humain*, 74(1), 1-30.
- Crahay, M. (2006). Dangers, incertitudes et incomplétude de la logique de la compétence en éducation. *Revue française de pédagogie. Recherches en éducation*, 154, 97-110.
- Dignath, C., & Büttner, G. (2008). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning*, 3(3), 231-264.
- Efklides, A. (2008). Metacognition: Defining Its Facets and Levels of Functioning in Relation to Self-Regulation and Co-regulation. *European Psychologist*, 13(4), 277-287.
- Goudreau, J., & Boyer, L. (2017). Chapitre 3. Dix ans de mise en œuvre d'un programme de 1er cycle universitaire en sciences infirmières basé sur l'approche par compétences: Toujours des enjeux d'évaluation. In Marianne Poumay (Ed.), *Organiser la formation à partir des compétences: Un pari gagnant pour l'apprentissage dans le supérieur* (pp. 63-79). Louvain-la-Neuve: De Boeck Supérieur.
- Jonnaert, P. (2009). *Compétences et socioconstructivisme: Un cadre théorique* (2<sup>nd</sup> ed.). De Boeck.
- Kahn, S., & Rey, B. (2017). La notion de compétence: Une approche épistémologique. *Éducation et francophonie*, 44(2), 4-18.
- Leclercq, D., & Poumay, M. (2004). Une définition opérationnelle de la Métacognition et ses mises en œuvre. *21ème colloque de l'Association Internationale de Pédagogie Universitaire (A.I.P.U.)* Université Cadi Ayyad de Marrakech (Maroc). «L'AIPU: 20 ans de recherches et d'actions pédagogiques; bilan et perspectives.»
- Masciotra, D., Jonnaert, P., & Daviau, C. (2004). *La compétence revisitée dans une perspective située*.
- Masciotra, D. (2005). Réflexivité, métacognition et compétence. *Vie pédagogique*, 134, 29-31.
- Mottier Lopez, L. (2017). La compétence à l'école pensée à partir de la perspective située de l'apprentissage. *Éducation et francophonie*, 44(2), 152-171.
- Panadero, E. (2017). A Review of Self-regulated Learning: Six Models and Four Directions for Research. *Frontiers in Psychology*, 8, 422.
- Pintrich, P., Wolters, C., & Baxter, G. (2000). Assessing metacognition and self-regulated learning. In G. Schraw & J. C. Impara (Eds.), *Issues in the measurement of metacognition* (pp. 43-98). Lincoln, NE: Buros Institute of Mental Measurements.
- Poumay, M., & Georges, F. (2017). Chapitre 2. Des balises méthodologiques pour construire un référentiel de compétences et une grille de programme. In Marianne Poumay (Ed.), *Organiser la formation à partir des compétences: Un pari gagnant pour l'apprentissage dans le supérieur* (p. 39-62). Louvain-la-Neuve: De Boeck Supérieur.
- Quiles, C. (2014). *Comment évaluer la métacognition? Intérêts et limites de l'évaluation de la conscience métacognitive «on-line»* [Doctoral dissertation, Université de Bordeaux].
- Tardif, J. (2017). Chapitre 1. Des repères conceptuels à propos de la notion de compétence, de son développement et de son évaluation. In *Organiser la formation à partir des compétences* (p. 15-37). De Boeck Supérieur.
- Tardif, J., & Dubois, B. (2013). De la nature des compétences transversales jusqu'à leur évaluation: Une course à obstacles, souvent infranchissables: *Revue française de linguistique appliquée*, XVIII(1), 29-45.
- Tardif, J., Fortier, G., & Préfontaine, C. (2006). L'évaluation des compétences: Documenter le parcours de développement. Chenelière-éducation.
- Tricot, A. (2017). *L'innovation pédagogique*. Retz.

## STIMULATION OF PRACTICES WITH EMERGENT LITERACY WITH STUDENTS IN THE INITIAL YEARS OF LITERACY

**Caroline Fernandes Brasil, Luana Baron Scollo, & Simone Aparecida Capellini**

*Investigation Learning Disabilities Laboratory (LIDA), Department of Speech and Hearing Sciences, São Paulo State University "Júlio Mesquita Filho" (UNESP) (Brazil)*

### Abstract

*Introduction:* In Brazil, there are few studies developed with emergent literacy and its impact on the development of reading and writing in students in the initial stage of literacy. *Objective:* to verify the educational effectiveness of a stimulation program with emergent literacy practices with students from the 1st and 2nd year of Elementary School. *Methods:* 20 students from the 1st and 2nd year of Elementary School participated in this study, distributed in two groups, GI composed by 10 students, 05 students from the 1st year and 05 students from the 2nd year submitted to the stimulation program and GII composed by 10 students, 05 students from the 1st year and 05 students from the 2nd year not submitted to the program of stimulation. All students were submitted to the application of the Cognitive-Linguistic Skills Assessment Protocol for students in the initial stage of literacy before and after the application of the stimulation program. The GI students were submitted to the application of the stimulation program with emergent literacy practices, consisting of 8 collective sessions with the presentation of the 8 books from the Stories Collection for the Development of Rhyme and Alliteration. *Results:* Both groups showed improvement in cognitive-linguistic performance, but the GI had a greater amount of skills developed. The GI students submitted to the stimulation program with emerging literacy showed better performance in skills considered predictors for the development of reading, such as copying forms, picture dictation, syllable segmentation, word dictation, word repetition, alliteration, rhyme, repetition of numbers in reverse order and rapid automatic naming of digits, while students from GII, not submitted to the stimulation program with emergent literacy, also showed better performance in skills considered predictors for the development of reading, such as copying forms, dictation figures and segmentation of syllables. *Conclusion:* The fact that GI students showed improvement in metaphonological skills is consistent because the focus of the stimulation program carried out was precisely to develop skills related to the proper use of the letter-sound conversion mechanism. The choice of stories used to carry out the program contained facilitating factors for the development of reading and writing. However, the students from the GII, who did not undergo the stimulation program with emerging literacy, also showed better performance in skills considered predictors for the development of reading, such as copying shapes, dictating pictures and segmenting syllables, showing that the improvement of the students from the GI in these skills cannot be attributed to the program, since the school also offered educational strategies in the classroom that enabled students to develop these skills.

**Keywords:** *Literacy, learning, reading, emergent literacy.*

---

### 1. Introduction

Literacy is a social construction, mediated by language, therefore, it is characterized by being inseparable from cultural and linguistic practices, as well as power relations in specific contexts (Gillen and Hall, 2003). In this way, literacy is molded and developed in the individual due to the different experiences that will be established throughout life (Gomes and Lima Santos, 2004).

Literacy intervention should occur in Early Childhood Education, when literacy is treated in the educational context, it assumes a new concept, the concept of emergent literacy, which is characterized by being a process based on experiences, practices and happiness with written language, which when positive, allow the development of speaking, reading and writing skills in the Early Childhood Education period (Dougherty, 1999; Smith et al., 2002; Roskos et al., 2003).

With the advent of the COVID-19 pandemic, social isolation was imposed as a measure to prevent and reduce the spread of the virus and, among these measures, in addition to the closure of many educational

institutions, the suspension of face-to-face classes and remote teaching were implemented (Camacho et al., 2020; Joaquim, Menezes, & Anna, 2020). In this view, this study aimed to verify the educational effectiveness of the stimulation program with emergent literacy practices with students in the 1st and 2nd year of Elementary School I.

### 2. Methods

This study was approved by the Research Ethics Committee of the home institution (4,862,668). This is a prospective cross-sectional cohort study, consisting of a convenience sample. The study included 20 students aged 6 to 7 years and 11 months from the 1st and 2nd years of Elementary School I of a Brazilian municipal public school with lower-middle socioeconomic status, distributed in:

**Group I (GI):** 10 students, of both genders, aged between 6 years and 7 years and 11 months, with five students from the 1st year and five students from the 2nd year submitted to the stimulation program.

**Group II (GII):** 10 students, of both sexes, aged between 6 years and 7 years and 11 months, five of which were in the 1st year and five in the 2nd year not submitted to the stimulation program.

All students in this study underwent the Cognitive-Linguistic Skills Assessment Protocol for Students in the Initial Literacy Phase (Silva and Capellini, 2019) in a pre- and post-testing situation for the application of the Emerging Literacy Practice Stimulation Program. The stimulation program consisted of 8 books from the Stories Collection for the Development of Rhyme and Alliteration (César, Santos and Capellini, 2019) carried out in alphabetical order with groups of 5 students.

### 3. Results

Figure 1. Performance of Students in the Cognitive-Linguistic Skills Assessment Protocol pre and post stimulation program of literacy.

SUBTESTS	Categories	GROUPS					
		I			II		
		Freq.	Perc.	Sig. (p)	Freq.	Perc.	P value
EDHPRE	1	0	0,00%	> 0,999	2	20,00%	0,317
	2	6	60,00%		4	40,00%	
	3	4	40,00%		4	40,00%	
EDNPOS	1	0	0,00%	0,102	1	10,00%	0,180
	2	6	60,00%		4	40,00%	
	3	4	40,00%		5	50,00%	
EASPRE	0	1	10,00%	0,034*	1	10,00%	0,046*
	1	1	10,00%		1	10,00%	
	2	1	10,00%		0	0,00%	
EASPOS	3	7	70,00%	0,034*	8	80,00%	0,046*
	2	1	10,00%		2	20,00%	
	3	9	90,00%		8	80,00%	
CFPRE	1	3	30,00%	0,317	2	20,00%	> 0,999
	2	7	70,00%		7	70,00%	
	3	0	0,00%		1	10,00%	
CFPOS	1	0	0,00%	0,317	1	10,00%	> 0,999
	2	7	70,00%		5	50,00%	
	3	3	30,00%		4	40,00%	
DPPRE	0	4	40,00%	0,034*	2	20,00%	0,180
	1	2	20,00%		3	30,00%	
	2	3	30,00%		4	40,00%	
DPPPOS	3	1	10,00%	0,034*	1	10,00%	0,180
	0	3	30,00%		2	20,00%	
	1	0	0,00%		2	20,00%	
DFPRE	2	3	30,00%	0,066	1	10,00%	0,034*
	3	1	10,00%		2	20,00%	
	0	3	30,00%		2	20,00%	
DFPOS	1	0	0,00%	0,034*	3	30,00%	0,023*
	2	4	40,00%		4	40,00%	
	3	2	20,00%		1	10,00%	
DN PRE	0	3	30,00%	0,317	2	20,00%	> 0,999
	2	0	0,00%		2	20,00%	
	3	7	70,00%		6	60,00%	
DN POS	1	1	10,00%	0,317	3	30,00%	> 0,999
	2	5	50,00%		3	30,00%	
	3	4	40,00%		4	40,00%	
RASPRE	1	2	20,00%	0,034*	3	30,00%	> 0,999
	2	4	40,00%		3	30,00%	
	3	4	40,00%		4	40,00%	
RASPOS	0	3	30,00%	0,034*	1	10,00%	> 0,999
	1	0	0,00%		2	20,00%	
	2	3	30,00%		3	30,00%	
RAOAPRE	3	10	100,00%	> 0,999	10	100,00%	> 0,999
	3	10	100,00%		10	100,00%	
	2	0	0,00%		1	10,00%	

SUBTESTS	Categories	GROUPS					
		I		Sig. (p)	II		P value
		Freq.	Perc.		Freq.	Perc.	
RAOAIPOS	3	10	100,00%	0,063	9	90,00%	0,083
	3	10	100,00%		10	100,00%	
LPPRE	0	6	60,00%	0,083	6	60,00%	0,083
	1	1	10,00%		0	0,00%	
	3	3	30,00%		4	40,00%	
LPPPOS	0	3	30,00%	0,083	3	30,00%	0,083
	1	1	10,00%		0	0,00%	
	2	1	10,00%		4	40,00%	
LPPPRE	0	6	60,00%	0,083	6	60,00%	0,083
	1	0	0,00%		1	10,00%	
	2	1	10,00%		0	0,00%	
LPPPOS	0	3	30,00%	0,083	3	30,00%	0,083
	1	0	0,00%		4	40,00%	
	2	1	10,00%		0	0,00%	
RPPRE	0	1	10,00%	0,008*	2	20,00%	0,102
	1	1	10,00%		0	0,00%	
	2	7	70,00%		7	70,00%	
RPPPOS	0	1	10,00%	0,008*	1	10,00%	0,102
	1	0	0,00%		1	10,00%	
	2	2	20,00%		7	70,00%	
APRE	3	8	80,00%	0,004*	2	20,00%	0,063
	0	4	40,00%		5	50,00%	
	0	4	40,00%		5	50,00%	

SUBTESTS	Categories	GROUPS					
		I		Sig. (p)	II		P value
		Freq.	Perc.		Freq.	Perc.	
APÓS	1	1	10,00%	0,024*	1	10,00%	0,038*
	2	5	50,00%		2	20,00%	
SSPRE	3	0	0,00%	0,024*	2	20,00%	0,038*
	0	0	0,00%		1	10,00%	
	1	1	10,00%		3	30,00%	
SSPOS	2	3	30,00%	0,024*	4	40,00%	0,038*
	3	6	60,00%		2	20,00%	
	0	2	20,00%		3	30,00%	
DSPRE	1	0	0,00%	0,102	1	10,00%	0,083
	2	4	40,00%		3	30,00%	
	3	4	40,00%		0	0,00%	
DSPOS	1	0	0,00%	0,102	5	50,00%	0,083
	2	1	10,00%		3	30,00%	
	3	9	90,00%		6	60,00%	
RPPRE	0	2	20,00%	0,025*	2	20,00%	0,157
	1	1	10,00%		0	0,00%	
	2	2	20,00%		5	50,00%	
RPPPOS	0	0	0,00%	0,025*	1	10,00%	0,157
	1	2	20,00%		0	0,00%	
	2	5	50,00%		5	50,00%	
RPPPOS	3	3	30,00%	0,025*	4	40,00%	0,157
	0	0	0,00%		1	10,00%	
	1	2	20,00%		0	0,00%	

SUBTESTS	Categories	GROUPS					
		I		Sig. (p)	II		P value
		Freq.	Perc.		Freq.	Perc.	
RNPPOS	1	1	10,00%	0,157	1	10,00%	0,317
	2	2	20,00%		4	40,00%	
	3	7	70,00%		5	50,00%	
RNPPRE	0	0	0,00%	0,157	1	10,00%	0,317
	1	1	10,00%		0	0,00%	
	2	2	20,00%		1	10,00%	
RNPPPOS	3	7	70,00%	0,157	8	80,00%	0,317
	1	0	0,00%		1	10,00%	
	2	2	20,00%		1	10,00%	
RNOIPRE	0	1	10,00%	0,025*	4	40,00%	0,034*
	1	5	50,00%		4	40,00%	
	2	2	20,00%		2	20,00%	
RNOIPOS	3	2	20,00%	0,025*	0	0,00%	0,034*
	1	2	20,00%		7	70,00%	
	2	6	60,00%		2	20,00%	
RANFPRE	3	2	20,00%	0,102	1	10,00%	0,059
	0	0	0,00%		1	10,00%	
	1	2	20,00%		3	30,00%	

SUBTESTS	Categories	GROUPS					
		I		Sig. (p)	II		P value
		Freq.	Perc.		Freq.	Perc.	
RANFPOS	2	5	50,00%	0,102	3	30,00%	0,157
	3	3	30,00%		3	30,00%	
	1	1	10,00%		3	30,00%	
RANDPRE	2	3	30,00%	0,025*	1	10,00%	0,059
	3	1	10,00%		0	0,00%	
	1	3	30,00%		3	30,00%	
RANDPOS	2	3	30,00%	0,025*	5	50,00%	0,059
	3	4	40,00%		2	20,00%	
	1	3	30,00%		3	30,00%	
MVPRE	1	3	30,00%	0,102	2	20,00%	0,157
	2	4	40,00%		4	40,00%	
	3	3	30,00%		3	30,00%	
MVPPOS	1	0	0,00%	0,102	2	20,00%	0,157
	2	6	60,00%		4	40,00%	
	3	4	40,00%		4	40,00%	

#### 4. Discussion

The fact that the students in GI showed improvement in metaphonological skills (rhyme, alliteration, and syllabic segmentation) is coherent because the focus of the stimulation program was precisely to develop skills related to the proper use of the letter-sound conversion mechanism, thus developing the phonological pathway for reading development; this is because the choice of stories used for the program contained facilitating factors for reading and writing development (Ellis, 1998; Alves, 2012).

However, among the GII students who did not undergo the emergent literacy stimulation program, they also showed better performance in skills considered predictors for reading development, such as copying shapes, dictating figures, and segmenting syllables, showing that the improvement of the GII students in these skills cannot be attributed to the program, since the school also offered educational strategies in the classroom that enabled the students to develop these skills.

#### 4.1. Implications and limitations

The number of subjects in this study was small, which may be a limiting factor for the generalization of its findings, however, this is one of the first Brazilian studies with emergent literacy, which in this way may contribute to the need to discuss these practices in classroom.

The fact that there were no statistically significant levels in the reading subtests or in the other subtests of the protocol used for evaluation in the two moments of the study does not invalidate the importance of these findings. On the contrary, it reinforces the need to carry out new studies with a greater offer of stimulation with emergent literacy, in order to verify the occurrence of changes in the performance of cognitive-linguistic skills of students in the initial phase of schooling as a result of more frequent stimulation and longer duration of the proposed activities.

#### 5. Conclusion

The data from this study revealed that GI students submitted to the stimulation program with emergent literacy showed better performance in skills considered predictors for the development of reading, such as copying shapes, dictating pictures, segmenting syllables, dictating words, repeating words, alliteration, rhyme, repeating numbers in reverse order, and fast auto naming of digits.

We emphasize that the fact that the GI students showed improvement in phonological skills (rhyme, alliteration, and syllable segmentation) is consistent, because the focus of the stimulation program carried out was precisely to develop skills related to the proper use of the letter-sound conversion mechanism, therefore, development of phonological route for the development of reading.

However, among the students from the GII, also showed better performance in skills considered predictors for the development of reading, such as copying shapes, dictating pictures and segmenting syllables, showing that the students' improvement of GI in these skills cannot be attributed to the program, since the school also offered educational strategies in the classroom that enabled students to develop these skills.

The study also highlights more than an educational problem, since the COVID-19 pandemic resulted in the blocking of access to school and increased a gap in the exposure of the little ones to emergent literacy practices in Early Childhood Education, reconfiguring the education system, society and consequently demonstrating that speech-language pathology professional, both from a clinical and educational perspective, is necessary, mainly to combine the areas of Education and Health.

#### References

- Alves, R. A. (2012). Promoção da literacia emergente através do programa ouvir as letras. In *Actas do 12º Colóquio de Psicologia e Educação* (pp. 1550-1567).
- Camacho, A. C. L. F., Joaquim, F. L., Menezes, H. F. D., & Sant'Anna, R. M. (2020). A tutoria na educação à distância em tempos de COVID-19: orientações relevantes/Tutoring in distance education in times of COVID-19: relevant guidelines. *Research, Society and Development*, 9(5), 3095-3151. <http://dx.doi.org/10.33448/rsd-v9i5.3151>
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Rata Rose*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Coelho Conrado*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Poppi Porco-Espinho*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Túlio Tartaruga*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Borboleta Bibi*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Fred Fofinho*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Gata Gabi*. Ribeirão Preto: BookToy.
- César, A. B. P. C.; Santos, B.; & Capellini, S. A. (2019). *Histórias para o Desenvolvimento de Rima e Aliteração: Samuel Sortudo*. Ribeirão Preto: BookToy.
- Dougherty, J. C. (Ed.). (1999). *Improving Early Literacy of Preschool Children: A Handbook for Prekindergarten Educators*. Texas Instruments Foundation.
- Ellis, A. W. (1998). *Reading, writing and dyslexia: a cognitive analysis*. Psychology Press.



- Gomes, I., & Lima Santos, N. (2004). Literacia: questões conceptuais e metodológicas para a construção de instrumentos de avaliação. In *Actas da X Conferência Internacional de Avaliação Psicológica: Formas e Contextos* (pp. 41-46).
- Roskos, K. A., Christie, J. F., & Richgels, D. J. (2003). The Essentials of Early Literacy Instruction. *Young Children*, 58(2), 52-60.
- Silva, C., & Capellini, S. A. (2019). *Protocolo de avaliação das habilidades cognitivo-linguísticas para escolares em fase inicial de alfabetização*. Book Toy.
- Smith, M., Anastasopoulos, L., Dickinson, D. K., & Sangeorge, A. (2002). *User's guide to the early language & literacy classroom observation toolkit: Research edition*. Paul H. Brookes.

# TEACHER TRAINING ON FUNDAMENTAL PROGRAMMING FOR MATHEMATICS AND TECHNOLOGY – WHAT ARE THE COURSE TAKEAWAYS?

**Peter Mozelius**

*Department of Communication, Quality Management and Information Systems,  
Mid Sweden University (Sweden)*

## Abstract

The introduction of computer programming in K-12 education is a prioritised initiative in many countries. In the Swedish context this is an ongoing process with support from the government and the National Agency for Education. The focus has been set on secondary school and how to implement programming as an extension for teaching and learning activities in mathematics and technology. Several studies have reported on how to optimise the teacher training, but less has been presented on learning outcomes that can have an impact on teaching and learning in secondary school. The aim of this study was to analyse and discuss how learning outcomes could be of use in secondary school teachers daily teaching and learning activities. The main research question to answer was: *"In what parts of secondary school mathematics and technology can programming add value, and how might this be related to the learning outcomes of the teacher training?"* Data have been gathered from course participants essays that were submitted in two batches of the teacher training course on programming. Essays were analysed thematically with the research strategy of analytical induction. Found themes have been grouped into main categories that are related to the essayists course outcomes. Most of the essayists have completed the course, but not all of them. Findings indicate that the subset of course takeaways that the essayists have chosen to reuse are related to their learning outcomes, but also to the stage of secondary school where they teach. Lower secondary school teachers with low learning outcomes have a tendency to choose the themes of visualisation of geometrical concepts and computational thinking. To be compared with upper secondary school teachers with high learning outcomes that had a preference for using programming to illustrate number series and statistics. However, there are a lot of variations from these themes and counterpoints, which is the main discussion in this paper. Interesting new themes that emerged from the analysis of the essays were Debugging, General problem solving

**Keywords:** *Programming education, teacher training, learning outcomes, Python, K-12 STEM.*

## 1. Introduction

To involve computer programming in K-12 education is a prioritised and ongoing initiative in Europe, and in many other parts of the world (Lye & Koh, 2014; Balanskat & Engelhardt, 2015; Lindberg, Laine & Haaranen, 2019). In Sweden context this process was initiated by the government and the National Agency for Education. A revised a revised curriculum was presented in 2017 where it also was stated that programming should be involved in secondary school mathematics and technology (Heintz et al., 2017). This reform would obviously require a large-scale and long-term teacher training, since more or less all secondary school teacher in Science, Technology, Engineering and Mathematics (STEM) ought to participate, but cannot participate at the same time. What has been highlighted in several research publications is that STEM teachers without appropriate training have severe problems to handle the involvement of programming in their teaching and learning activities (Royal Society, 2017; Pörn, Hemmi & Kallio-Kujala, 2021).

The rationale for this study is that several research studies have reported on challenges and opportunities in the teacher training (Menekse, 2015; Humble & Mozelius, 2021), but less has been presented on learning outcomes that can have an impact on the actual teaching and learning in secondary school. As described in Mozelius and Humble (2022), this process should be seen as a two-stage rocket with the second stage, post teacher training, as the most important for a long-term success. The aim of this study was to analyse and discuss how learning outcomes could be of use in secondary school teachers

daily teaching and learning activities. The main research question to answer was: *"In what parts of secondary school mathematics and technology can programming add value, and how might this be related to the learning outcomes of the teacher training?"*

## **2. Research context – A course on programming for secondary school teachers**

Several Swedish universities have developed contract courses to address the necessary teacher training. At the Mid Sweden University tailored courses on programming in K-12 settings have been given since 2018. The course is where this research has been conducted is one of many courses to support the curriculum development initiative. A lesson learnt is that a reuse of standard courses from Bachelor's programmes does not fit this target group. As an example, this kind of teacher training courses need a higher emphasis on didactic concepts and programming assignments aligned to STEM. With the idea that didactic concepts and STEM aligned assignments could be reused in course participants' daily teaching and learning activities. Examples of didactic concepts in the course are pair programming, visualisation, computational thinking and game-based learning (Mozelius, 2018).

From the beginning, and according to the instructions from the National Agency for Education, the course was of 7,5 ECTS, divided in the five main sections: 1) Programming in school, why, what and how? 2) The fundamental building block of programming; 3) Didactics for Technology and Mathematics; 4) Didactics for programming education; and 5) Mini-project. Considering the fact that the course participants are full-time working teachers, the course has been run at a 25% study pace. In 2020 the syllabus framework was redesigned to comprise 5 ECTS, and to have a stricter focus on textual programming. To compare with the original version that presented various other types of programming such as block programming and unplugged programming. In this new course design, Python was chosen as the only programming language.

Due to the outburst of the Corona pandemic, the new version of the course had to shift from a blend of synchronous face-to-face and asynchronous online activities to a full online course. Important to provide new alternatives for synchronous group activities. The video conference system Zoom has replaced the previous face-to-face meetings and activities such as ensemble programming and problem solving in smaller groups. What could be seen as a major challenge for the course, has turned out to be successful and efficient without lowering the pass rate. When the older version of this course only had an uptake of teachers from the Mid-Sweden region, the redesigned online version of the course have had a nation-wide enrolment.

## **3. Methods and materials**

The overall strategy for this study was the action research approach where the author also has been teachers and facilitators in the involved course instances. Action research can be described as a practical but systematic research method that "enables teachers to investigate their own teaching and their student's learning" (Nolen & Putten, 2007, p. 401). The action research design in this study was in the British tradition of pedagogical action research, and as described by Norton (2018, 266 p. 71), an approach "that links research to improvement of practice and is education orientated". Data was gathered from course participants essays submitted in two batches of the described teacher training course. Essays were analysed thematically with the strategy of analytical induction, an iterative process in which preliminary themes and categories were developed early in the analysis process. Later, new found themes were compared to the earlier, to either support or refute existing categories and the relationships between them. Most of the essayists completed the course, and the analysed essay was the eighth assignment of ten in the course instances. As inspiration for the essay writing, four research articles aligned to the topic, were provided in the virtual learning environment. All essayists have been kept as anonymous as possible, and quotes have been translated from Swedish to English by the author. Some Swedish expressions and idioms have been replaced with their English equivalents to improve the readability and understanding.

## **4. Findings and discussions**

Found themes were grouped into categories that are related to the essayists course outcomes. Findings show that the subset of the course content that the essayists have chosen to reuse are related to their learning outcomes, which also was an overall idea in the course design. Moreover, the different stages of secondary school where the essayists carry out their daily teaching and learning activities make an obvious difference. Therefore, the results from lower and upper secondary school are presented

separately here below. There have been more teachers from lower secondary school in the selected course batches and there were more findings to report in this category.

#### **4.1. Lower secondary school**

The two different trails for how to integrate the course takeaways in teaching and learning activities are not solely, but more clearly identified for lower secondary school. As expressed by one of the essayists "Currently I see programming in two different tracks; on one hand programming for its own sake, and on the other hand as a tool to better understand concepts such as geometry". However, regarding geometry several essayists found relevant ways to combine the two trails.

##### **Geometry**

Several good examples were found in the essays where relatively short snippets of programming code could support fundamental geometrical algorithms such as calculating circumferences, areas and volumes of various kinds of polygons. In one essay it is mentioned that "I think that programming should be involved as a natural part of geometry and algebra in the beginning", and that "Regarding geometry, I believe that it could be a way to understand the various algorithms that calculates areas and circumferences for geometrical figures". Another essayist points out that "Programming could visualise geometry and how different objects change, when different variables change" and that "Geometrical figures could of course be drawn on a whiteboard, but programming gives us a faster and more interactive tool". There are also ideas for how to calculate angle sums in geometrical figures, and how angles in a polygon could be related to the number of corners in a polygon. To involve programming in basic geometry is in some essays combined with the next category of visualisation.

##### **Visualisation**

Many teachers bring up visualisation of the geometry concepts in the previous section. An easy way of doing this is to use the Python Turtle module, a ingoing library in the standard Python environment that enables users to create shapes and figures with a pen on a virtual canvas. One of the teachers that started the course with no earlier programming experience found it harder to start with text-based programming compared to the more visual block programming. This teacher that also teach mathematics for primary school students (grade 4), tells that it was interesting to draw geometrical figures with Python Turtle, but that that younger students can get stuck in an "unreflected doing", and just drawing patterns. There are also other forms of visualisation mentioned in the essays, such as when a teacher presents the idea of a program that visualises exponential growth, and the growth of high interest rates. All suggestions in the essays are for 2D-graphics, and that 3D-graphics would require add-on modules that could not be part of an introductory course. Several essayists also suggest to start out with block programming to get a more visual introduction to programming and computational thinking. With the idea that "Scratch could be a tool that creates motivation for further programming".

##### **Programming in technology**

The courses had a majority of teachers with mathematics as the main subject, but there were also some teachers in technology, and teachers teaching in both, and more subjects. It seems like teachers in technology have got a lot of new hardware resources during the last years, and one of them wrote that "Our school has recently purchased a robot and a 3D printer that the students should program and steer. It feels both exciting and scary, and will be a moment when my recently achieved programming skills will be tested." Technology teachers often bring up programming as a useful and necessary tool for control and regulation technology. A teacher brings up in his essay that "the initial programming was problematic, and that the municipalities 'IT Office' could not install Python properly on the school computers". His way forward was to switch to makecode.microbit.org, to get rid of installation issues. Microbit is a small pocket-sized computer that is good for illustrating how software can interact with hardware. This gave a new concrete touch to programming, and that "Two girls that earlier 'hated' programming became the new facilitator that helped other students". There are also essayists sharing experiences on non-working technology, and the frustrating feeling of not being able to carry out an intended lesson plan due to tech trouble. One teacher highlighted that "Tech trouble is a realty that we have to live with, and unfortunately technology-based assignments sometimes have to be skipped".

#### **4.2. Upper secondary school**

The essays from the upper secondary school teachers showed more specific suggestions, and a preference for using programming to work with algorithms and statistics, to illustrate number series and to solve equations. One teacher mentions that he wants to involve more concrete programming than the more general suggestions that have been given from the Swedish National Agency for Education.

He highlights that "As a upper secondary school teacher I'd expect that the fundamentals of programming have been learnt in lower secondary. There is no time for going through programming languages and computational thinking". One of his concrete example is to implement the so called 'pq-formula' to solve second grade equations, that is mentioned by several upper secondary school teachers. Two of them have also inserted programming code and a lesson plan for how to apply this in the Python programming language. Another idea is to import the Python statistics module, to "To reuse ideas in the course assignments to calculate mean and median values". One of the upper secondary school teachers points out that "It will take quite a lot of time to introduce programming, and in the beginning, it should be with the idea of using programming where it obviously is more efficient. An example of that is in the solving of numerical problems where a computer iterates so much faster than a human". This idea is partly new, but on the other hand programmable pocket calculators has been used for many years for numerical solutions such as the Newton-Raphson method.

### 4.3. Common emerging themes

#### **Debugging**

One lower secondary school teacher wrote that she during the course "has found strategies for error tracing, and internet forums with help on debugging". Several other teachers bring up that the general debugging, that they have been forced to in the solving of the course assignments, have given them the confidence to program in front of their student groups. A bit the same for the upper secondary school teachers as well, where one of them writes that "I've learnt a lot, and especially when I've got stuck and have had to error trace my code". Another teacher, that needed two attempts to complete the course, writes that "It felt like a personal victory when I, in my second attempt, was able to handle everything myself.", and that "programming is a good training for finding errors in solutions".

#### **Computational thinking and general problem solving**

In one answer the essay writer brings up the discussions on computational thinking that were a part of the course. That students could improve their computational thinking skills and their general problem solving "motivates programming as part of the curriculum to a higher degree, and might make more teachers interested in learning to program". Some of the teachers that took this course had no earlier experience at all, on the other hand there were also teacher with very good prerequisites. One teacher mentions in her essay that she "just one year ago had plans to leave teaching for a programming job in the industry". With the richer experience of programming, it was claimed that "much in programming is about problem solving, which of course can be of use in mathematics as well", and that "students probably could see the value of problem solving more clearly when they start programming, and even stronger if they program in pairs or in groups". One of the teachers writes that problem solving will be one of the focus themes in her school, next semester when programming should be integrated in mathematics. Other more general themes that were suggested be aligned to the mathematical syllabi are 'Probability & Statistics' and 'Relationships & Change'.

### 5. General discussion

There is a clear alignment between the categories that were found in the analysis, and the stated learning objectives in the teacher training course, which also was intended in the original course design (Mozelius, 2018). Examples of programming assignments that have been brought on from the course assignments and group exercises are to write code for classical algorithms such as Eratosthenes sieve, and the Fibonacci series. At the same time, teachers present new and creative ideas on how to apply programming in their daily teaching and learning activities. The teacher attitudes in this study are probably significantly more positive than the ones of the average technology and mathematic teachers, since this is a course that the most reluctant teachers never will take. To quote one of the teacher essays: "Based on my own experiences I know that there is a certain resistance among the teachers that have no earlier programming experiences. They look like they are longing for retirement when this question is raised. Here I know that there will not be any programming in their classes - which probably is understood by the National Agency for Education as well.". The first years of the described initiative is a good start, but the challenge that remains is how to achieve the goal of 'Programming for all'.

### 6. Conclusion and future work

In a brief answer to the research question "*In what parts of secondary school mathematics and technology can programming add value, and how might this be related to the learning outcomes of the teacher training?*". The conclusion is that lower secondary school teachers with low learning outcomes

had a tendency to choose the themes of visualisation of geometrical concepts and computational thinking. This should be compared with the upper secondary school teachers with high learning outcomes that had a preference for using programming to illustrate number series and statistics. However, there were also several individual variations and counterpoints, with new emerging themes such as debugging and general problem solving. Moreover, there is a clear relation to the learning outcomes of the teacher training course, but there are also a few surprising exceptions that give ideas for future course updates. Findings from this study will serve as input for the next iteration of intervention and evaluation in the spirit of pedagogical action research. It would also be interesting to compare the findings from this study with the analysis of teachers' lesson plans that was conducted in Mozelius and Humble (2022).

## References

- Balanskat, A., & Engelhardt, K. (2015). Computing our future. Computer programming and coding. Priorities, school curricula and initiatives across Europe. *European Schoolnet*, Brussels.
- Heintz, F., Mannila, L., Nordén, L. Å., Parnes, P., & Regnell, B. (2017). Introducing programming and digital competence in Swedish K-9 education. In V. Dagienė, & A. Hellas (Eds.), *Informatics in Schools: Focus on Learning Programming: 10th International Conference on Informatics in Schools: Situation, Evolution, and Perspectives* (pp. 117-128). Springer, Cham.
- Humble, N., & Mozelius, P. (2021). Enhancing Pedagogy to Andragogy in the Redesign of Teacher Training Courses on Programming. In C. Busch, M. Steinicke, R. Frieß, & T. Wendler (Eds.), *Proceedings of the 20th European Conference on e-Learning (ECEL 2021): A Virtual Conference Supported by University of Applied Sciences HTW Berlin, Germany* (pp. 210-217). Reading, UK: Academic Conferences and Publishing International Limited.
- Lindberg, R. S., Laine, T. H., & Haaranen, L. (2019). Gamifying programming education in K-12: A review of programming curricula in seven countries and programming games. *British Journal of Educational Technology*, 50(4), 1979-1995.
- Lye, S. Y., & Koh, J. H. L. (2014). Review on teaching and learning of computational thinking through programming: What is next for K-12?. *Computers in Human Behavior*, 41, 51-61.
- Menekse, M. (2015). Computer science teacher professional development in the United States: a review of studies published between 2004 and 2014. *Computer Science Education*, 25(4), 325-350.
- Mozelius, P. (2018). Teaching The Teachers To Teach Programming: On Course Design and Didactic Concepts. In *11th annual International Conference of Education, Research and Innovation* (Vol. 11, pp. 8031-8037). The International Academy of Technology, Education and Development.
- Mozelius, P., & Humble, N. (2022). Programming in K-12 Mathematics—A two-step rocket. In *INTED 2022, 16th annual International Technology, Education and Development Conference*, Valencia, Spain, [DIGITAL], March 7-8, 2022. (Vol. 16, pp. 2389-2397). IATED Academy.
- Nolen, A. L., & Putten, J. V. (2007). Action research in education: Addressing gaps in ethical principles and practices. *Educational researcher*, 36(7), 401-407.
- Norton, L. (2018). *Action research in teaching and learning: A practical guide to conducting pedagogical research in universities*. Routledge.
- Pörn, R., Hemmi, K., & Kallio-Kujala, P. (2021). Inspiring or confusing—a study of Finnish 1–6 teachers' relation to teaching programming. *LUMAT: International Journal on Math, Science and Technology Education*, 9(1), 366-396.
- Royal Society. (2017). *After the reboot: Computing education in UK schools*. Policy Report.

# PRE-SERVICE TEACHERS' KNOWLEDGE OF MATHEMATICS: A FRAMEWORK FOR SUSTAINABLE DEVELOPMENT OF STUDENT KNOWLEDGE

Natalia Karlsson<sup>1</sup>, & Wiggo Kilborn<sup>2</sup>

<sup>1</sup>*Department of Pedagogy and Didactics, Södertörn University, Huddinge, Stockholm (Sweden)*

<sup>2</sup>*Faculty of Education, University of Gothenburg, Gothenburg (Sweden)*

## Abstract

The purpose of this article is to draw attention to, analyze and discuss the following issues: (1) What mathematics should teacher education include, in order for student teachers to gain knowledge of a teaching practice that ensures the progression in students' mathematics development, and (2) How can the subject-specific content in an algebra course for student teachers be designed through an interaction between formal concepts in mathematics and the content of practical mathematics teaching with focus on algebra. An analysis of these issues is carried out within a theoretical framework of didactics of mathematics, related to a research context. This article is based on two research projects, MIL (Mathematics in teacher education) and SKUM (Student teachers' knowledge and perceptions of mathematics) as well as ongoing research work with a focus on the quality of student teacher education in mathematics and the didactics of mathematics in the K–3 and 4–6 programs at Södertörn University.

**Keywords:** *SMK model and pre-service teacher knowledge in mathematics, student teacher learning for teaching, algebra in teacher education, Abelian groups and teaching, rational numbers and teaching.*

---

## 1. Introduction

Mathematics is part of a cultural heritage and is an important tool for perceiving and developing the increasingly complicated world around us. Therefore, a primary purpose of teacher education in mathematics is to provide a perspective on the teaching of mathematics that is characterized by both science and how science can be implemented in school in relation to students' learning. This means that teacher education should focus both on the development of teacher students' own knowledge of mathematics and on how this can be translated into teaching in school in terms of how students learn mathematics at different ages (Hill et al., 2008). This applies not least to how they can present mathematics in a well-structured way, based on its concrete origins. The goal is, that the student teachers perceive the importance of what students gradually learn during their first years of school, based on individual students' abilities and needs, which will be generalized in the direction of the academic subject of mathematics (Subramaniam, 2019). This implies, that the mathematics taught during the first years of schooling must be preliminary, and must be, a simplified form of mathematics, that makes it accessible to all students, but at the same time is based on sustainable and developable mathematical concepts and methods. Accessibility also deals with student teachers' ability to find a continuity in students' learning from pre-school to grade 9 and onwards. This means that students successively learn the internal structures of the concepts as essential properties which in turn must be generalized with the aim of understanding the significance of the concepts and their connections and relationships to other concepts. To perceive and follow such a learning process in students' learning requires that the student teachers themselves are able to process and produce knowledge in their own learning. In other words, they must be able to take a second-order perspective on students' learning, which is intimately related to a first-order perspective on their own learning of mathematics (Leatham, 2006). This is a matter of solid self-awareness of how knowledge is perceived and developed, and what misconceptions may arise in learning. Pupils' misconceptions of mathematical concepts and methods can, like incorrect generalizations during earlier school years, cause serious consequences when students reach secondary school. To promote students' learning of mathematics and to perceive and correct their misconceptions, requires that student teachers have solid knowledge of the current mathematics, related to practical teaching.

This complexity also requires the transformation of formal mathematical concepts to a level that enables teacher students to learn. From this point of view, it requires a good overview of and insight into

the actual content, and an ability to break down the content, thus taking the teacher students' individual perceptions of the actual concept into account (Askew 2008). In addition, (Ball & Bass, 2000) emphasize that a lack of teacher knowledge about mathematical content, as well as subject matter knowledge in mathematics, can never be compensated for by practical experience. This means that today's teacher education should aim to prepare student teachers in such a way that they are able to teach a form of mathematics that supports the mathematical development of the students. Another aspect is, that the impact of the student teachers' mathematical knowledge and their experience from their studies in mathematics from primary and secondary school is very strong and crucial for their reflections about the opportunity to study mathematics and the didactics of mathematics in teacher education. The same aspects are problematized also by other researchers (Radovic, Black, Williams, & Salas, 2018).

## 2. Background

In this article the results of two ongoing theoretical research works are followed up: namely *Student teacher knowledge and perceptions of mathematic* (SKUM) and *Mathematics in Teacher Education* (MIL) (Karlsson, 2015). The purpose of the theoretical study is to analyze what mathematics in teacher education means with respect to student teachers' knowledge of mathematical content, and the sustainable development of students' mathematical knowledge in elementary school, with a particular focus on algebra. This project focuses on the following research questions. *RQ1* What mathematics should teacher education include, in order for student teachers to gain knowledge of a teaching practice that ensures the progression in students' mathematics development. *RQ2* How can the subject-specific content in an algebra course for student teachers be designed through an interaction between formal concepts in mathematics and the content of practical mathematics teaching with focus on algebra.

### 2.1. The Subject Matter Knowledge model for pre-service teachers' learning of mathematics

Over the years, several researchers have claimed that teachers' knowledge of mathematics and knowledge of teaching is not sufficient to develop students' learning in mathematics. This led to a need to develop a "practice-based" theory called Subject Matter Knowledge (SMK). This theory forms the basis for what mathematics teachers should be able to teach. According to Ball, Thames and Phelps (2008) and Hill et al, (2008), the SMK model is divided into three areas, namely Common Content Knowledge (CCK), Specialized Content Knowledge (SCK) and Horizon Content Knowledge (HCK).

*“Common content knowledge is held by an adult who can use a method to solve a mathematical problem whereas specialized content knowledge is mathematical knowledge that is unique to teaching”* (Ball et al., 2008, p. 399).

Ball et al. (2008) emphasizes that teachers' CCK is a necessary factor for teaching, but it requires an interaction with SCK. One interpretation of this is that CCK is about the student's perspective of the content while SCK is about the teacher's perspective of the same content. SCK is a prerequisite for keeping focus on the "learning object" and offering a suitable variation of the content, from lower to higher levels of difficulty. At the same time, it is important to be aware that mathematics taught in the earlier school years is often based on preliminary concepts that will gradually be developed into more correct mathematical concepts. This means that it is not enough for teachers to simply understand the mathematics they teach. They also need to understand it in such a way that the content can be unpacked and developed in later school years. This put demands on teachers' ability to summarize the progression of students' learning from year 1 and onwards, in order to ensure the progression in teaching, which in turn leads to a need for knowledge in HCK, including knowledge of the curriculum in mathematics. Consequently, HCK is about seeing mathematics in a wider perspective, not least how the mathematics taught to younger children is connected to teaching at later stages and vice versa. It is also about how basic mathematical patterns (structures) permeate mathematics at all stages.

### 2.2. The SMK model from a Swedish perspective

In the same year that Shulman (1986) described what teachers should be able to teach, a research review in three parts called *Fackdidaktik I – III* was published in Sweden (Marton, 1986). Already a basic view of the SMK was presented. Under the heading “The origin of subject- didactic knowledge”, Marton wrote that one can easily get the impression that one always achieves subject-didactic knowledge through the application of general didactic theories being applied to different subject matters. This is by no means the case. The subject-didactic specialties are autonomous in the sense that, although they can borrow theories and models from neighboring sciences, especially from general didactics, both description and theory formation must be developed from within, based on the special content. Marton described the



research on subject didactics that was conducted in Gothenburg in the 1970s (Kilborn, 1979; Lybeck, 1981) and stated that studies of what and how the aspects of the teaching that take their point of departure in a mapping of the qualitatively different ways in which students perceive the phenomena covered in teaching, can be considered a research specialization within the didactic field. This direction can tentatively be called phenomenographic didactics (p. 68). A summary of this work is that what many years later was called SMK was a well-established area in Sweden already in the 1980s, but for various reasons, was not developed further as mathematics didactic research but instead was developed in the form of phenomenographic research (Marton, 2015).

### 3. Algebra in teacher education. Why algebra?

An important feature of teacher training is that student teachers develop algebraic reasoning based on generalize mathematical ideas, linked to algebraic concepts. This applies not least to concepts that constitute the basis of modern algebra and the conceptual relationships between algebra and the generalization of arithmetic, algebra and patterns, algebra and mathematical models and the meaning of algebraic symbols (Kaput, 2008). This presupposes that the student teachers can take a teacher's perspective on students' learning so that the continuity in, and expansion of, algebra in students' learning includes conceptual relationships between different number areas from natural numbers to real numbers. This means, among other things, that the conceptual relationships previously used for natural numbers also apply to negative numbers, rational numbers and real numbers, even if the operations themselves need to be modified. At the same time, it is important to perceive subtraction as the inverse operation of addition, and division as the inverse operation of multiplication. To help students make such generalizations, it is necessary for the student teachers to be provided with sufficient knowledge of algebra in order to understand how an extension of arithmetic in a conceptual sense works, before they start to teach that content (Kieran, 2004). It is about how students can learn algebra by working informally with the four rules of arithmetic methods and natural numbers in grades 1-6, but in such a way that they will later be able to apply these to whole, rational and real numbers. To understand these generalization processes, the student teachers need meta-knowledge of algebra.

#### 3.1. Abelian groups

Basic arithmetic assumes two Abelian groups (van der Waerden, 1971), one for addition and one for multiplication. A group consists of a set, for example natural numbers, and an operation, such as addition. The following conditions apply to addition as *Abelian group for addition*.

- For all  $a$  and  $b$  in the group, the sum  $a + b$  also belongs to the group. The group is said to be closed under addition.
- For all  $a$  and  $b$  in the group,  $a + b = b + a$ . This is the commutative law.
- For all  $a$ ,  $b$  and  $c$  in the group,  $(a + b) + c = a + (b + c)$ . This is the associative law.
- There is a neutral element  $0$  such that  $a + 0 = a$  for all  $a$  in the group.
- For all  $a$  in the group there is an element  $(-a)$  in the group such that  $a + (-a) = (-a) + a = 0$ . Here  $(-a)$  is called the (additive) inverse of  $a$  and vice versa.

Understanding the meaning of the Abelian groups is a key to algebraic ideas and logic. At the same time, it gives the student teacher an understanding of why students should learn mathematical concepts, what is decisive when introducing mathematical concepts and what is essential characteristics of the concept. A closer analysis of the *Abelian group for addition* shows that the first three points give information about which addition operations can be performed and how an addition algorithm can be built. This provides an important knowledge of what content the teaching ought to include with focus on what students should learn about algebra. Concerning the natural numbers, these three points are early known to all students, at least informally. To get further and understand subtraction and how to work with negative numbers, the last two points become important. For every natural number such as 4, there is an inverse, an opposite number,  $(-4)$ . In this way, not only the negative numbers are defined, but also subtraction of whole numbers. The subtraction  $a - b$  can be defined as  $a + (-b)$ . Based on this, it is possible to explain why  $a - (-b) = a + b$ . Simply stating procedurally that "same signs give plus and different signs give minus" does not lead to any developable knowledge. Moreover, the two minus signs have completely different meanings, they just look similar.

There is another *Abelian group for multiplication*.

- For all  $a$  and  $b$  in the group, the product  $a \cdot b$  also belongs to the group. The group is said to be closed under multiplication.
- For all  $a$  and  $b$  in the group,  $a \cdot b = b \cdot a$ . This is the commutative law.
- For all  $a$ ,  $b$  and  $c$  in the group,  $(a \cdot b) \cdot c = a \cdot (b \cdot c)$ . This is the associative law.
- There is a neutral element  $1$  such that  $a \cdot 1 = a$  for all  $a$  in the group.

- For all  $a$  in the group (provided that  $a \neq 0$ ), there is an element  $\frac{1}{a}$  such that  $a \cdot \frac{1}{a} = 1$ .  
 $\frac{1}{a}$  is called the (multiplicative) inverse of  $a$  and vice versa.

In order to link addition to multiplication, there is the distributive law:  $a \cdot (b + c) = a \cdot b + a \cdot c$ . An analysis of the definition for multiplication gives the student teachers an understanding that multiplication is an operation in arithmetic with special properties. The student teachers can also understand how important the distributive law is, not only to explain how the multiplication algorithm is structured but also its important role in mental arithmetic. By studying the definition of the group for multiplication, the student teachers can also realize the risks with a one-sided definition of multiplication as repeated addition. The commutative and associative laws of multiplication are difficult to derive from repeated addition, because of its one-dimensional nature. Repeated addition does not provide any insight into the two-dimensional structure of multiplication. As with addition, students early on master the first three points in the Abelian group for multiplication, when it comes to natural numbers, at least informally, although far from everyone understands the structure and properties of multiplication. The last two points in the definition deal with the inverse (reversed) operation of multiplication. With the help of the inverse, the student teachers can understand an important property of multiplication, namely how, starting from the natural numbers, they can not only define the rule of division of  $a / b$  as  $a \cdot \frac{1}{b}$ , but also the basic fractions  $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \dots$ . At the same time, the meaning of the multiplication operation must be redefined when the set of numbers is extended from whole numbers to rational numbers. To understand this and thereby create continuity in teaching, it is important that student teachers at all stages study basic algebraic concepts. This is a CCK which is a necessary basis for understanding the SMK which in turn provides the basis for a teacher student's ability to teach algebra in school.

### 3.2. Rational numbers, proportionality, and algebra

According to van der Waerden, (1971),

- Rational numbers are defined by quotients of integers  $a$  and  $b$ , where  $\frac{a}{b} = a \cdot \frac{1}{b} = \frac{1}{b} \cdot a$  and  $b \neq 0$ . Important properties of the rational numbers are that they form equivalence classes like  $\frac{a}{b} = \frac{c}{d}$ , where  $a \cdot d = b \cdot c$ . Each such equivalence class consists of infinite numbers of the type  $\frac{2}{5} = \frac{4}{10} = \frac{6}{15} = \frac{8}{20} = \frac{10}{25} = \frac{12}{30} \dots$
- They form a commutative field of numbers, which means that all the arithmetic laws that apply to whole numbers also apply to rational numbers. This means, that you do not have to start over from square 1 every time you change number range.
- Two new rules for calculation, must be introduced, namely  $\frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}$  and  $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$ .

This shows an important property of the rational numbers, namely that they are divided into equivalence classes, which means that every rational number in fractional form can be written in an infinite number of ways. This in turn means that there is a connection between rational numbers as fractions, proportions, ratios and rational equations (Kieren, 1976). An extension of arithmetic to algebra should thus include this. Another essential property is that the same arithmetic laws, the commutative, the associative and the distributive laws, also apply to rational numbers. This means that the arithmetic laws are a necessary key for the extension of number ranges from natural numbers to real (and complex) numbers and an algebra where the laws of arithmetic are expressed with symbols. This algebraic definition of rational numbers illustrates the importance of knowledge of mathematics (CCK) which in turn leads to knowledge of teaching content.

## 4. Conclusions and discussions

This article discusses findings regarding what mathematics in teacher training can mean in relation to mathematics didactic research such as the SMK model and how an interaction between formal mathematics and school mathematics with a focus on algebra can be achieved. Against this background, the student teachers can be offered a mathematical content that in turn can be transformed into teaching practice and in the long run benefit their future students. This article also draws attention to the need for the development of teacher training, where connections to research can be used when designing courses in mathematics didactics for future mathematics teachers. This, in turn, can be the start of a life-long development of teachers' competences. This article points out that student teachers' own knowledge of mathematics and algebra (CCK) is a key to their understanding of what the content in teaching is about

and what is meant by continuity in and sequencing of the content in mathematics teaching. In addition to this, a focus in teacher education should be on student teachers' knowledge of mathematics, where their knowledge of the practice of teaching is a logical continuation of their own knowledge of mathematics in combination with theories and empirics about mathematics teaching. An important conclusion is that an interaction between practice and a theoretical foundation can lead to meaningful learning for the student teachers and, in the long run, for their students' learning in mathematics at school.

We would like to conclude by thanking the student teachers at Södertörn University and the active teachers who have participated in our research studies and who have discussed and dared to try our ideas and thoughts.

## References

- Askew, M. (2008). Mathematical discipline knowledge requirements for prospective primary teachers, and the structure and teaching approaches of programs designed to develop that knowledge. In P. Sullivan & T. Wood (Eds.), *The international handbook of mathematics teacher education. Volume 1: Knowledge and beliefs in mathematics teaching and teaching development* (pp. 13-35). Rotterdam, The Netherlands: Sense.
- Ball, D. & Bass, H. (2000). Interweaving content and pedagogy in teaching and learning to teach: Knowing and using mathematics. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 83-104). Westport: Ablex Publishing.
- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407.
- Hill, H. C., Ball, D. L., & Schilling, S. G. (2008). Unpacking pedagogical content knowledge: Conceptualizing and measuring teachers' topic - specific knowledge of students. *Journal for Research in Mathematics Education*, 39(4), 372-400.
- Hill, H. C., Blunk, M. L., Charalambous, C. Y., Lewis, J. M., Phelps, G. C., Sleep, L., & Ball, D. L. (2008). Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study. *Cognition and Instruction*, 26(4), 430-511.
- Kaput (2008). What is algebra? What is algebraic reasoning? In J. Kaput, D. Carraher, & M. Blanton (Eds.), *Algebra in the early grades* (pp. 5-18). Mahwah, NJ: Laurence Erlbaum/Taylor & Francis Group & National Council of Teachers of Mathematics.
- Karlsson, N. (2015). *Matematik i lärarutbildningen: Studenters kunskaper i och uppfattningar om matematik. En forskningsrapport från MIL – och SKUM-projekten* [Mathematics in teacher education: Teacher students' knowledge of and perceptions of mathematics. A research report from the MIL and SKUM projects]. Huddinge: Södertörn University, Working Paper 15:4.
- Kieran, C. (2004). Algebraic thinking in the early grades: What is it? *The mathematics Educator*, 8(1), 139-151.
- Kieren, T. (1976). On the mathematical, cognitive and instructional foundations of rational numbers. In R. A. Lesh (Ed.), *Number and measurement: Papers from a research workshop* (pp. 101-144). Columbus, OH: ERIC/SMEAC.
- Kilborn, W. (1979). *PUMP-projektet. Bakgrund och erfarenheter* [PUMP-project. Background and experiences]. (Utbildningsforskning, FoU-rapport 37). Stockholm: Skolöverstyrelsen.
- Leatham, K. (2006). Viewing mathematics teachers' beliefs as sensible systems. *Journal of Mathematics Teacher Education*, 9(1), 91-102.
- Lybeck, L. (1981). *Arkimedes i klassen*. Göteborg Studies in Educational Sciences 37. Göteborg: Acta universitatis Gothoburgensis.
- Marton, F. (1986) *Fackdidaktik*. V. 1. Lund: Studentlitteratur.
- Marton, F. (2015). *Necessary conditions of learning*. London: Routledge.
- Radovic, D., Black, L., Williams, J. & Salas, C. E. (2018). Towards conceptual coherence in the research on mathematics learner identity: a systematic review of the literature. *Educational Studies in Mathematics*, 99(1), 21-42.
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.
- Subramaniam, K. (2019). Representational coherence in instruction as a means of enhancing students' access to mathematics. In Graven, M., Venkat, H., Essien, A. & Vale, P. (Eds), *Proceedings 43<sup>rd</sup> Annual meeting on the International Group for the Psychology of Mathematics Education* (Vol. 1), (pp. 33-52). South Africa: PME.
- van der Waerden, B. L. (1971). *Algebra*. New York: Springer Verlag.

## **RETHINKING LEARNING POTENTIALS: THE BENEFITS OF LEARNING ACROSS THE LIFE SPAN**

**Denise Calhoun, & Reyna García Ramos**

*Graduate School of Education & Psychology, Pepperdine University (USA)*

### **Abstract**

Is there ever a point in life when it is too late to learn? Researchers are continuously concerned about ways to intervene cognitive and communicative decline in older adults. In fact, many of the symptoms associated with aging seem to resemble early childhood development issues like limited mobility, and poor communication (Matteson, et al., 2007). With this in mind, there are a number of questions about the relationship between early development and later stages in the life span that merit consideration, such as what is the connection between these widely separated stages in life, and could it be possible to use these similarities and differences to raise awareness on the learning potential of older adults specifically? This study, therefore, emphasizes researching the effects of enhancing communicative and cognitive ability during later adulthood, as well as bringing awareness to families, staff, and administrators of elder care homes on methods that support older individuals. This idea gives rise to further queries, such as why the abilities of older adults fluctuate to varying degrees as they age. To answer these questions, a systematic review was conducted to explore the interplay between socio-emotional, environmental, physical health, and nutrition in the development and maintenance of language and cognitive skills. As such, the findings in this study indicated that learning in each of these developmental stages depends on many of the same characteristics. Awareness of these factors may help older adults address loneliness and social isolation in nursing and assisted living facilities. With the expanding focus on multigenerational learning, this work adds to a growing body of research that emphasizes learning across the life span

*Keywords: Learning, life span, dementia, cognition, language.*

---

### **1. Introduction**

In view of the current climate of the world healthcare crisis revolving around the invasion of the coronavirus, there's a rising concern for the welfare and safety of our aging population as well as children. The rapid spread of this worldwide pandemic has affected how we work, live, socialize, and function in our daily lives which has impacted the healthcare system in our schools and senior communities (Ellerbeck, 2022). The effects of the pandemic have brought awareness of how the lack of socialization has affected both groups emotionally, physically, and most specifically, cognitively (Ellerbeck, 2022; Guevarra, 2022). This brings attention to the parallels between various theories of learning that have an impact on both ends of the life span spectrum of development which includes the use of engaging activities to improve language and cognition, constructing knowledge from the environment, family involvement, utilizing skills that can only be mastered with guidance, and making connections to prior learning through the use of visual imagery and elaboration.

The emphasis of this study, therefore, is on researching the effects of enhancing communicative and cognitive ability during later adulthood, as well as bringing awareness to families, staff, and administrators of elder care homes on methods that support older individuals. This idea gives rise to further queries, such as why the abilities of older adults fluctuate to varying degrees as they age. What effects do socio-emotional factors, physical fitness, diet, and environment have on the deterioration of cognitive development? Do the same elements influence learning in early childhood and later adulthood? And can older adults continue to learn in later years? To this end, there are a number of factors about the relationship between early development and later stages in the life span that merit consideration, such as what is the connection between these widely separated stages in life, and could it be possible to use these similarities and differences to raise awareness on the learning potential of older adults specifically?

To answer these questions, a systematic review was conducted to explore the interplay between socio-emotional, environmental, physical health, and nutrition in the development and maintenance of language and cognitive skills in both groups. This systematic review begins with examining learning

theories and neuroscience implications, as well as how children and adults learn. Later this review makes connections using implications from the COVID-19 Pandemic and ends with reevaluating the learning potential of older adults in a systematic review of various studies. Future considerations will also be discussed.

## 2. Learning theories and neuroscience implications

There are a variety of learning theories that warrant attention, but for the purpose of this review, the primary theories discussed will be Vygotsky and Bandura's social cognitive theory as well as Knowles and Tyler's theory on how adults learn. Since many theories originate from early stages of development, this review will begin with discussing the social learning theories of Bandura and Vygotsky (Knowles, Holton, & Swanson, 2011).

Bandura, (1997, 2007) outlines four major sources of self-efficacy; *inactive mastery experience*; *vicarious experience*; *verbal persuasion*; *physiological and affective states*. Inactive mastery are exercises that increase in difficulty. Through vicarious experiences it is suggested that efficacy beliefs are altered through group sharing experiences of accomplishments and competencies. Verbal persuasion is based on the idea that through continuous feedback and encouragement, certain abilities of individuals will be elevated. The fourth source, physiological and affective states, reinforces relaxation techniques to alleviate memory anxiety during stressful times (Bandura, 1997, 2007).

Another concept developed by Bandura (1976), is the *Social Learning Theory*. The assumption of this theory implies that individuals learn from observing others around them. Individuals in this context are models of different genders and personalities who can be influential family members, friends, peer groups or teachers. Bandura (1976), however, makes a distinction between simply emulating and imitating a behavior and identifying with a behavior.

Vygotsky's research, in contrast, is on how language and culture shape the development of thought in individuals. He further contends that language is perceived as an influential device for thinking (Wertsch, 2008). Vygotsky's research is also in the area of developmental psychology, education, and psychopathology. In this respect his assumptions are aligned with other social cultural theorists. Many of these theorists believe that historical events, the nature of societies, and different generational influences, are possibly related to how individuals think (Alwin, 2008)

A unique feature of Vygotsky's theory is *the zone of proximal development* which suggests that some learning and tasks can only be accomplished with the guidance of a facilitator or a mentor (Wertsch, 1985). This element warrants consideration when assessing the learning potential of early childhood development as well as later adulthood. Mentors, according to Wertsch (1985), enhance growth in learning by generating trust, empathy, and engaging interactions leading to increased plasticity in the brain. Through dialogue within social interactions, Johnson (2006), in fact, argues that mentors contribute to the development of the brain. Moreover, through discourse, mentors have the ability to comprehend one's thoughts and raise questions that have the potential to increase neuronal processes of reflection. Due to its potential to create connections, reflection is equally as relevant as experience in the learning process (Johnson, 2006).

Knowles, Holton, & Swanson (2011), contend that adults are motivated to learn through experiential needs and interests that learning will satisfy. Tyler (1969), on the other hand stresses general learning principles, such as the principle of practice, the range of possibility, and the concept of producing several outcomes from the same learning experience. There is a consensus with all, however, on the benefits of connecting prior knowledge for optimum learning and desired outcomes (Knowles et al., 2011 & Tyler, 1969). Tyler (1969) further posits that connecting prior knowledge to desired outcomes creates interests.

Besides creating interest, the incorporation of thought into learning theories inspired Bandura (1985) to modify his theory to be referred to as the *Social Cognitive Theory* (SCT). The major cognitive roles in psychosocial functioning include self-reflective and self-regulatory processes (Bandura, 1985). In this respect, research in cognitive roles in psychosocial functioning include neuroscience associations.

Neuroscience implications involve examining a variety of elements that affect cognitive processes in the brain. Findings in studies are leaning to the conclusion that the brain is a social organ and acquires information through shared experiences (Cozolino & Sprokay, 2006). The authors, Cozolino and Sprokay (2006) have further concluded that the brain develops best in the context of interactive discovery and narratives or stories that support memory. Keeping this in mind, Wolfe (2006) claims that the brain functions best when meaning and emotion are displayed.

Another type of neuroscience explored in this review is social cognitive neuroscience. Through using tools like functional magnetic imaging, Lieberman (2013) has found notable results on how the brain responds to the social world. In particular, Cozolino and Sprokay (2006) concur that the brain

thrives best within the context of social engagement. To this end, the aforementioned social cognitive theories reinforce the conjecture that social interaction and meaningful engagement are conducive to learning for both ends of the life span spectrum.

### 3. How children learn

While children's development is unique to each child, several developmental milestones indicate a child is on pace to meet those milestones successfully. A consensus is that categories in the areas of physical, language, cognitive and psychosocial development are key to understanding a child's whole growth (Papalia & Martorell, 2015). Between the ages of 3-6 years, there is rapid growth in each developmental category. Factors, including socioeconomic status can impact the growth and opportunities for later learning such as access to high-quality preschool in the early years (Reynolds, 2012). As children grow and transition from the toddler stage into the early elementary age, the work of Vygotsky and Piaget has provided a framework for the need to give children many opportunities to interact with others of the same age and also with varied adults, including grandparents (Papalia & Martorell, 2015; Slavin, 2018). Additionally, if you consider the research on Intergenerational Learning (IGL), it is clear, that concepts related to learning across the lifespan and from nontraditional settings in family and community create what Fitzpatrick (2019) calls the "promise" as a way to "deliver meaningful and transformative learning environments for both young and old." IGL is a growing body of work that is gaining prominence at the research, policy, and practice levels (Fitzpatrick, 2019).

### 4. How adults learn

Lindeman (1926) concurs with Knowles et al. (2006) that experience is the most persuasive motivator for adult learning. In other words, the needs, interests, life situations, experiences, self-concepts, and individual differences need to be considered in adult learning. In this regard, interests, according to Tyler (1969) are connected to attitudes which are driven by behavior. Understanding attitudes is needed when speaking to adult learners. Attitudes are defined by Tyler (1969) as a tendency to react when a reaction doesn't actually take place (e.g., an individual may be frustrated with a staff member, but doesn't express it verbally). Attitudes are significant because they influence behavior and a change in behavior can suggest learning. The reaction, however, must be positive or satisfying for learning to occur (Tyler, 1969). To this end, learning for adults is heightened when desirable attitudes are promoted.

When considering engagement, this review relies on two major themes based on gerontology research, a *sense of control* and *social engagement*. Avlund, Damsgaard, & Holstein (1998), and Bennett (2002), suggest that adults project positive health outcomes when they participate in meaningful social engagement with others. Similarly, studies have shown positive outcomes when older adults experience a sense of self-efficacy (Rodin, 1989). To this end, a *sense of control* and *social engagement* appear to be important within the context of promoting communicative interaction and learning for adults. In fact, researchers, such as Castel (2019); Lieberman (2013); and Seifert (2006) have conducted studies illustrating a positive correlation between social interaction and cognition.

Another factor to consider in adult learning is plasticity which refers to the brain's ability to change, meaning its malleability. The question is, however, to what degree of plasticity affects cognitive aging. To answer this, one must think in terms of biological effects and environmental influences, the same as when assessing children's ability to learn and process information (Hertzog, 2009). One must according to Hertzog (2009) consider a person's lifestyle, such as the advantages of practicing good nutritional habits, regularly participating in physical exercise, and interacting socially, all of which affect cognitive functioning, as well as one's level of cognitive reserve. Similarly, these practices are also linked to the learning potential and psychosocial development of children (Ellerbeck, 2022).

### 5. Making connections: Implications of the COVID-19 pandemic

After examining the many factors connected to learning on both ends of the life span spectrum, it is no wonder that children and older adults experienced many of the same issues during the pandemic. It is, in fact, becoming more apparent that both groups suffered similar consequences due to mandatory restrictions limiting socialization among families, friends, peers, and most specifically interacting within large groups (Brooke & Jackson, 2020). Social isolation is not a new concern for our older population. It is an occurrence that many have experienced from time to time due to life transitions such as the death of a loved one, a divorce or a move to a new place (Rokach, 1990; Rokach et al.). Moreover, there has been increasing evidence indicating that social isolation and loneliness are connected to high blood

pressure, heart disease, obesity, a weakened immune system, anxiety, depression, cognitive decline, and an increased risk of developing Alzheimer's Disease (Wu, 2020). Consequently, due to the coronavirus, the risks of social isolation and loneliness have been magnified leading to concerns involving mental health issues for both groups.

Moreover, it is also becoming evident that older adults in care homes were dying indirectly from COVID-19 due to compromised mental and physical health issues resulting from social distancing. Khimm (2020) reported in an NBC News press release that lockdowns and visitor restrictions failed miserably to protect nursing home residents. To this end, children were also affected by lack of socialization, but in a different way.

Restrictions regulating interactions among large groups during the pandemic severely disrupted traditional education. Children were forced to participate in distance/online learning nationwide. This shift in learning resulted in digital inequality as well as inaccessibility to the Internet, (McElrath, 2020). The impact of being cut off from school, friends, and teachers has been devastating for many, especially the vulnerable, those experiencing food and housing insecurities, and/or learning disabilities. These children most specifically have endured the greatest loss, widening the learning gap in our educational system (Ellerbeck, 2022).

## **6. Reevaluating the learning potential of older adults**

To illustrate how the human brain is wired to connect and is related to the social world, Lieberman (2013) claims that studies have shown how mammals are disconnected from other vertebrates due to their capacity to feel social pains and pleasures linking well-being to social connectedness. This need for connectedness is also displayed in infants. Awareness of these discoveries warrants revisiting Maslow's hierarchy of needs theory. Maslow (2013) contends that individuals move up the pyramid of needs beginning with basic physiological demands and end with a maximum psychological need of self-regulation. Conversely, Lieberman's (2013) study suggests that infant mammals need a committed caregiver at birth to make sure biological needs are met which implies that food, water, and shelter are not basic needs for infants. To this end, being socially connected and cared for seem to take precedence over all other needs. In view of these implications, the learning potential of older adults living in nursing homes could be affected by a lack of love and a sense of belonging.

An additional point worth mentioning in Lieberman's (2013) study is his discussion of mental pain versus physical pain. His study equates physical pain to social pain, inferring that the brain responds to both pains in the same manner. Maclean (1993) concurs, implying that there is a sense of separation that causes pain for mammals. This doesn't, however, mean that social and physical pain are identical, it simply suggests that social pain is a bona fide pain the same as bodily pain (Lieberman, 2013). This concept is demonstrated in Bowlby's (1969) attachment theory. The relentless crying and distress of a child due to the absence of his/her mother according to Bowlby (1969) is linked to pain. Moreover, other studies have shown how children under the age of five who are separated for long periods of time developed deficits in literacy and behavior (Lieberman, 2013). Awareness of these findings could have implications for deficits in cognitive functioning for older adults separated from loved ones while living in nursing or assisted living homes.

Another study by Erickson, et al. (2007) suggests that in later life, the brain only loses a part of its ability to function indicating that the types of activities older adults engage in appear to be instrumental in its development. This was a randomized study consisting of a group of 34 older adults from 55 to 80 with a mean age of 66.11. Data was also collected on 31 younger adults participating in both the training and control group. The study examined interventions that could have an impact on reversing age-related cognitive declines. Findings indicated that a certain amount of plasticity is retained well into later adulthood and the types of activities conducive to learning depend on elements that involve effective information processing attributes such as thinking, memory, and attention (Bauer, 2009).

## **7. Conclusion**

After researching several studies on how children and older adults learn, the analysis of this systematic review was narrowed down to three studies including a discussion of several related peer reviewed articles. Considering the repercussions of the 2020 pandemic on the mental and cognitive functioning of both groups, the lack of social interaction appears to be a key element affecting the learning potential of individuals. Other notable factors included one's lifestyle practices consisting of an enriched and healthy environment (e.g., good nutrition, physical, and engaging activities, as well as relying on prior knowledge and participating in meaningful interactions). To this end, future considerations should include implementing learning strategies that involve reinforcing meaningful and more challenging activities to sustain the independence of older adults as well as to help them remain connected to society. Their welfare should be preserved the same as we care for our children.

## References

- Alwin, D. F. (2008). Social structure and cognitive change. In S. M. Hofer, & D. F. Alwin (Eds.), *Handbook of cognitive aging: Interdisciplinary perspectives* (pp. 418-444) Sage publications.
- Avlund, K., Damsgaard, M. T., & Holstein, E. E. (1998). Social relations and mortality: An eleven-year follow-up study of 70-year-old men and women in Denmark. *Social Science & Medicine*, 47, 635-643.
- Bandura, A. (1976). *Social learning theory*. New Jersey: Prentice-Hall.
- Bandura, A. (1985). *Action: A social cognitive theory*. New Jersey: Prentice-Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman and Company.
- Bandura, A. (2007). Self-efficacy. *International encyclopedia of organization studies*.
- Bauer, P. J. (2009). Learning and memory: Like a horse and carriage. In A. Needham & A. Woodward (Eds.), *Learning and the infant mind* (pp. 3-28). Oxford University Press.
- Bennett, K. M. (2002). Low level social engagement as a precursor of mortality among people in later life. *Age and Ageing*, 31, 165-168
- Bowlby, J. (1969). *Attachment and loss, volume i: Attachment*. New York: Basic Books
- Brooke, J., & Jackson, D. (2020). Older people and COVID-19: Isolation, risk and ageism. *Journal of Clinical Nursing*, 29(13-14), 2044-2046.
- Castel, A. (2019). *Better with age: The psychology of successful aging*. Oxford University Press.
- Cozolino, L., & Sprokay, S. (2006). Neuroscience and Adult Learning. In Johnson & Taylor (Eds.), *The neuroscience of adult learning, number 110* (pp. 11-18). California: Jossey-Bass.
- Ellerbeck, H. (2022). Educating children remotely: a focus on socio-emotional learning. The Institute for Human Development and Social Change.
- Erickson, K. L., Colcombe, S. J., Wadhwa, R., Bherer, L., Peterson, M. S., Paige, E., Scalf, P. E., Kim, J. S., Alvarado, M., & Kramer, A. F. (2007) Training-induced plasticity in older adults: Effects of training on hemispheric asymmetry. *Neurobiology of Aging*, 28, 272-283.
- Fitzpatrick, A. (2019). Towards a Pedagogy of Intergenerational Learning in Intergenerational Learning in Practice: Together Old and Young, Kernan & Cortellesi (eds) London, Routledge 2019.
- Guevara, H. (2022). The impacts of COVID-19 on the social development of young children. Retrieved from First Five Years Fund website: <https://www.ffyf.org/how-has-covid-19-impacted-infants-and-toddlers-social-development/>
- Hertzog, C. (2009) Use it or lose it: An old hypothesis, new evidence, and an ongoing controversy. In H. B. Bosworth & C. Hertzog. (Eds.), *Aging and cognition: Research methodology and empirical advances* (pp.161-179). American Psychological Association
- Johnson, S. (2006). The neuroscience of the mentor-learner relationship. In S. Johnson & K. Taylor (Eds.), *Neuroscience of adult learning, number 110*, (pp. 63-69), California: Jossey-Bass.
- Knowles, M. L., Holton, E. F., & Swanson, R. A. (2011). *The Adult Learner*. (7<sup>th</sup> ed.). Gulf Publishing.
- Lieberman, M. D. (2013). *Social: Why our brains are wired to connect*. Broadway Books.
- Lindeman, E. (1926). *The meaning of adult education*. New York Republic.
- Macleay, P. D. (1993). Introduction: Perspectives on cingulate cortex in the limbic system. *Neurobiology of Cingulate Cortex and Limbic Thalamus: A Comprehensive Handbook* Birkhauser. 1-19.
- Maslow, A. H. (2013). *A theory of human motivation*. (A reprint of 1943 ed.). Martino Fine Books.
- McElrath, K. (2020, August). Nearly 93% of households with school-age children report some form of distance learning during COVID-19. United States Census Bureau.
- Papalia, D. and Martorell, G. (2015). *Experience Human Development* (13<sup>th</sup> Ed.) New York, NY: McGraw Hill.
- Reynolds, A. J. (2012). *Success in early intervention: The Chicago Child-Parent Centers*. Lincoln: University of Nebraska Press (Reprinted from 2000).
- Rodin, J. (1989). Sense of control: Potentials for intervention. *Annals of the American Academy of Policy and Social Science*, 503, 29-42.
- Rokach, A. (1990). Surviving and coping with loneliness. *The Journal of Psychology*, 124, 217-219.
- Rokach, A., Orzeck, T., & Neto, F. (2004). Coping with loneliness in old age: A cross-cultural comparison. *Current Psychology*, 23(2), 124-137.
- Slavin, R. E. (2018). *Educational Psychology: Theory and Practice*. (13th Ed). New York: Pearson.
- Seifert, K. L. (2006). Cognitive development and the education of young children. In B. Spodek & O. N. Sarancho (Eds.), *Handbook of research on the education of young children* (pp. 9-21). Erbaum.
- Tyler, R.W. (1969). *Basic principles of curriculum and instruction*. The University of Chicago Press.
- Wertsch, J. (2008). From social interactions to higher psychological processes. *Human Development*. 51, 66-79.
- Wolfe, P. (2006). The role of meaning and emotion in learning. In S. Taylor & K. Johnson (Eds.), *The neuroscience of adult learning, number 110* (pp. 35-41). California: Jossey-Bass.
- Wu, B. (2020). Social isolation and loneliness among older adults in the context of COVID-19: A global challenge. *Global Health Research and Policy*. 5(27).



## RECOMPOSITION AND PHOTOMONTAGE AS A STIMULUS FOR THE DEVELOPMENT OF CREATIVITY IN TEACHING VISUAL ARTS

**Marija Brajčić<sup>1</sup>, & Dubravka Kušević<sup>2</sup>**

<sup>1</sup>Ph.D., associate professor, Department of Preschool Education

<sup>2</sup>Ph.D., assistant professor, Department of Teacher Education

University of Split, Faculty of Humanities and Social Sciences (Croatia)

### Abstract

Recomposition and photomontage are an integral part of contemporary art and should be implemented in the contemporary teaching of Visual Arts. This paper aimed to determine whether the use of recomposition and photomontage in Visual Arts classes stimulates student creativity. The research was carried out from 2019 to 2022 among students at the Department of Teacher Education and the Department of Preschool Education at the Faculty of Humanities and Social Sciences in Split, who applied the methods of recomposition and photomontage in Visual Arts classes. The research was qualitative, with the use of observation method and descriptive method, and a total of 133 students participated in the research. The resulting artworks were divided into groups according to the degree of creativity that the students expressed in those works. After the research, it was concluded that the use of recomposition and photomontage stimulated student creativity. However, a significantly greater degree of freedom could have been reached in terms of combining, using imagination and creating new ideas.

**Keywords:** *Creativity, photomontage, recomposition, student, teaching Visual Arts.*

---

### 1. Introduction

The social changes in the 21st century require changes in all areas of life, especially in the field of education while the demands for changing the paradigms of acquiring knowledge require a quick reaction from educational institutions (Stoll, Fink, 2000). Redesigning and rethinking the existing educational concepts are complex and necessary processes because the strengths of tradition and inertia in theory and practice with their insensitivity to progressive turmoil partly suppress the path to the affirmation of more efficient, functional and rational educational work.

The term creativity comes from the Latin word *creare*, which means power of creation, invention and production, but it can also be translated as the art of creation and participation in something useful or valuable (Simel S., Gazibara S., 2013). In the vocabulary of psychology, creativity is described as an activity that gives new and original products, in the material or spiritual sense (Petz et al., 1992). Creativity is not an unambiguous phenomenon that can be precisely determined, so today we distinguish a multitude of different definitions and understandings of this concept. Majl points out that creativity implies connecting previously unrelated things and being creative means shaping the unshaped (Majl, 1968). According to Furlan, creativity is original, unique and adaptable in terms of using knowledge, as opposed to imitation (Furlan, 1950). Stevanović sees creativity as a way of finding new and original solutions and as a kind of intellectual inventiveness (Stevanović, 1986).

In pedagogical terms, there are two definitions of creativity: it is a synonym for creation, that is, creating new and original solutions, and also a trait or set of traits to be expressed in the act of creation (Kardum, V., 2011).

As it can be seen, there are many understandings of the concepts of creativity and creation, however, what they have in common is creating something new and original, giving original ideas, taking other positions, a new way of approaching problems, a successful step into the unknown, openness to experience, perceiving new relationships between phenomena (Kardum V., 2011). Stimulating student creativity requires innovation, changing and improving existing ideas and thinking outside the box (Simel S., Gazibara S., 2013). Creative work always has the power to release creative energy and encourage class participation (Stevanović, 1986).

In the 1960s and 1970s, Paul E. Torrance showed in many studies that creativity in the classroom could be encouraged in the following ways: by taking into account unusual questions; imaginative and unusual ideas; by respecting and appreciating ideas; by ensuring the time in which ideas are evaluated; by combining evaluation with causes and consequences (as qtd. in Bognar L., 2012).

In Visual Arts activities, there are different artistic methods that students use to express themselves creatively. One of these methods is recomposition. "Recomposing represents the process of decomposing a previously created composition in flat or space-plastic design and newly composing the decomposed elements in a completely new way, into a new form, a new visual content" (Jakubin M., 2000: 136). These activities are useful for students because they help to develop divergent thinking, reasoning, creativity and creation.

## 2. Design

Aiming to explore the impact on the development of student creativity, research was conducted from 2019 to 2022 among the students at the *Department of Teacher Education* and the *Department of Preschool Education* at the Faculty of Humanities and Social Sciences in Split. During eight academic hours of Visual Arts, students applied recomposition and photomontage while painting. Recomposition was achieved in two ways in student works. In one group, students used two previously created old artworks to recompose them in new artworks during four academic hours. In another group, students achieved recomposition using the photomontage technique (during four academic hours). A total of 133 students participated in the research. Participants were happy to respond and participate in the research.

## 3. Objectives

The research *subject* was the Visual Arts activities of students in the Department of Preschool Education and the Department of Teacher Education.

The *aim* of this study was to examine whether recomposing as an artistic method would encourage creativity in student artistic expression.

Based on the research aim, we have defined the following research *tasks*:

1. to examine whether there are differences in artistic creativity between student artworks created using recomposition and those created using photomontage
2. to examine whether this kind of artistic expression will stimulate stereotypical and schematic artistic expression in students.

After identifying the research *subject*, *aim* and *tasks*, we formulated the research *hypothesis*. The research starts from the general hypothesis that there are differences in the degree of creativity between student artworks created using recomposition and those created using photomontage.

To properly analyze the main research hypothesis, two sub-hypotheses were formulated:

H1 It is assumed that students will show a high degree of creativity in works created using photomontage.

H2 It is assumed that recomposition and photomontage will not stimulate stereotypical and schematic artistic expression in students.

## 4. Methods

Qualitative and quantitative methodologies were applied in the research. The qualitative methodology was based on the observation and analysis of student artworks. The works were evaluated by the authors of the research (art pedagogues) using the following criteria for assessing the creativity of student artworks: a) an unusual representation – an original idea, b) unity in the artistic composition, c) good technical presentation, d) successfully combined artistic elements in the new artwork.

According to the above criteria, three groups of student artworks were identified and coded with numbers: 0 - no elements of creativity, 1 - with elements of creativity, and 2 - creative artwork. The analysis of artworks was carried out according to the above criteria. For the purposes of the analysis, the percentages were calculated, which included the quantitative methodology in the research analysis.

## 5. Discussion

The artistic method of recomposition enables students to organize their artwork on new bases, i.e. it encourages students to think creatively about new ways of connecting and structuring the decomposed artistic and compositional elements. In this process, based on their knowledge and experience, students apply creative activity to come to new artistic insights and artistic results in a different way. Thus,

students have enough time to develop creative ideas and their artistic creation occurs spontaneously as a result of a divergent activity.

Creativity and creation establish the modern concept of education, and the development of artistic creativity is a specific feature of artistic creation and an indispensable need during artistic activities if aiming to spark creative artistic ideas that will arise as a result of the affirmation of divergent/creative thinking in students. Creative thinking should be developed because it improves intellectual functioning and problem-solving in students, not only in artistic situations but also in external activities, thus resulting in success in different areas of life. The atmosphere of creativity and creation during artistic activities does not arise from the curriculum or the artistic content of the work, but from the approach to the artistic problem that enables the openness to diversity, to rare, unexpected, original procedures that do not support conformity in thinking, but point to the risk of coming to a different solution, exploring the unexplored; the elastic, flexible and paradoxical concepts of work and direct empirical experiences in the process of artistic expression. During their work, students were given complete freedom in their artistic creation.

In the first research task, we wanted to examine whether there are differences in artistic creativity between student artworks created using recomposition and those created using photomontage. We started from the assumption that students would show a high degree of creativity in the works created using photomontage. The first group of artworks was created using the method of recomposition during four academic hours with 72 participants. During the artistic activities, the students decomposed shapes, colors, sizes, surfaces and completely recomposed their two old artworks. Creating new visual compositions enabled a dynamic restructuring of the existing visual content. By observing student artworks and the course of their work, we noticed they showed interest and motivation in creating new artworks, using mainly the collage of old artworks. Students themselves have chosen which old artworks to recompose and create a new composition from them. Playing with ideas and materials, students tried to create a new abstract composition. Almost all students completed their artwork within the agreed time frame. An analysis of the artworks showed that the artworks were of different artistic qualities. Examples of individual artworks by category are shown in Table 1.

Table 1. Exemplary coded student artworks – recomposition (using old artworks).


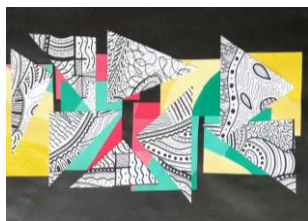

0 No elements of creativity	1 With elements of creativity	2 Creative artwork
		




Table 2. Student artistic creativity expressed in recomposing the old artworks.

0		1		2		Σ	
f	%	f	%	f	%	f	%
47	65%	21	29%	4	6%	72	100%

Table 2 shows student creativity according to the above assessment criteria in using the methods described (coded with 0, 1 and 2). From the above results, we can conclude that almost 65% of student artworks showed no elements of creativity. Such elements were observed in 29% of artworks, while only 6% were identified as creative works. Artworks with elements of creativity and creative artworks (code 1 and code 2) belong to 35% of students who managed to make a step forward in creative artistic expression, which is a high percentage, knowing that divergent thinking is the most difficult to encourage and achieve.

The second group of artworks was created using the method of recomposition-photomontage. Exemplary artworks according to the explained criteria are shown in Table 3. A total of 61 students participated in this activity, and artworks were created for four academic hours. In this part of the research, the participants were also happy to cooperate and create their compositions with interest. They used photographs from different magazines and collage paper. In some artworks, a sense of humor was observed.

Table 3. Exemplary coded student artworks – photomontage.

0 No elements of creativity	1 With elements of creativity	2 Creative artwork
		

In Table 4, we can notice that students were more creative when using photomontage and the recomposition performed by photomontage gave them better possibilities in creating new artworks. According to the results, a total of 49% of artworks showed no elements of creativity. Such elements were observed in 36% of artworks, and 15% were identified as creative artworks.

Table 4. Student artistic creativity expressed in recomposition using photomontage.

0		1		2		$\Sigma$	
f	%	f	%	f	%	f	%
30	49%	22	36%	9	15%	61	100%

In this part of the research, we confirmed the first hypothesis that students would show more creativity in artworks created using photomontage, thus confirming the general hypothesis.

In the second research task, we assumed that recomposition and recomposition-photomontage would not encourage schematic and stereotyped expression in students. Schemes and stereotypes in artistic expression presuppose a lack of involvement, an impersonal and unimaginative way of artistic expression that does not require thinking and that prevents the creator from trying to perceive and express something new. Schemes and stereotypes in artistic expression have an imitative-reproductive character, therefore they are considered undesirable and prevent artistic creativity. They do not allow innovation and improvisation, which are essential in achieving creativity. Since creativity is one of the important human characteristics, implying freedom from role models, it is important for personal growth and development, but also for the successful development of many social activities. Table 5 shows exemplary stereotypical and schematic student artworks.

Table 5. Exemplary stereotypical and schematic student artworks.



Recomposition	Photomontage
	

Table 6. Stereotypes and schemes in student artistic expression.

0		1		$\Sigma$	
f	%	f	%	f	%
20	66%	10	34%	30	100

In table 6, artworks including no stereotypical and schematic elements are coded with 0 while stereotypical and schematic student artworks are coded with 1. Table 6 shows that out of 30 works in which there are no elements of creativity, 66% of them do not include stereotypical and schematic elements, and 34% include such elements. In the second hypothesis, we assumed that recomposition and photomontage would not encourage stereotypical and schematic artistic expression in students. The results show that most students (66%) did not apply stereotypical and schematic solutions in their artistic expression, which confirmed our second hypothesis. The participants achieved a creative shift away from the usual way of thinking.

## 6. Conclusions

Using the artistic method of recomposition, students were offered greater freedom in artistic activities in terms of imagination and combination in creating their artworks. The offered artistic material (old artworks, magazine collage) was a good incentive to spark a number of ideas and unusual imaginative artistic combinations. However, we expected that the student artworks created using the methods of recomposition and recomposition-photomontage would be more creative, since these methods allow manipulating ideas and creating unusual artistic representations. A certain number of artworks with elements of creativity and creative artworks indicate that student creativity was initiated, but we believe that these methods could have better stimulated students to express themselves creatively. Schemes and stereotypes were observed in 34% of student artworks, which indicates that a large number of students managed to think creatively and create new interesting artistic compositions. Creativity should be encouraged in the classroom whenever possible because it plays a significant role in educating creative, innovative and capable students.

## References

- Bognar, L. (2012). Kreativnost u nastavi. *Napredak*, 153 (1), 9-20.
- Furlan, I. (1950). *Psihologija podučavanja*. Zagreb: Školska knjiga.
- Jakubin, M. (2000). *Likovni jezik i likovne tehnike*. Zagreb: Educa.
- Kadum, V. (2011). Kreativnost u nastavi matematike. *Metodički obzori*, 6(2011)3, 165-174.
- Majl, A. (1968). *Kreativnost u nastavi*. Sarajevo: Svjetlost.
- Petz, B. et al. (1992). *Psihologijski rječnik*. Zagreb: Prosvjeta.
- Simel, S. Gazibara, S. (2013). Kreativnost u nastavi Hrvatskog jezika. *Život i škola : časopis za teoriju i praksu odgoja i obrazovanja*. 1(29), 188-204.
- Stevanović, M. (1986). *Kreativnost nastavnika i učenika u nastavi*. Pula: Istarska naklada.
- Stoll, L. & Fink, D. (2000). *Mijenjajmo naše škole: kako unaprijediti djelatnost i kvalitetu škola*. Zagreb: Educa.

# HOW TO BE POLITICAL? EXPLORING EARLY CHILDHOOD UNDERSTANDING OF POLITICS ECOLOGICALLY AND PHILOSOPHICALLY

**Gudrun Marci-Boehncke<sup>1</sup>, Matthias Rath<sup>2</sup>, & Madeleine Rusch<sup>2</sup>**

<sup>1</sup>*Institute for Diversity Studies, TU Dortmund University (Germany)*

<sup>2</sup>*Institute for Philosophy, Ludwigsburg University of Education (Germany)*

## Abstract

The interdisciplinary project PoJoMeC, funded by The Federal Agency for Civic Education in Germany, investigates children's understanding of politics at preschool and primary school age. We understand the theoretical background of the primarily didactic research, the ecological model of human development according to Bronfenbrenner (1979), as a process "emerging from the interaction of individual and context" (Rosa, & Tudge, 2013, 244). We interpret "context" as a fundamental medial orientation (Lichtenberger, 2012). Our research methods focus on the children's explicit knowledge, their medial sources of information, and their concepts of rule-governed action. The paper presents a pilot study on the PoJoMeC project.

On the one hand, this pilot study concretizes the survey of the socio-ecological rule systems that constitute the students' political consciousness at the respective levels. On the other hand, this paper extends our concept in terms of argumentation theory by using a matrix from philosophy didactics. In the study, nine students from upper primary school classes (grade 4) are interviewed. In our research conception, we assume this group of students can reach general rules on Bronfenbrenner's macro system level. In the next step, we analyzed the interviews concerning the quality of the justifications the students gave for the validity of their rule assumptions on the micro-, meso-, and macrosystem. In doing so, we draw on Frank Brosow's (2020) TRAP-Mind-Theory. The TRAP-Mind-Matrix provides an instrument to capture the cognitive appropriation of social rules to understand the political in general. Parents, media, and schools have essential political responsibilities in this context.

**Keywords:** *Political thinking, early education research, ecological theory of human development, TRAP-Mind-Theory.*

---

## 1. Introduction

Climate change, peace, sustainable development, and inclusive participation of different groups in our society are just some of the tasks that need to be tackled politically today and tomorrow. UNESCO (2019, 2021) has summarized these tasks in the *17 Sustainable Development Goals*, which are strongly normative. They deal not only with the environment but also with its protection, health maintenance, and the entire diversity of society. Not only should this diversity be enshrined, but human rights should follow. Such goals require the acceptance of society as a whole to be realized. Active participation in social reality depends, above all, on the political understanding of citizens. However, this requires knowledge and general political awareness, which must be imparted and acquired from an early age.

In what follows, we understand "politics" as human communication and action to establish and enforce generally binding regulations and decisions within and between people. Creating an awareness of what this responsibility means and what role everyone should play in it is a central educational goal. To this end, we have already described elsewhere the theoretical framework within which a political or civic education must be conceptualized (Marci-Boehncke, Rath, Goll, & Steinbrecher, 2022). This civic education must begin early because political attitudes, beliefs, and stereotypes also develop in early childhood and are difficult to change throughout life.

For modern society, moreover, media play a central role in conveying and developing a worldview and thus also in safeguarding democracy (Marci-Boehncke, Rath, Delere, & Höfer, 2022). Language is just as important as images, films, and other forms of communication. We thus advocate a broad concept of media that goes beyond a purely technical perspective. The world, and thus potentially

every citizen, is internationally networked. Global citizenship education in the digital age depends on knowledge of the initial conditions of political thought. Formally, these questions seem answerable regarding developmental psychology (cf. Wegemer, & Vandell, 2020). In terms of content, however, what constitutes political consciousness as a condition of political education is unclear, especially for early childhood. Knowledge about what children understand by politics and whether or what political competencies they bring with them to elementary school and develop by the time they move on to secondary school is still scarce. Empirical research seems particularly difficult in this age group because the topic is considered very abstract. Given the children's rudimentary writing and reading skills, it is impossible to study larger cohorts (cf. van Deth, Abendschön, Rathke, & Vollmer, 2007). Due to the young age, political participation is hardly perceived here. In contrast, older school age is already well-researched (cf. Hunter, & Rack 2016; Rowe 2005; Flanagan 2014).

The heterogeneities of the research, the target group, the subject-specific questions, and the wide-ranging object field initially suggest a multimethod approach. In this context, previous studies (Marci-Boehncke, & Rath, 2013) also allowed us to draw on experience in child-directed questioning (interviews) with playful approaches. Recently, we have extended this range of methods to include picturizing strategy (Tkotzyk, & Marci-Boehncke, 2022; Tkotzyk, Lategahn, & Marci-Boehncke, 2022). That also brings symbolic picture cards into play. In our pilot study to be presented here, they are also an entry point into the discussion of the social frame of reference of the political rules and the environmental topics that the children choose.

## **2. Social frame of reference and medial mediation**

With a social frame of reference, we highlight the different social systems people access for themselves during their development. These frames of reference expand in the context of ontogenetic development. Uri Bronfenbrenner (1979) has differentiated five systems, beginning with the microsystem immediately surrounding the child through the mesosystem, exosystem, macrosystem, and chronosystem. The macrosystem and exosystem include, among other things, the state political organization and the related ideological attitudes and beliefs that determine a policy. The mesosystem provides the institutional bridge between the micro- and macrosystems and determines the institutional framework of the microsystem and its actors.

We limit our study to the three main systems micro-, meso- and macrosystem. The microsystem is the closest social framework that goes directly beyond the individual, such as the family with parents, followed by the mesosystem that includes the first educational institutions, such as kindergarten and school, and later peers. Finally, the macrosystem is a system of general social order in which general laws apply, which we represent in our study through Germany. These systems, conceived concentrically by Bronfenbrenner, provide the material, each of varying complexity, for developing a child's political consciousness. However, the politically relevant aspects, the increasing social integration of the child into existing social structures and their regularity, remain strictly separated in the systems. While these systems are thought to be permeable, they seem differentiated in the process. Following the revisions Bronfenbrenner made to his theory, Vélez-Agosto, Soto-Crespo, Vizcarrondo-Oppeneimer, Vega-Molina, and García Coll (2017) were able to construct a less delineating model of human development. In this, culture, in its various manifestations, has a comprehensive function in the expansive structure of social relations. Language and communication are the central practices of the culture in this regard. Drew Lichtenberger (2012) extends this systems model of Bronfenbrenner quite substantially. He directly adds to the innermost circle of the microsystem, a "ring" of media communication that encircles the individual. That is to make clear "how technology can now mediate many of our direct interactions with our world and one another." This media ring symbolizes media presence from early childhood (Marci-Boehncke & Rath, 2013). In the media-influenced microsystem, symbolization, and thus media, becomes the central mediating agent of regularity.

To capture the political awareness of rules, we decided in the pilot study to focus on a topic discussed in families, educational institutions, and the public sphere: the protection of the environment. We focused on the children's "ecological awareness" (Capra, 2012) or "ecological consciousness" (O'Sullivan, & Taylor, 2004). With Capra (2012), we argue that "ecological literacy" is a central educational goal in the school mesosystem and that "ecological awareness" is a good conversation starter for capturing children's political consciousness.

### 3. Procedure

In our topic-specific pilot study, nine students (five male, four female) were interviewed. For reasons of comparability, children of the same age (9 years old) and of the same grade 4 elementary school ("fourth grade" in German "Grundschule") were interviewed. The interviews took place at school as individual interviews.

In preparation, various picture cards were spread out on a table. To start the interview, the topic of the interview and the three levels, based on Bronfenbrenner's "Ecological Model of Human Development" (1979), were addressed. Three large maps showing a family, a school, and Germany (symbolically in the form of a map of Germany, in the colors of the country's flag) represented the three environmental systems surrounding the children on the micro-, meso-, and macro levels selected for the study. Furthermore, several picture cards were available to the students as possible conversation starters, all related to "environmental protection." The children could choose between illustrated rules, such as waste separation, and between the causes and effects of climate change due to progressive environmental pollution. During the conversation, the respondents were asked to intuitively select picture cards and talk about them. That was to reveal the learners' explicit knowledge regarding the topics that are relevant in the field of education for sustainable development. A total of eleven topics were visualized: (1) Buying regionally and seasonally, (2) Conscious and sustainable nutrition, (3) Renewable energy sources, (4) Saving resources, (5) Minimizing CO<sub>2</sub> consumption, (6) Protecting and preserving forests, (7) Protecting animals and preserving biodiversity, (8) Avoiding environmental and marine pollution, (9) (Plastic) waste avoidance, (10) Recycling as well as (11) Waste separation.

The questions addressed in each interview were left up to the interviewees. They decided what they wanted to talk about by selecting a picture card. The picture cards represented either a rule related to (non-) sustainable or environmentally conscious actions or a consequence of following or not following these rules. The guiding questions were intended to encourage the children to explain which of the rules and consequences they already knew and to whom they applied. In the further course of the survey, by assigning the picture cards to the respective system levels, it was checked whether the children were already aware of environmental topics' rules. Subsequently, the children's justifications were categorized according to Brosow's TRAP-Mind Matrix (2020) and the four characteristic levels of justification, "Thinking," "Reflecting," "Arguing," and "Philosophizing." We tried to design the dialogue in a way that subjects would be encouraged to reason and philosophize by asking follow-up and reflective questions, such as "What do you think about the rules?", "What would happen if these rules did not exist or if no one followed them?", "What would have to happen to stop climate change?" and "Why doesn't everyone follow the rules to protect the environment?" whenever possible.

### 4. Findings

Overall, there was an exciting asymmetry in terms of the breadth of rule awareness and the idea of the origin of the rules. The children were given picture cards and a lead-in to the interview that focused on rules about issues of environmental protection. Eleven themes were presented to the children and visualized through picture cards. These eleven topics were also specified on three social reference levels according to Bronfenbrenner and introduced again in each case: Microsystem Family, Mesosystem School, and Macrosystem Germany. That is, the eleven topics were offered a total of 33 times. In addition, guiding questions were asked to record the children's rule awareness at each system level differentiated according to Bronfenbrenner and to inquire about reasons for a rule conviction according to the TRAP-Mind-Matrix. These questions were answered as follows in table 1 (Tab. 1).

However, evaluating the answers concerning a political awareness of rules is difficult. Which categorization allows us to determine this expression as generally binding rules and decisions? We use a current system from philosophy didactics, the TRAP-Mind Theory. In his theory, Frank Brosow (2020) distinguishes four levels of justification for normative ideas, similar to the social rules we examine. The theory combines two main aspects: First, it is based on current empirical findings in cognitive psychology. Second, it aims at the fundamental ethical criterion of the universalizability of an argument. It aims to make understandable what happens when, in the rational processing of problems, we name increasingly generalizable reasons to plausibilize our preferences or judgments. "The TRAP-Mind-Theory has a functionalistic understanding of reasons. A reason is not a consideration of its kind. Any thought deliberately used to support or attack a consideration is considered a reason by the TRAP-Mind-Theory" (Brosow, 2020, p. 26).

In practical analysis, the TRAP-Mind-Theory offers a matrix of rational argumentation on four levels: "Thinking" remains on the level of description, and "Reflecting" aims at a conception, here of just rule determination. At the "Arguing" level, definitions and contexts of justification are offered.



"Philosophizing," finally, comprises the ability to develop theories and justify them based on theory. For our evaluations, the levels of increasingly generalizing reasoning ("for ourselves, others or all people" (Brosow, 2020, p. 15) of preferences are of particular importance.

Table 1. Guiding questions on the reference levels.

<i>guiding questions</i>	<i>Level</i>	<i>given answers</i>
who makes the rules?	Microsystem	parents / children / all together
	Mesosystem	school principal / teacher
	Macrosystem	the society / parliament / politicians / court / police / German Chancellor / unknown
rule origin	Microsystem	parents, idols, role models / media / unknown
	Mesosystem	classroom rules / media / education system
	Macrosystem	education system / media / laws / unknown
consequences from rules	for all three system levels	effects on the interviewee himself / on animals / on all humans / on nature / climate change and global warming

A total of 364 sequences were analyzed from the nine interviews. It was particularly noticeable that the main focus of the sequences was on the macrosystem: in total, 310 of the 364 sequences were located in the macro system. The microsystem was found in 47 sequences, whereas the mesosystem school was found in only seven sequences. Our results are, therefore, initially puzzling: of the 364 sequences, virtually none are found in the mesosystem, although school as an institution of the mesosystem is formative for all students. The distribution of the sequences over the four levels of the TRAP-Mind-Matrix looks as follows (table 2):

Table 2. Number of sequences over the TRAP-Mind level

<i>TRAP-Mind-Level</i>	<i>microsystem</i>	<i>mesosystem</i>	<i>macrosystem</i>
<i>Thinking</i>	11	1	57
<i>Reflecting</i>	6	1	48
<i>Arguing</i>	3	1	28
<i>Philosophizing</i>	0	0	6

## 5. Conclusions

Two aspects, in particular, are interesting for our pilot study: The broad media theme we introduced with Lichtenberger (2012) is reflected in the response sequences: At all three system levels, media (newspapers, television, radio, Internet) are named as sources for rule knowledge, but not books. That shows that media not only determine childhood today as a matter of course but that in the various social systems, these media are also explicitly introduced by the mediating social instances, as a justification instance as well as a source of information. The second relevant aspect is the striking lack of argumentative responses in the mesosystem. The children receive detailed information about the overall social justification (as also shown by naming the originators of rules). We also assume the familial rules to be experienced as valid as a matter of course and can therefore be named. The school mesosystem, on the other hand, is left out. Since the school cannot be neglected as a social instance (especially since education is explicitly mentioned several times), we assume a particular social function of the school mesosystem.

In contrast to the family's direct experience, the macro system society is only present to the students in a mediated way. In addition to the family, it is primarily the school that assumes this mediating function. The school refers to the rule validity, the rule origin, and the rule actors in the

macrosystem and therefore does not come into view as a rule instance in its own right. It will be an essential aspect of our further research to analyze this mediating function of the mesosystem further and thus to make clear the mediating importance of school for the political rule consciousness of the upcoming generation.

## References

- Brosow, F. (2020). TRAP-Mind-Theory. Philosophizing as an Educational Process. *Journal of Didactics of Philosophy, IV* (1), 14-33. Retrieved December 9, 2022, from [https://www.philosophie.ch/attachment/272/download/JDPh\\_2020\\_Volume\\_4\\_Number\\_1](https://www.philosophie.ch/attachment/272/download/JDPh_2020_Volume_4_Number_1).
- Capra, F. (2012). Ecological Literacy. *Resurgence & Ecologist*, 272. Retrieved December 9, 2022, from <https://www.resurgence.org/magazine/article3659-ecological-literacy.html>
- Flanagan, C. (2013). *Teenage Citizens: The Political Theories of the Young*. Cambridge, MA: Harvard University Press.
- Hunter, P., & Rack, J. (2016). Advancing young citizens' political literacy through social-sciences curricula. *Research Information for Teachers*, 3, 23-28. Retrieved December 9, 2022, from <https://dx.doi.org/10.18296/set.0053>
- Lichtenberger, D. (2012). Shaping influences – human development. *Blog*. Retrieved December 9, 2022, from <https://drewlichtenberger.com/6-shaping-influences-human-development/>
- Marci-Boehncke, B., & Rath, M. (2013). *Kinder – Medien – Bildung. Eine Studie zu Medienkompetenz und vernetzter Educational Governance in der frühen Bildung*. München, Germany: Kopäd.
- Marci-Boehncke, G., Rath, M. O., Goll, T., & Steinbrecher, M. (2022). How to Become Political? Basic Concepts for Exploring Early Childhood Understanding of Politics. In M. Carmo (Ed.), *Education and New Developments 2022* (pp. 179-183). Lissabon: InScience Press.
- Marci-Boehncke, G., Rath, M., Delere, M., & Höfer, H. (2022). Medien – Demokratie – Bildung: Normative Vermittlungsprozesse und Diversität in mediatisierten Gesellschaften. In G. Marci-Boehncke, M. Rath, M. Delere & H. Höfer (Eds.), *Medien – Demokratie – Bildung: Normative Vermittlungsprozesse und Diversität in mediatisierten Gesellschaften* (pp. 1-10). Wiesbaden, Germany: Springer VS.
- Rosa, E. M., & Tudge, J. (2013). Urie Bronfenbrenner's Theory of Human Development: Its Evolution from Ecology to Bioecology. *Journal of Family Theory & Review*, 5, 243-258.
- Rowe, D. (2005). The Development of Political Thinking in School Students: An English Perspective. *International Journal of Citizenship and Teacher Education*, 1 (1), 97-110.
- O'Sullivan, E. V., & Taylor, M. M. (2004). Glimpses of an Ecological Consciousness. In O'Sullivan, E.V. & Taylor, M.M. (Eds.), *Learning Toward an Ecological Consciousness: Selected Transformative Practices* (pp. 5-23). New York: Palgrave Macmillan. Doi:10.1007/978-1-4039-8238-4\_2
- Tkotzyk, R., & Marci-Boehncke, G. (2022). Research with young children: Do picture concept maps work as interview tool in early childhood research? *Proceedings of INTED 2022*, 7258-7267. doi:10.21125/inted.2022.1836
- Tkotzyk, R., Lategahn, J., & Marci-Boehncke, G. (2022). Picturizing strategy: Introducing a new participatory interview tool in research with young children. *Proceedings of ICERI 2022*, 2260-2265. doi:10.21125/iceri.2022.0572
- UNESCO (2019). *Futures literacy: anticipation in the 21st Century*. Retrieved August 8, 2022, from <https://unesdoc.unesco.org/ark:/48223/pf0000372349.locale=en>
- UNESCO (2021). *Future Literacy. An essential competency for the 21st century*. Retrieved December 9, 2022, from <https://en.unesco.org/futuresliteracy/about>
- van Deth, J. W., Abendschön, S., Rathke, J., & Vollmer, M. (2007). *Kinder und Politik. Politische Einstellungen von jungen Kindern im ersten Grundschuljahr*. Wiesbaden, Germany: Springer VS.
- Vélez-Agosto, Nicole M., Soto-Crespo, José G., Vizcarrondo-Oppenheimer, Mónica, Vega-Molina, Stephanie, & García Coll, Cynthia (2017). Bronfenbrenner's Bioecological Theory Revision: Moving Culture from the Macro into the Micro. *Perspectives on Psychological Science*, 12(5), 900-910. doi:10.1177/1745691617704397
- Wegemer, C. M., & Vandell, D. L. (2020). Parenting, temperament, and attachment security as antecedents of political orientation: Longitudinal evidence from early childhood to age 26. *Developmental Psychology*, 56, 1360-1371.

## **DOUBT IN RELIGIOUS FUNDAMENTALISM: EDUCATION BETWEEN AUTHORITY AND RATIONAL AUTONOMY**

**Rahel Kellich**

*Educational Science and Psychology, TU Dortmund University (Germany)*

### **Abstract**

A fundamentalist religious practice determines daily life, personal beliefs, and interaction with fellow human beings. Children and adolescents who grow up in fundamentalist homes are often collaterally involved in their parents' religious practice. Therefore, a self-determined decision about potential religious participation is usually anticipated and exchanged for authoritarian patterns of upbringing. When this practice demands blind trust in the universality of the religion and its scriptures, this is mainly reflected in educational practices and how authority determines them.

The ability to doubt is fundamental, particularly regarding critical opinion-forming, social participation, and democratic involvement. But how does the possibility of young people learning to doubt situate itself in this field of tension of religious infallibility? To pursue this topic, the influence of multi-layered authority in a religious fundamentalist education on the emergence and handling of *doubt* is examined and compared to the requirements for developing an autonomous personality. A delegitimation of doubt in pedagogical practice can lead to difficulties in the child's autonomy development. It is, therefore, in the interest of society and institutions to promote the ability to exercise autonomy. This paper attempts to generate a broader and interdisciplinary understanding of the interaction of doubt in religious fundamentalism and the development of rational autonomy.

**Keywords:** *Autonomy, doubt, religious fundamentalism, educational authority, democracy education.*

---

### **1. Introduction**

The sense and the active act of *doubt* are part of each human life. At the same time, it is a protective function and a decision-making aid. Children and adolescents who have grown up in religious-fundamentalist homes tend to learn from an early age to answer moral questions based on sacred scriptures or the determinations of clerical authority figures (Peels, 2022). Worldly things can easily be differentiated into *good* and *evil* (Baurmann, 2007). This can guide a god-fearing lifestyle. In this paper, I aspire to examine how a fundamentalist lifestyle and an authoritarian upbringing in this sense are related to the learning of doubt in childhood and adolescence in an educational-philosophical way. It will address the consequences of (not) learning to doubt and whether and how an autonomous lifestyle can develop in this context. Therefore, I will begin by looking at infallibility in fundamentalist contexts and its impact on the authority exercised on children and adolescents. I then situate the emergence and handling of doubt in this environment. After a definitional sequence on the focus on autonomy and autonomy learning, I place this in the context of limited doubt in the second part of the paper. The aim here is to shape a view about upbringing and its influences on people in such circumstances. In particular, the paper contributes to the study of the limits of authority in education and fundamentalist education patterns per se, especially the aspect of dealing with autonomy (learning) in education (e.g., Giesinger, 2020/ Dietrich, 2021/ Westlund, 2021). The intention here is not to condemn educational concepts but to take a deeper look into the causes and consequences of doubt and emphasize the lack of doubt in relation to the shaping of autonomy. During the philosophical-epistemic investigations in this paper, I work with the defining assumption of fundamentalism that the infallibility of certain beliefs is a criterion for fundamentalist communities. Thus the condemnation of doubt is a necessary component. I do not thereby exclude the possibility that there are fundamentalist structures in other contexts that do not make use of the infallibility doctrine. The explanations are intended to draw connections between different academic working fields deliberately.

## 2. Belief in infallibility as a possible "pillar" of fundamentalism

Numerous explanatory approaches and attempts at definition, in at least equally diverse fields of research, deal with the foundations and effects of fundamentalist lifestyles. An issue repeatedly mentioned as a definitional cornerstone of this phenomenon is the infallibility of the respective religion, the relevant Holy Scripture (e.g., Malcolm, 2021; Baurmann, 2007 et al.), scholars, or prophets.

In his 'BicFam' definition of fundamentalism, Peels (2022, p. 13) describes the pillar "Literalism and infallibility" as "Fundamentalisms tend to confer total authority on certain texts [...]". These texts, in particular the *holy* scriptures of various religious communities, are *infallible* and to be understood literally. Any attempts at interpretation and hermeneutics are categorically rejected (Peels, 2022). Therefore any person who understands otherwise would have fallen into an aberration. The rules and teachings of the fundamentalist communities are "universal and absolute". Accordingly, the plurality of thought and social belief cannot be fruitful, but people can only be saved if they join the community (Peels, 2022, p. 13).

The guidelines believers can take from these infallible and universal religious dogmas are anchored in a "dualistic worldview" (Almond et al., 1995, p. 134). The world is thus divided into *good* and *sinful*, *righteousness* and *apostasy*. Emerson and Hartman (2006) describe this phenomenon further, saying that for believers, it is clear whether people belong to a fundamentalist community: Either one adheres to the strict rules or not. This diametrical view of the world has specific implications for the everyday lives of believers in fundamentalist communities. In particular, family and sexual life, food and dress codes, gender relations, and general behaviours are often predetermined (Almond et al., 1995). Thus, there is mostly a clear path of righteousness in fundamentalist constructs (Fulton et al., 1999). If we look at the difference between 'literal' and 'symbolic' understanding of sacred scriptures, it becomes apparent that, especially in times of increasingly flexible lifestyles, beliefs, and secularisation, the literal understanding gives believers continuity, certainty, and the assurance that for every problem there is a correct response (Fontaine et al., 2005). If one acknowledges these rules and guidelines, since they are taken from a scripture regarded as *infallible*, universally valid, and holy, it can be concluded that, on the one hand, doubt is not desirable and, on the other hand, it is sinful, since it doubts the holiness and is thus to be suppressed. I will explore this derivation in the context of education and autonomy in the following chapters.

## 3. Pedagogical authority in fundamentalism

In the previous chapter, I pointed out that the apparent *infallibility of faith* in certain fundamentalist structures can have a concrete and far-reaching influence on how people shape their lives. When institutions such as religious communities, scriptures, or other human constructs are presented and seen as infallible, they exert a particular authority on the recipients. Whether it is the interaction between employers and employees, in educational institutions, or individual education: authoritarian structures can be found everywhere. Authority sets necessary guidelines but can also become a limitation of development towards a self-reliant person. Thus, authority often arouses particularly negative associations, although it can be required in an educational context. For example, younger children with not yet fully developed abilities can learn from persons with trained intellectual and institutional authority (Westlund, 2021). Scholars widely distinguish between two forms of authority: practical and theoretical. First grants a person the legitimacy to give instructions, which in turn should be followed by others. The second recognizes people as experts in specific fields without the direct implication of following their advice (Schmidt, 2011; Giesinger, 2018). For example, in our case, fundamentalist communities could see the legitimacy of religious opinion leaders or, among others, *holy scriptures* as direct communication of *higher powers* to people as a practical authority. In contrast, a moderate and critical engagement with religion and faith could lead to involved scriptures or persons being seen as theoretically authoritarian.

In most social contexts and according to the ECtH<sup>1</sup>, parents have the right to educate their children according to their ideas and beliefs, as long as this education locates itself within the legal framework (EctH, 2022). It is, therefore, easy for parents and other adults in the adolescent's environment to exercise authority. Particularly in the case of younger children, however, the question always arises as to whether their individual moral and mental development enables them to distinguish between the illegitimate and legitimate exercise of power (Giesinger, 2018).

In many fundamentalist communities, parental and occasionally institutional education is based on faith and adherence to the prescribed rules of life. "In their view, strength in faith and strict obedience to God's commands constitute the primary goals of child education" (Dietrich, 2021, p. 563). Educators

<sup>1</sup> European Court of Human Rights, Article 2, Protocol 1

thus exercise the authority of knowledge and truth as supposed transmitters of faith. This education tends to suggest to young people that they are not the creators of their own lives but that everything is predetermined (even before birth) and to be trusted so that no decisions should be taken outside this framework. (Dietrich, 2021).

This educational style takes its lead from an inherently strongly authoritarian construct (Peels, 2020), the fundamentalist practice of religion. It exerts an enormous influence on its followers through its authoritarian form of organization (rules of conduct, obedience to religious authorities) (Emerson & Hartman, 2006; Almond et al., 1995).

Parents in these settings seem to aspire to teach their children about the *truth* and *salvation* they have experienced in a way that is right and essential for them. One could speak here of a double exercise of authority. On the one hand, religious authority is exercised on the parents, who in turn transfer it to the children, usually from their best knowledge and convictions, through mostly strict rules and guidelines. At the same time, from a certain age, faith can also exert a direct authoritarian influence on children and adolescents, as they fear not only parental but also God's disfavor if they break any rules. It depends on the individual case, which influence weighs more heavily.

#### **4. The interplay of authority and doubt in education**

By formulating the double authoritarian dependence of adolescents, I have highlighted the extent to which they are clamped to clear guidelines. The following analysis is not primarily about self-*doubt* but about doubting and critically questioning one's environment, life plans, and designs. Doubt can therefore be seen as healthy skepticism toward one's environment (Cambridge Dictionary, 2022).

The ability to doubt or to question things critically is closely related to obedience relationships and, in the case of children and young people, to the authority exercised by adults and guardians. According to Giesinger (2018), one can only speak of obedience if it is not demanded through force; the individual thus "[...] voluntarily acquiesces in the normative demands of others"<sup>2</sup> (Giesinger, 2018, p. 611). This raises the question of whether children and young people in fundamentalist communities understand compliance with rules as coercion or whether this becomes an intrinsic habitus. This involves both the observance of religiously influenced parental rules and the direct divine regulations. On the one hand, humans must be able to trust to some extent. Without this basic trust, fundamental social interactions can hardly function if we just look at children's primary trust in their parents in their early development years. On the other, this essential trust should also show boundaries where the transition to critical questioning and reflection begins.

Children in fundamentalist groups are often kept away from anything that might distance them from following *God's Word* and, thus, the *truth*. There is, therefore, a particular attempt to draw a front to secular and progressive movements (Peels, 2020). Perhaps also out of fear, much is done to prevent doubts from arising. This one-dimensional worldview can also naturally limit the possibilities of being open-minded or even acting autonomously. It can be deduced from this that the over-exertion of authority on young people here leads to any doubt about these rules being understood as questioning God Himself. When one knows only one universal *truth*, doubting it is made difficult. Thus, in religious fundamentalism, children and adolescents are often not trained to make basic decisions, to choose critically between different concepts, and, therefore, to doubt. I imply that this can lead to a lack of ability to critically examine one's life concepts or even to doubt them.

This does not mean that people in fundamentalist structures are free of doubt. Studies show that even a critical view of one's faith does not necessarily lead to a rejection of the fundamentalist way of life but rather to the opposite (Schouten, 2018). This phenomenon can be mentioned as a possible explanation due to the narrow worldview discussed. Therefore, even the most plausible arguments against a person's initial worldview do not necessarily lead to a change of fundamental convictions and can only be adjusted with difficulty since, otherwise, the entire worldview could be overturned.

#### **5. Autonomy(acquisition) in the context of limited doubt**

As highlighted in the previous chapters, authority is often over-emphasized in religious fundamentalist educational constructs. When it is more difficult for adolescents to find a constructive relationship to doubt and critical engagement with life decisions, the question arises of how strongly these prepositions influence the acquisition of an autonomous way of life.

When we talk about autonomy, we also talk about the purpose of liberal education. Kymlicka (1989, p. 18) speaks of 'rational revisability', i.e., the ability to formulate one's values, beliefs, or goals. In aiming to achieve autonomy, various intrinsic and external essential prerequisites, which I will focus on,

---

<sup>2</sup> Translated from German: "[...] freiwillig auf die normativen Ansprüche anderer ein."

are needed. According to Taylor (2017), among others, open-mindedness is a necessary, though not sufficient, factor. This, in turn, would consist of the prerequisites needed to learn something new, to question old convictions, and, if necessary, to revise them. Dietrich (2021, p. 565) speaks of similar prerequisites that must be fulfilled to constitute an autonomous person as “critically rethinking” or “[...] changing their most important projects and ambitions”. Without different options from which people can choose with reasonable grounds and without coercion, there would be no basis for autonomy. Intending to be able to act autonomously, indoctrination and thus an impediment to free and rational decision-making must also be avoided (Taylor, 2017). If parents take this decision away from their children, it has concrete consequences for their children's future prospects. (Dietrich, 564). Finally, autonomous individuals are the foundation of a democratic society (Taylor, 2017), so it is in the general interest of even this society to promote them. Of course, it must be remembered that all ideas and options are influenced by certain dogmas or political and sociological backgrounds. A democratic and pluralistic society must be able to tolerate this to a certain extent.

Interesting in this context is the argumentation of Giesinger (2018), who sees autonomy as uncoupled from simply following rules. An autonomous education process aims to encourage children to question rules rather than force them to obey. In this sense, a strong authoritarian upbringing can influence the development of autonomy skills in childhood. Assuming that compliance with fundamentalist religious rules is based on strict obedience, it can be concluded that children follow the rules not only because they make sense to them or are even plausible but because compliance is expected by the authority figure, even if coercion does not necessarily have to be involved. To a certain extent, adolescents are deprived of their decision-making power and, thus, of the chance to generate autonomy (Giesinger, 2018). According to Giesinger, another point that should be addressed is inherent moral education. Since adolescents are not involved in the decision-making process of the rules to be followed, they are more inclined to hand over moral responsibility to the person exercising authority. Ethical rules are therefore not questioned according to their purpose in themselves but are only examined concerning consequences by authorities.

Since indoctrination, in contrast to open-mindedness as a prerequisite for autonomy, tends to lead to close-mindedness (Callan & Arena, 2009), further research is needed to determine whether most fundamentalist attempts at teaching are indoctrination of adolescents and where the limits of education are crossed into indoctrination (e.g., Drerup, 2018). However, suppose one follows Peels (2020), who says that access to education is limited for members of fundamentalist groups and adds the above-average exercise of authority and demand for obedience in the lives of adolescents in religious fundamentalism. In that case, one deduction can be made: Through excessive authority and the attempted suppression of doubts through fear of (divine) disfavor and punishment, the educational support in learning a broad horizon and open-mindedness can at least be doubted. Therefore, my thesis is that the intensity of authority in religious-fundamentalist education, with the criteria applied in this paper, exceeds the scope of what is appropriate or even acceptable for adolescents.

I want to return to Dietrich (2021), who admits both the freedom from coercion and the prerequisite of having several options for autonomy formation. Both, as illustrated, are probably to be denied in some fundamentalist movements. Objectively, many young people would have the opportunity, even though challenging, to turn away from fundamentalist teachings. Still, those who are encouraged from an early age to follow the *path of truth* may not later recognize their full potential to evaluate alternative options (Dietrich, 2021). When interviewed, members of religious *high*-fundamentalist groups relatively rarely mentioned doubts about God or their religion. However, when doubts did arise, they tended to be interpreted in a pro-religious direction, strengthening the respondents' faith rather than challenging it (Altemeyer & Hunsberger, 1992). (Rare) doubts seem to move people as not questioning their faith and beliefs per se, but rather their attitude towards faith. The origin here could be that education did not lay the foundations for tools to deal with doubts that arise.

According to Vergote, one of the prominent origins of doubt in adolescence is the conflict between authority and autonomy (Vergote, 1997). One might think that this contradicts the thesis that adolescents in this context cannot sufficiently develop their doubts, let alone learn possible solutions for inner conflicts since this area of tension should become visible here. It should be countered that this tension most likely also occurs among these adolescents. The crucial point is another, namely: how these doubts are overcome. And in these cases, they are resolved in a supposedly faith-promoting direction.

Even given these deductions, it cannot be assumed causally that autonomy cannot develop in strong authoritarian relationships as total control is usually not exposed, and possibilities for own thoughts, therefore, can arise. Here, special consideration must be given to the type of school attended (e.g., public school or home-schooling) or the general living environment of the adolescents. In other words, to what extent do they come into contact with different people and thus also different opinions and lifestyles? However, as leaving the community would present individuals with enormous mental and

social challenges, many would choose not to do so (Dietrich, 2022). Going further, Taylor (2017) sees a governmental responsibility to ensure that adolescents have sufficient opportunities for critical thinking and, therefore, the possibility to make autonomous decisions and act democratically.

## 6. Conclusion

Doubts are a social corrective, part of every democratic society, and integral to adolescent development. However, due to a mostly strongly authoritarian style of education in religious fundamentalism, which is guided by ideas of obedience, it is suggested to adolescents that these doubts are harmful to their faith and their relationship with God and should therefore be avoided. Children and adolescents at this point experience difficulties in learning how to deal with doubts that arise despite all attempts to suppress them. The consequence of this can be difficulties in finding their individual autonomy. Fundamentalist structures can accordingly maintain themselves. To promote self-determination, autonomy, and the capacity for democracy in these parts of society, the research field of educational prevention and intervention, as in educational institutions or extracurricular activities, must be stressed more intensely in these contexts.

## References

- Almond, G. & Sivan, E., Appleby, R. S. (1995). Fundamentalism: genus and species. In M. E. Marty & R. S. Appleby (Eds.), *Fundamentalisms Comprehended* (pp. 399–424). Chicago: Univ. Chicago Press.
- Altemeyer, B. & Hunsberger, B. (1992). Authoritarianism, Religious Fundamentalism, Quest, and Prejudice. *International Journal for the Psychology of Religion*, 2(2), 113–133.
- Baurmann, M. (2007). Rational Fundamentalism? An Explanatory Model of Fundamentalist Beliefs. *Episteme*, 4 (2), 150–166.
- Callan, E. & Arena, D. (2009). Indoctrination. In: H. Siegel (Ed.) *Oxford Handbook of Philosophy of Education*. 104–121, (ed.). Oxford: Oxford University Press.
- Cambridge Dictionary. (2022, n.d.). Doubt. <https://dictionary.cambridge.org/dictionary/english/doubt>
- Dietrich, F. (2022). *Critical Reflection and the Limits of Parental Authority*. In: *Journal of Applied Philosophy*, 39 (4), 562–580.
- Drerup, J. (2018). „Zwei und zwei macht vier.“ Über Indoktrination und Erziehung. *Diskurs Kindheits- Und Jugendforschung*, 13(1), 7–24.
- Emerson, M. O. & Hartman, D. (2006). The Rise of Religious Fundamentalism. *Annual Review of Sociology*, 32, 127–144.
- European Court of Human Rights (ECtHR). (2022, n.d.) Handbook on European law relating to the rights of the child. [https://www.echr.coe.int/documents/handbook\\_rights\\_child\\_eng.pdf](https://www.echr.coe.int/documents/handbook_rights_child_eng.pdf)
- Fontaine, J. R. J. & Duriez, B., Luyten, P., Corveleyn, J., Hutsebaut, D. (2005). RESEARCH: “Consequences of a Multidimensional Approach to Religion for the Relationship Between Religiosity and Value Priorities.” *International Journal for the Psychology of Religion*, 15(2), 123–143.
- Fulton, A. S., Gorsuch, R. L. & Maynard, E. A. (1999). Religious orientation, antihomosexual sentiment and fundamentalism among Christians. *Journal for the Scientific Study of Religion*, 38, 14–22.
- Giesinger, J. (2018). Pflicht zum Gehorsam? Legitime Autorität in der Schule. *Pädagogische Rundschau*, 72(5), 609–620.
- Kymlicka, W. (1989). *Liberalism, Community, and Culture*. Oxford: Oxford University Press.
- Malcolm, F. (2021). The Rationality of Fundamentalist Belief. *Journal of Social Philosophy*. 00. 1–20. <https://doi.org/10.1111/josp.12440>
- Peels, R. (2022). On Defining ‘Fundamentalism’. *Religious Studies*. 1–19.
- Peels, R. (2020). Responsibility for Fundamentalist Belief. In K. McCain & S. Stapleford (Eds.), *Epistemic Duties: New Arguments, New Angles*. 221–238. London: Routledge.
- Schmid, H. (2011). *Moralische Integrität: Kritik eines Konstrukts*. Berlin: Suhrkamp Verlag AG.
- Schouten, G. (2018). Political liberalism and autonomy education: Are citizenship-based arguments enough? *Philosophical Studies*, 175(5), 1071–1093.
- Taylor, R. M. (2017). Education for autonomy and open-mindedness in diverse societies. *Educational Philosophy and Theory*, 49(14), 1326–1337.
- Vergote, A. (1997). *Religion, Belief and Unbelief: A Psychological Study*. Amsterdam: Amsterdam University Press.
- Westlund, A. C. (2021). ‘Who’s to Say?’: Responsibility, Entitlement, and Educating for Autonomy. *Journal of Applied Philosophy*, 39(4), 597–615.

# EARLY IDENTIFICATION OF ACADEMIC FAILURE ON HIGHER EDUCATION: PREDICTING STUDENTS' PERFORMANCE USING AI

**Fidel Cacheda, Manuel F. López-Vizcaíno, Diego Fernández, & Víctor Carneiro**

*Center for Information and Communications Technologies Research (CITIC)*

*Department of Computer Science and Information Technologies, Campus de Elviña s/n, 15071 (Spain)*

## Abstract

In this work we focus on the early identification of academic failure in higher education as a mean to allow educators to provide an early intervention and help students on a risky position to achieve academic success. For this purpose, we define a dataset of more than one thousand students with their respective grades collected from a Computer Networks course on a Computer Science degree at a Spanish university throughout four years. From the dataset we extract different features corresponding to the laboratory and quiz assignments proposed to the students during the course that intend to represent the effort and accomplishment achieved by the students. A preliminary analysis of the dataset shows a potential relation between the scores achieved throughout the course and the final exam mark. The aim is to predict if a student will pass or not the final exam using only information extracted from the different laboratory and quiz assignments. In this sense, we define a data mining classification task following a supervised learning approach where a selection of well-known machine learning algorithms is evaluated following a 10-fold cross-validation scheme to assess the performance and robustness of the models. Our results show that using Random Forest we can accurately predict in more than 91% of the cases if a student will pass or not the final exam, achieving a F1-score of 0.916. Moreover, we perform a feature importance analysis highlighting how laboratory assignments features have a higher contribution to the learning model than quiz assignments.

**Keywords:** *Early identification, higher education, academic failure, machine learning, artificial intelligence.*

## 1. Introduction

Student success has been defined by York et al. as “academic achievement, satisfaction, acquisition of skills and competencies, persistence, attainment of learning objectives, and career success” (York, Gibson, & Rankin, 2015). In fact, student success is considered a key metric on higher education institutions for assessing their quality (Alyahyan & Dustegor, 2020).

The use of Artificial Intelligence and, more specifically, Data Mining techniques allow us to mine large amounts of data and education is one important field where Data Mining can be applied. In fact, Educational Data Mining (EDM) has risen as a research field that involves statistics, data mining and machine learning, and other fields to analyze educational big data effectively (Xiao, Ji, & Hu, 2022), (Batoool et al., 2022).

In this article, we focus on the early identification of academic failure in higher education as a mean to allow educators to provide an early intervention and help students on a risky position to achieve academic success. A dataset is defined with more than one thousand students' grades on a Computer Networks subject. Several features corresponding to the laboratory and quiz assignments are extracted and a data mining classification task is proposed to predict if a student will pass or not the final exam.

## 2. Related works

EDM comprehends multiple research works involving the discovery of knowledge patterns about educational facts and the learning process (Anoopkumar & Rahman, 2016), such as performance (Saa, 2016), success (Martins, Miguéis, Fonseca, & Alves, 2019), satisfaction (Alqurashi, 2019) or dropout rate (Pérez, Castellanos, & Correal, 2018), among others.



Our work is more related with the prediction of students' academic performance. In this sense, the authors of (Mueen, Zafar, & Manzoor, 2016) test three classification algorithms (Naïve Bayes, Neural Network, and Decision Trees) to predict students' performance on two undergraduate courses. Sivasakthi applies different classification algorithms to predict programming performance on a Computer Application course proposing a knowledge flow model (Sivasakthi, 2017). In (Putpuek, Rojanaprasert, Atcharyachanvanich, & Thamrongthanyawong, 2018) the students' performance is predicted based on their personal background, including gender, scholarship awarded, previous educational background, admission type, talent and province of high school, although a moderated accuracy was achieved. In (Almarabeh, 2017) a simple comparison of different classification algorithms is presented using a dataset of 225 students. Yassein et al. in (Yassein, Helali, Mohomad, et al., 2017) search for patterns to predict students' performance and discover that the most affecting factor is class attendance. More recently, (Alsariera et al., 2022) analyses some research works published between 2015 and 2021, concluding that machine learning can be beneficial to identify various academic performance areas.

These previous works are related with ours in the sense that the aim is to predict students' academic performance, although the early detection of a potential low performance is also relevant in our research.

### 3. Course description

This work has been performed collecting the data from a subject on Computer Networks taught at the degree in Computer Science Engineering at the University of A Coruña (Spain). This subject is taught in the second semester of the second year and it takes 6 credits of European Credit Transfer System (ECTS), which correspond to 60 hours of classroom teaching plus 90 hours of personal work.

The course is focused on the main aspects of networking, including the main features, functionalities and structure of computer networks and Internet. This subject constitutes the first approach to computer networking for most students and the main objective is that students understand the different layers and protocols that come into action when two devices communicate using TCP/IP.

The subject has assigned four sessions per week (one hour per session): two theoretical sessions on different days and two consecutive sessions for the laboratory. The syllabus of the course is as follows:

- Topic I – Introduction to computer networks, Internet and TCP/IP
- Topic II – Application layer: Web, email and DNS
- Topic III – Transport layer: UDP and TCP
- Topic IV – Network layer: IP, subnetting and routing
- Topic V – Link layer: ARP, Ethernet and WiFi

Throughout the course, each student must individually develop and present the following laboratory projects, which are not mandatory:

- Project I: Introduction to socket programming in Java
- Project II: Basic Java Web server
- Project III: Introduction to Network simulation with Cisco Packet Tracer
- Project IV: Network simulation – Subnetting and routing

Also, students are presented with two quizzes throughout the course that must solve online. These quizzes are composed of questions from the theory lessons and are intended to reinforce the students' continuous learning. The first quiz covers topics I and II, while the second quiz covers topics III and IV.

The evaluation of the subject includes a theoretical exam (two calls are available for the students, one at the end of the semester and another approximately one month later) that corresponds to 70% of the final grade and the students are required to achieve at least a grade of 4 (out of 10) to compute the final grade. The final grade also includes the laboratory and quiz grades, as 25% and 5%, respectively (no minimum grade is required in this case). To pass the subject, a final mark greater than or equal to 5 must be achieved by the student.

### 4. Dataset and features

#### 4.1. Dataset

We have built a dataset collecting the grades from the Computer Network subject presented on the previous section throughout four years: 2017-18, 2018-19, 2020-21, 2021-22. We skip the year 2019-20 because the Covid pandemic produced changes on the students' evaluation.

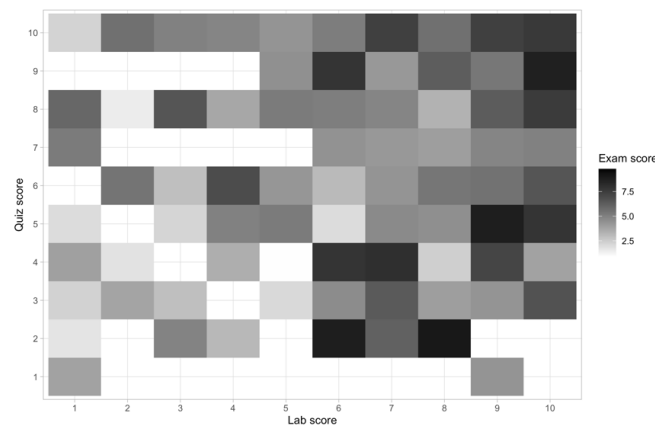
Table 1. Dataset summary.

	Number of students	Laboratory		Quiz		Exam	
		Pass	Fail	Pass	Fail	Pass	Fail
2021-22	256	134	122	177	79	169	87
2020-21	289	170	119	225	64	197	92
2018-19	244	169	75	159	85	188	56
2017-18	261	181	80	175	86	189	72
<b>Total</b>	<b>1050</b>	<b>654</b>	<b>396</b>	<b>736</b>	<b>314</b>	<b>743</b>	<b>307</b>

Table 1 presents a summary of the main characteristics of the dataset. The dataset is composed of more than one thousand students with their respective grades. We summarize the number of students that pass and fail each one of the main evaluation parts. We consider that a student passed the exam if in any of the two calls she/he achieved a score higher than or equal to 4. Also, the number of students that failed the exam includes the students that did not show up. For evaluation purposes, only students that actually did the exam will be taken into consideration which reduces the total number of failed exams to 158.

Our intuition is that students that perform well during the course (i.e. in the laboratory and quizzes) will tend to also perform well in the final exam. Figure 1 presents a heat map of the exam scores with respect to the laboratory (X axis) and quiz (Y axis) scores. From the figure we can observe how darker tones (corresponding to higher exam scores) are located on the right half of the figure and, specially, on the upper corner corresponding to higher grades on both laboratory and quiz assignments, confirming our intuition.

Figure 1. Heat map of exam scores with respect to laboratory and quiz scores.



## 4.2. Features

From the dataset, we extract several features that are divided into two groups, depending on if they correspond to laboratory or quiz grades. All scores are normalized to operate between 0 and 1.

Laboratory features include the following:

- Laboratory assignments scores: one feature for each assignment (denoted as Lab1, Lab2, Lab3 and Lab4).
- Laboratory score (Lab\_score): final laboratory score.
- Laboratory passed (Lab\_passed): boolean value indicating if the student passed the laboratory assignments (i.e. lab score higher than or equal to 5).
- Laboratory effort (Lab\_effort): percentage of assignments submitted.
- Average, standard deviation and median for laboratory assignments scores (Lab\_avg, Lab\_std and Lab\_median)
- Number of passed laboratory assignments (N\_lab\_passed)
- Number of laboratory assignments submitted (N\_lab\_tried)

For the quizzes, analogous features have been extracted.

Moreover, the aggregation of laboratory and quiz scores was calculated as the average (denoted as LabQuiz\_score).

## 5. Data mining problem

We focus on one task: to predict if a student will pass the final exam, just taking into consideration the work done by the student throughout the course in terms of laboratory and quiz assignments.

For this purpose, we define a data mining classification task following a supervised learning approach. We consider the following standard off-the-shelf machine learning algorithms that intend to cover the main techniques: J48, JRip, LibLinear, Logistic Regression (LR), Naïve-Bayes (NB), Random Forest (RF) and SVM.

The evaluation is conducted following a 10-fold cross-validation scheme to assess the performance and robustness of the models. To address the class imbalance (743 students passed the exam vs. 158 that failed) we oversample the minority class using Synthetic Minority Oversampling Technique (SMOTE). As evaluation metrics, we report our results on the percentage of accurately predicted instances, F1-measure, Receiver Operating Characteristics (ROC) Area Under the Curve (AUC), Precision Recall Curve (PRC) AUC and Root Mean Squared Error (RMSE).

## 6. Experimental results

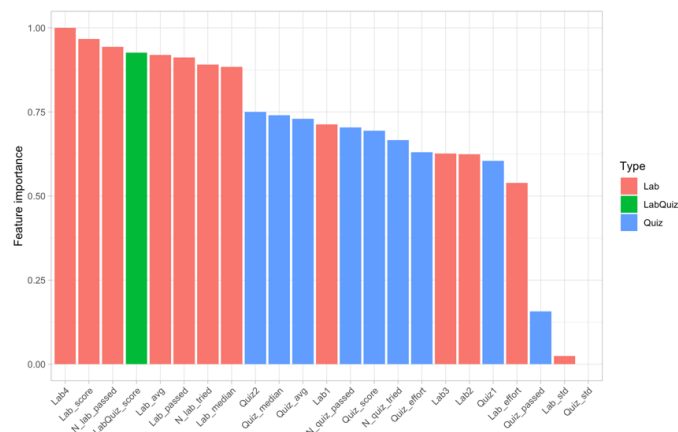
In Table 2, we present the results for the models trained on the proposed dataset. Random Forest is the best performing model, being able to predict accurately more than 91% of the cases and the F-score is 0.916. Also, for all remaining metrics, RF is consistently the best performing model.

Table 2. Results for failure detection using all features.

Model	Correctly classified	F1	ROC AUC	PRC AUC	RMSE
J48	88.12%	0.881	0.866	0.795	0.330
JRip	87.06%	0.871	0.873	0.830	0.332
LibLinear	85.20%	0.852	0.825	0.737	0.384
LR	84.80%	0.848	0.890	0.878	0.338
NB	77.84%	0.777	0.837	0.777	0.459
<b>RF</b>	<b>91.64%</b>	<b>0.916</b>	<b>0.939</b>	<b>0.897</b>	<b>0.259</b>
SVM	82.42%	0.824	0.799	0.707	0.419

We perform an ablation study, repeating the evaluation considering only laboratory features and only quiz features. In both cases, results did not improve the best performing model from Table 2. In general terms, using only laboratory features achieved better results than using only quiz features. This result is expected, since the laboratory assignments must be developed individually by each student, while quiz assignments can be answered collaboratively and, therefore, may not reflect accurately the student effort and knowledge in the subject.

Figure 2. Features importance.



Finally, we analyze feature importance on Figure 2 by measuring Pearson’s correlation between each feature and the class. We applied min-max normalization to Pearson’s correlation values obtained.

Laboratory features are represented in red, while quiz features are showed in blue. The feature aggregating both values is displayed in green. From the figure, we can observe how laboratory features are more important for the classification task than quiz features confirming the results from the ablation study. Also interesting is the high position in the ranking for the aggregation feature LabQuiz\_score.

## 7. Conclusions

In this work we have showed how following a supervised learning approach and using only information extracted from the grades obtained in laboratory and quiz assignments, we are able to predict if a student will pass or fail the final exam in more than 91% of the cases. Moreover, our feature performance analysis shows how laboratory assignments features have a higher contribution to the learning model than quiz assignments.

In the near future, we expect to apply these results throughout the course to identify students on a risky position that may require further supervision and evaluate their potential improvement.

### Acknowledgements

This research was supported by the Ministry of Economy and Competitiveness of Spain and FEDER funds of the European Union (Project PID2019-111388GB-I00) and by the Centro de Investigación de Galicia "CITIC", funded by Xunta de Galicia and the European Union (European Regional Development Fund- Galicia 2014-2020 Program), by grant ED431G 2019/01.

### References

- Almarabeh, H. (2017). Analysis of students' performance by using different data mining classifiers. *International Journal of Modern Education and Computer Science*, 9(8), 9.
- Alqurashi, E. (2019). Predicting student satisfaction and perceived learning within online learning environments. *Distance Education*, 40(1), 133–148.
- Alsariera, Y. A., Baashar, Y., Alkaws, G., Mustafa, A., Alkahtani, A. A., & Ali, N. (2022). Assessment and evaluation of different machine learning algorithms for predicting student performance. *Computational Intelligence and Neuroscience*, 2022.
- Alyahyan, E., & Dustegor, D. (2020). Predicting academic success in higher education: literature review and best practices. *Internat. Journal of Educational Technology in Higher Education*, 17(1), 1–21.
- Anoopkumar, M., & Rahman, A. M. Z. (2016). A review on data mining techniques and factors used in educational data mining to predict student amelioration. In 2016 international conference on data mining and advanced computing (sapience) (pp. 122–133).
- Batool, S., Rashid, J., Nisar, M. W., Kim, J., Kwon, H.-Y., & Hussain, A. (2022). Educational data mining to predict students' academic performance: A survey study. *Education and Information Technologies*, 1–67.
- Martins, M. P., Miguéis, V. L., Fonseca, D., & Alves, A. (2019). A data mining approach for predicting academic success—a case study. In International conference on information technology & systems (pp. 45–56).
- Mueen, A., Zafar, B., & Manzoor, U. (2016). Modeling and predicting students' academic performance using data mining techniques. *Internat. journal of modern education & computer science*, 8(11).
- Pérez, B., Castellanos, C., & Correal, D. (2018). Predicting student drop-out rates using data mining techniques: A case study. In Ieee colombian conference on applications in computational intelligence (pp. 111–125).
- Putpuek, N., Rojanaprasert, N., Atcharyachanvanich, K., & Thamrongthanyawong, T. (2018). Comparative study of prediction models for final gpa score: a case study of rajabhat rajanagarindra university. In 2018 ieee/acis 17th international conference on computer and information science (icis) (pp. 92–97).
- Saa, A. A. (2016). Educational data mining & students' performance prediction. *International Journal of Advanced Computer Science and Applications*, 7(5).
- Sivasakthi, M. (2017). Classification and prediction based data mining algorithms to predict students' introductory programming performance. In 2017 international conference on inventive computing and informatics (icici) (pp. 346–350).
- Xiao, W., Ji, P., & Hu, J. (2022). A survey on educational data mining methods used for predicting students' performance. *Engineering Reports*, 4(5), e12482.
- Yassein, N. A., Helali, R. G. M., Mohomad, S. B., et al. (2017). Predicting student academic performance in ksa using data mining techniques. *Journal of Information Technology & Software Engineering*, 7(5), 1–5.
- York, T. T., Gibson, C., & Rankin, S. (2015). Defining and measuring academic success. *Practical assessment, research, and evaluation*, 20(1), 5.

## EXPLORING EARLY CHILDHOOD UNDERSTANDING OF POLITICS AND THE IMPACT OF (DIGITAL) MEDIA EDUCATION

**Raphaela Tkotzyk, Johanna Lategahn, & Gudrun Marci-Boehncke<sup>3</sup>**

*Institute for Diversity Studies, TU Dortmund University (Germany)*

### Abstract

For decades, young children were not considered active members of our society (Butschi & Hedderich 2021). This is a problematic perception considering that, for example, in democratic societies, democracy and democratic behavior must be learned and practiced by each generation anew (Deutscher Bundestag 2020), since we are not born as democratic beings. Furthermore, in today's world children get confronted with aspects such as climate change, gender disparities, health care, or peace at an early age. That is why participation, global citizenship education as well as the 17 SDGs of the United Nations Agenda 2030 are already embedded in early education programs and concepts.

However, research on child-centered and rights-based participation processes in early education is a major gap. Yet the few recent studies suggest that children as young as 5 years old have some political awareness (Berti 2005; Goll 2020; Schauenberg 2014). Thereby, we understand political awareness to be the recognition of and reflection on topics of public interest that are discussed in the media and trigger public interest at the same time. But when do children of pre-K- and elementary school-age develop this awareness? And what role do the different types of (digital) media play in this process? Exactly these questions the interdisciplinary research project PoJoMeC at TU Dortmund University, funded by the Federal Agency for Civic Education in Germany, seeks to explore.

In this paper, we present preliminary results of 14 qualitative interviews with children aged 4 to 8. The interviews were conducted with the *Picturizing Strategy* (Tkotzyk, Lategahn & Marci-Boehncke 2022), a method developed by us specifically for the work with young children who not yet can read and write. To systematize the results, we applied a refinement of Bronfenbrenner's Ecological Theory of Human Development (1979) and an argumentation-theoretical model used in philosophy didactics, the so-called *Trap-Mind-Theory* (Brosow 2020). By evaluating the results, conclusions can be drawn not only about the significance of (digital) media and media use regarding the transmission of prior political knowledge, but also about the supposedly negative role of educational institutions in this process, even though research repeatedly shows that digital media and their use are important for children's development and their participation in society (Burnett & Merchant 2018).

**Keywords:** *Digital media literacy, media use, early childhood research, global citizenship education, political awareness.*

---

### 1. Introduction – Young children, media use and political literacy

In her article “Der politische Dämon” (engl. The political demon), Wenke Husmann states that just a few hundred years ago it was common to enthrone children and there are still countries in which children hold leadership positions today (Husmann 2021). “The idea of childhood as its own stage of life, as special status, is a very Western and by comparison very young concept” (Husmann 2021). This leads to the fact, that for decades, young children were not considered active members of our society (Butschi & Hedderich 2021). This totemization, as Husmann calls it, leads to a political marginalization of children (Husmann 2021), which is problematic because in democratic societies, democracy and democratic behavior must be learned and practiced by each generation anew (Deutscher Bundestag 2020), since we are not born as democratic beings (Negt 2010). In today's world, however, children get confronted with aspects such as climate change, gender disparities, health care, or peace at an early age. That is why participation, global citizenship education as well as the 17 SDGs of the United Nations Agenda 2030 are already embedded in early education programs and concepts. The degree to which the young generation is active in the role of citizen is reflected in their engagement in civil society

discussions (Hasebrink, Lampert & Thiel 2020). However, (inter-)national research shows that political interest and awareness does not start in adolescence, but already at pre-school age (Goll 2020; Tkotzyk, Lategahn & Marci-Boehncke 2022).

Media plays an important role in this, as children grow up in an environment shaped by (digital) media from the very beginning (Kieninger et al. 2021). In Germany and most European countries, 72 percent of zero to six year olds can access digital devices and formats on a daily basis (Jax et al. 2020). Therefore, media must be seen as part of children's culture (MFKJKS 2018) and yet at the same time as worldview generators (Rath 2000). Since politics is primarily delivered through the media (Endeward et al. 2016), civic and political education is closely tied to media education. However, this is not new; neither from the perspective of political education (Oberle 2017) nor from the perspective of media education (Wagner 2013, KMK 2012 & 2016). The ongoing digitization is also accompanied by a strong change in the participation of citizens (Manzel 2017), for which a competent handling of media is extremely important. It is fair to say that the competent use of media is the basis for political literacy (Oberle 2017). However, the interaction between political education and media education has so far received little attention in early education. Furthermore, research on child-centered and rights-based participation processes in early education is a major gap.

But when do children of pre-K- and elementary school-age develop this awareness? And what role do the different types of (digital) media play in this process? Exactly these questions the interdisciplinary research project PoJoMeC at TU Dortmund University, funded by the Federal Agency for Civic Education in Germany, seeks to explore.

In this paper, we present results of 14 qualitative interviews with children age 4 to 8. The interviews were conducted with the *Picturizing Strategy* (Tkotzyk, Lategahn & Marci-Boehncke 2022), a method developed by us specifically for the work with young children who not yet can read and write. To systematize the results, we applied a refinement of Bronfenbrenner's Ecological Theory of Human Development (1979) and an argumentation-theoretical model used in philosophy didactics, the so-called *Trap-Mind-Theory* (Brosow 2020).

## **2. Challenges when working with young children – The picturizing strategy (PS)**

As already mentioned, up to now mainly the political knowledge of young people has been subject of research. This is on one hand because younger children have not been the subject of research for long, and on the other hand because working with young children at preschool age holds multiple challenges because linguistic, interactive, and cognitive skills are not entirely developed (Butschi & Hedderich 2021; Vogel 2021). The main challenge, however, might be the limited narrative competence. Young children may understand complex words and sentences but they are not able to fully express themselves because their language skills are still developing. Also, the not yet entirely developed cognitive ability hinders young children to provide reflective responses, to reconsider their answers, and to restructure their thoughts. Another aspect that makes this kind of research difficult is the concentration span of 15 minutes maximum (Domsch 2014). Considering these aspects, we develop the Picturizing Strategy, which is based on the concept map strategy according to Novak and Canas (1990). Instead of using nodes, connecting references, and arrow labels, which are inherent for concept maps, we created a set of researcher produced visuals (Wuggenig 1990), because visual methods allow a different access to the object of investigation than research methods based on writing and numbers (Lobinger & Mengis 2018). It is known from adult research that pictures are also easier to absorb than words, but also direct attention better (Gilarski 2020). To systematize the results, we applied a refinement of Bronfenbrenner's Ecological Theory of Human Development (1979) and an argumentation-theoretical model used in philosophy didactics, the so-called *Trap-Mind-Theory* (Brosow 2020).

## **3. The development of a political awareness through (digital) media use by young children**

Before we will discuss the content of our test results in regard to political awareness, we would like to draw attention to the aspect of concentration span in young children, which is according to Domsch (2014) about 15 minutes. However, our interviews showed that with 13:37 minutes only one child fell below this time frame. All the other children exceeded it. The longest single interview (with a 4-year-old) contained a total length of 25:30 minutes. The longest interview overall is a double interview with two 6-year-old girls. Here we record 37:40 minutes. We attribute this fact to the novel interview method we developed especially for this topic and the main test group of young children.

### **3.1. Results on political awareness and (digital) media use**

In terms of content, we relied on the basic idea of rule awareness. This is because primary political socialization is based on experiences that have no explicit content-related reference to the political sphere. It includes learning that is also not explicitly political, but influences a person's behavior, such as following rules. This leads to 4 key questions: (a) What rules exist?, (b) Who determines rules?, (c) How do children know about these rules?, (d) And what happens when rules were broken? To connect with the children and their world, we chose familiar topics from both media and family communication. At the time of our interviews, this was mainly the Corona pandemic and the governmental imposed rules and restrictions.

The interview results show that both preschoolers and elementary school children notice all three levels of society (family, educational institutions, and society itself). Especially the rules concerning Corona but also certain rules of etiquette. However, it was noticeable that the younger children were more oriented to the interviewer's questions, while the elementary school children spoke more freely and on their own initiative. This is a fact that can also be found in the evaluation of the TRAP-Mind-Theory. The results also show that the younger children consider rules to be meaningful, but they are unable to justify their statement. The elementary school children see rules in part as necessary to prevent chaos from breaking out. It is also becoming clear that although rules are perceived as very restrictive, as soon as the meaning of the rules is understood, the children show understanding for the regulations. Elementary school children also already perceive the 3 powers (legislative, judicial and executive) and show partial knowledge of global society issues. Another interesting aspect that emerged from the interviews is the fact that first graders are already able to make connections between their own actions and the effects on society, whereas kindergarten children are not yet able to do so.

When it comes to clarifying the question "Who determines rules?", we have to differentiate between the three levels. All children were able to assign different authorities to the different levels. With regard to the question of how the children know about rules - in other words, the question of media influence - it becomes apparent that there are major differences at the micro and meso levels. It is clear from the interviews that at the micro level, i.e. in the family, children receive their "knowledge" through the primary media. This means that children learn about the rules and how to behave through communication with their parents, grandparents or even siblings. At the same time, however, it is clear that not only primary media are used, but also secondary, tertiary and quaternary media, especially in the family environment. In educational institutions, knowledge is passed on to children mainly via primary and secondary media.

### **3.2. The TRAP-Mind-Theory**

According to Brosow, the TRAP-Mind-Matrix "introduces a problem-oriented technique of philosophizing, based on empirical research in cognitive psychology" (Brosow 2020). It understands philosophizing as an educational process, which is planable and empirically provable (Brosow 2019). As shown in table 1, the matrix contains three areas and four levels. It divides three areas of contemplation that define the kind of problem we are dealing with – "understanding", "evaluating" and "acting" (Brosow 2020). The way in which we are dealing with the problem is divided into the four levels of (1) "thinking", (2) "reflecting", (3) "arguing" and (4) "philosophizing" (see table 1). The thoughts are developed from one level to another by adding reasons to considerations that are already made. Each level contains two stages where the reasons can either be tested or untested. Accordingly, the process of testing and correcting leads from thinking via reflecting and arguing to philosophizing (Brosow 2020). The DNA-matrix of philosophizing enables a clear distinction from approaches in which "philosophizing" is understood as a free association of ideas. On one hand, it identifies the different level between mere ideas, opinions and impulses and on the other hand it shows well-founded concepts, judgments and decisions and emphasizes that 'well-founded' does not always mean 'well-reasoned'. The actual scope of the (good) reasons given in support of a consideration must fit the claim with which the consideration is presented (Brosow 2020). To put it simply: I measure "good reasons" by my own experience (reflection). If I want other people to accept or adopt my thinking, I must give them arguments that they also consider as "good reasons" based on their experience (reasoning). If a consideration claims to be a generally valid theory, it must be based on objective arguments that are accepted by all people, no matter what their individual and group experiences are (philosophizing). (Brosow 2020).

Table 1. Structure of TRAP-Mind-Theory according to Brosow 2020.

Area:	Level:	Thinking	Reflecting	Arguing	Philosophizing
Understanding		Idea (description/association)	Concept (justified idea)	Definition (justified set of concepts)	Theory of Meaning (justified justification)
Evaluating		Opinion (believe/attitude)	Judgment (justified opinion)	Argumentation (justified set of judgments)	Theory of Quality (justified justification)
Acting		Impulse (motive)	Decision (justified impulse)	Stance/Praxis (justified set of decisions)	Theory of Behavior (justified justification)

Regarding philosophizing with children, the focus is not on evaluation because the aim is not to find out how well children can philosophize. Much more than that the TRAP-Mind-Theory should enable the way in which children justify their opinions so that they can be supported in the quality of their justifications. Also the highest level of philosophizing is not always the goal to be reached because there are questions where taking a subjective perspective makes more sense than an objective approach, such as justifying on the reflection level (Brosow 2020). In our case this would be if the interviewed children are asked about their rules at home, because that is where a subjective opinion is wanted.

With the help of the TRAP-Mind-Theory, we were able to determine that all children participating in the study reach the level of “thinking”. Argumentations, however, were mainly done by preschool children out of their own situation and positively for their own good. The level of “reflection” did not occur in preschool children.

#### 4. Conclusion

With the help of the Picturizing Strategy, we found that children perceive the social levels and can also make statements about their hierarchical arrangements. With regard to the influence of (digital) media, it is important to stress that already young children have a high rate of television consumption and live in households with various digital media. Thus children acquire their conception of the world and a prior political understanding through media use. Therefore, digital media has to be in the focus of educational processes in regard to creating a critical and constructive discurs on educational equity. However, our research showed, that in the family environment children come into contact with all four types of media, while in educational institutions there is no access whatsoever to digital media. Probably due to this fact, the interviewed children, as the research project reveals, do not consider educational institutions as transmitter of political knowledge. This is striking insofar that the states’ core curriculum requires teachers to integrate all kinds of media into the learning environment. Considering these results it is of particular urgency to deepen the research on this matter because integrating digital media into the learning environment is a central part of the educational curricula of schools as stated by the standing conference of the ministers of education and cultural affairs in Germany.

#### References

- Berti, A. E. (2005). Children’s understanding of politics. In M. Barret & E. Buchanan-Barrow (Eds.), *Children’s Understanding of Society* (pp. 69 – 103). Hove: Psychology Press.
- Bronfenbrenner, U. (1979). *The Ecology of Human Development: Experiments by Nature and Design*. Cambridge: Harvard University Press.
- Brosow, F. (2020): TRAP-Mind-Theory. Philosophizing as an educational process. *Journal of Didactics of Philosophy*, Vol. 4, pp. 14-33. Burnett, C. & Merchant, G. (2018). *New media in the classroom. Rethinking primary literacy*. London: SAGE Publications Ltd.
- Butschi, C. & Hedderich, I. (2021). Kindgerecht forschen. Ein Überblick. In I. Hedderich, J. Reppin & C. Butschi (Eds.), *Perspektiven auf Vielfalt in der frühen Kindheit. Mit Kindern Diversität erforschen* (pp. 101 – 119). Bad Heilbrunn: Verlag Julius Klinkhardt.
- Deutscher Bundestag (2020). *16. Kinder- und Jugendbericht. Förderung demokratischer Bildung im Kindes- und Jugendalter* (pp. 7-12). Berlin: Bundesministerium für Familie, Senioren, Frauen und Jugend.
- Domsch, H. (2014). Konzentration und Aufmerksamkeit. In A. Lohau & M. Glüer (Eds.), *Entwicklungsforschung im Kindesalter. Grundlagen, Diagnostik und Intervention* (pp. 63 – 82), Göttingen: Hogrefe Verlag.



- Endeward, D. et al. (2016). Schnittstellen. Wo Medienbildung zur Politischen Bildung wird. In *Computer + Unterricht, Vol. 102*, pp. 4 - 8.
- Gilarski, K., Müller, V. & Nissen, M. (2020). Mapping-Techniken zur Unterstützung des wissenschaftlichen Arbeitens. Retrieved 27.12.2022 from [https://archiv.ub.uni-heidelberg.de/volltextserver/28619/1/UBHD\\_Mapping-Techniken.pdf](https://archiv.ub.uni-heidelberg.de/volltextserver/28619/1/UBHD_Mapping-Techniken.pdf).
- Goll, T. (2020). Politische Konzepte junger Kinder – Ergebnisse einer explorativen Teilstudie.
- Hasebrink U., Lampert C. & Thiel K. (2020). Digitale Teilhabe von Kindern und Jugendlichen. Ergebnisse der EU Kids Online-Befragung in Deutschland 2019. Hamburg: Verlag Hans-Bredow-Institut.
- Husmann, W. (2021). *Der politische Dämon*. Retrieved 02.01.2023 from [https://www.zeit.de/kultur/2021-09/kinder-wahlkampf-armin-laschet-interview-enkelkinderbriefe-klimaschutz?utm\\_referrer=https%3A%2F%2Fwww.google.com%2F](https://www.zeit.de/kultur/2021-09/kinder-wahlkampf-armin-laschet-interview-enkelkinderbriefe-klimaschutz?utm_referrer=https%3A%2F%2Fwww.google.com%2F).
- Jax, M. et al. (2020). *Die Allerjüngsten (0-6J.) & digitale Medien*. Retrieved 27.12.2022 from [https://www.saferinternet.at/fileadmin/redakteure/Projekt-Seiten/Safer\\_Internet\\_Day/Safer\\_Internet\\_Day\\_2020/Safer\\_Internet\\_Day\\_2020\\_Infografik.pdf](https://www.saferinternet.at/fileadmin/redakteure/Projekt-Seiten/Safer_Internet_Day/Safer_Internet_Day_2020/Safer_Internet_Day_2020_Infografik.pdf).
- Kieninger, J. et al. (2021). *miniKIM-Studie 2020. Kleinkinder und Medien. Basisuntersuchung zum Medienumgang von Kleinkindern*. Retrieved 27.12.2022 from [https://www.mfps.de/fileadmin/user\\_upload/lfk\\_miniKIM\\_2020\\_211020\\_WEB\\_barrierefrei.pdf](https://www.mfps.de/fileadmin/user_upload/lfk_miniKIM_2020_211020_WEB_barrierefrei.pdf).
- Kultusministerkonferenz (KMK) (2012). *Medienbildung in der Schule (Beschluss der Kultusministerkonferenz vom 08.03.2012)*, Berlin.
- Kultusministerkonferenz (KMK) (2016): *Bildung in der digitalen Welt. Strategie der Kultusministerkonferenz (Entwurf der Kultusministerkonferenz vom 27.04.2016)*, Berlin.
- Lobinger, K. & Mengis, J. (2018). Visuelle Medien. Forschen mit Bildern – Erforschen von Bildern. In K. Lobinger (Ed.), *Handbuch visuelle Kommunikationsforschung*. (pp. 1 – 24) Wiesbaden: Springer VS.
- Manzel, S. (2017). *Medienkompetenz als Schlüsselkompetenz für politische Urteils- und Handlungsfähigkeit*, pp. 207 – 217. Bonn: Bundeszentrale für politische Bildung.
- Novak, J.D. & Canvas, A. J. (2008). The Theory Underlying Concept Maps and How to Construct Them. In *Technical report IHMC CmapTools 2006-01 Rec 01-2008*, Florida Institute for Human and Machine Cognition.
- MFJKS (2018). *Bildungsgrundsätze für Kinder von 0 bis 10 Jahren in Kindertagesbetreuung und Schulen im Primarbereich in Nordrhein-Westfalen*. Freiburg: Herder Verlag.
- Negt, O. (2010). *Der politische Mensch. Demokratie als Lebensform*. Göttingen: Steidl.
- Oberle, M. (2017). Medienkompetenz als Herausforderung für politische Bildung. In H. Gapski, M. Oberle & W. Staufer (Eds.), *Medienkompetenz – Herausforderung für Politik, politische Bildung und Medienbildung* (pp.187 – 196). Bonn: Bundeszentrale für politische Bildung.
- Schauenberg E-M. (2014). “Mama, was ist ein Obama?“ – frühkindliche Konzepte von Politik und die Frage nach der Organisation anschlussfähigen Politiklernens. In R. Behrens (Eds.) *Kompetenzorientierung in der politischen Bildung – überdenken – weiterdenken* (pp. 59-69). Schwalbach/Ts.: Wochenschau Verlag.
- Tkotzyk, R., Lategahn, J. & Marci-Boehncke, G. (2022). *Picturizing Strategy: Introducing a new participatory interview tool in research with young children*. In ICERI 2022 Proceedings (pp. 2260 – 2265), Seville.
- Vogel, S. (2021). Mit Kindern Interviews führen: Ein praxisorientierter Überblick. In I. Hedderich, J. Reppin & C. Butschi (Eds.), *Perspektiven auf Vielfalt in der frühen Kindheit. Mit Kindern Diversität erforschen* (pp. 142 – 157). Bad Heilbrunn: Verlag Julius Klinkhardt.
- Wagner, U. (2013). Ein souveränes Leben mit Medien gestalten – Normative Perspektiven medienpädagogischer Forschung. In M. Karmasin, M. Rath & B. Thomaß (Eds.), *Normativität in der Kommunikationswissenschaft* (pp. 267 – 288). Wiesbaden: Springer Fachmedien.
- Wuggenig, U. (1990). Die Fotobefragung als projektives Verfahren. In *Angewandte Sozialforschung, Vol. 16*, pp. 109 – 129.

## DEMOGRAPHIC CHARACTERISTICS OF TEACHERS' PERCEPTIONS TOWARDS THE USE OF TECHNOLOGY IN EARLY CHILDHOOD EDUCATION

**Baliqis Oladele Adeyinka<sup>1</sup>, Adebunmi Yetunde Aina<sup>2</sup>, & Ayodele Abosede Ogegbo<sup>3</sup>**

<sup>1</sup>*Department of Educational Foundations and Counseling Psychology, Lagos State University (Nigeria)*

<sup>2</sup>*Department of Education Management and Policy Studies, University of Pretoria (South Africa)*

<sup>3</sup>*Department of Science and Technology Education, University of Johannesburg (South Africa)*

### Abstract

The study focuses on the influence of demographic characteristics on early childhood education teachers' perception of the use of technology in teaching young children in Lagos state, Nigeria. This study's research design was quantitative, implying that an Ex post-facto research design was employed. Questionnaires were developed and administered to 100 randomly selected early childhood education teachers from 20 different schools in Lagos, Nigeria. The data collected was analyzed using descriptive statistics and linear regression analysis and the hypothesis was tested at a probability level of 0.05. Results revealed that teachers had positive perceptions (Mean=1.68, SD=.829) towards the use of technology in teaching young children. However, teachers' perception towards the use of technology was not statistically influenced by their demographic characteristics.

**Keywords:** *Early childhood education, technology, demographic factors, teacher perceptions.*

---

### 1. Introduction

The use of technology in a developmentally appropriate way can improve young children's learning, especially in the areas of emergent literacy, communication, problem-solving, and social skills through cooperation, and aiding children with disabilities and special needs (Blackwell et al., 2014). The majority of early childhood teachers are trailing behind in their use of ICT for high-quality instructional delivery, despite the benefits of technology use on young children's development and learning (Safitry et al., 2015). Nigeria trailed behind in terms of demands and expectations for technological use in education, but it was not left out (Owate et al., 2014). ICT is acknowledged by the Federal Republic of Nigeria's government as a byproduct of technological progress and as an innovation in education in the National Policy on Education (FRN, 2014). Utilizing technology tools can improve teachers' capacity for professional growth as well as the relationships and lines of communication between early childhood centres, parents, and other stakeholders in the early childhood education sector (Yusuf, 2010). Despite the advantages of using technology in Nigeria's ECE classrooms, studies show that technology integration into teaching and learning is a complicated process that may run into several problems (Olowe, 2012). These problems include, among other things, issues with educators, time, shortage of power supply, resource availability, manpower, limited technology tools and budgetary allocation (Aminu & Samah, 2019). Furthermore, in the study conducted by Onasanya, et. al, (2010) it was discovered that the majority of teachers in Nigeria either lacked the necessary skills or chose not to employ technology tools in their lessons.

Looking closely into the perception of ECE teachers on the use of technology in Nigeria, very few studies were conducted. A study shows that the majority of teachers (88.76%) believe that the use of technology in teaching and learning activities can improve children's ability to learn, although, teachers' usage of ICT in teaching is still somewhat limited (Garba & Alademerin, 2014). In a study conducted by Aminu & Samah (2019) on teachers' perception of the use of technology in teaching and learning in Zamfara state, Nigeria, the findings indicate a highly positive teacher perception of the use of technology. It appears that no study focuses on factors that influence teachers' perceptions of technology usage in early childhood education. To contribute to knowledge in the field of education technology and early childhood education, this study aimed to explore the factors that influence ECE teachers' perceptions of technology use in teaching young children. More specifically, the study was guided by the following research questions:

- 1) What are Nigerian ECE teachers' perceptions towards the use of technology in teaching young children?
- 2) Do teachers' demographic variables (age, gender, marital status, teaching experience, and educational qualification) influence their perceptions towards the use of technology in early childhood education in Nigeria?

The study hypothesis is

H<sub>0</sub>: Teachers' demographic variable significantly influence their perceptions of technology use in early childhood education.

The findings and recommendations of this study are significant as they would bring to light relevant information that would enhance technology usage in Nigeria's ECE sector. Additionally, policymakers, researchers, and practitioners will be able to pinpoint the areas that need to be addressed regarding the usage of technology in ECE settings.

## 2. Conceptual framework

The Unified Technology Acceptance and Use of Technology (UTAUT) by Davis (1985) served as the theoretical base for this investigation. According to the UTUAT model, perceptions towards the use of technology are based on four main constructs: performance expectancy, effort expectancy, enabling factors, and social impact (Venkatesh et al., 2003). Performance expectancy, also known as perceived usefulness, refers to how much a teacher believes that using technology tools would increase his or her instructional performance. Studies have shown that the role of performance expectancy on behavioural intention is moderated by age and gender. Abubakar and Ahmad (2013) found that age and gender have significant moderating effects on the role of performance expectancy on behavioural intention. The degree to which a person thinks using a particular ICT tool may be simple is referred to as effort expectancy (Kiboro, 2018). Gender, age, and experience were hypothesized to influence the relationship between the constructs because the influence of effort expectancy on behavioural intention is larger in many experienced employees and young women (Abubakar & Ahmad, 2019; Venkatesh et al., 2003). The constructs of the UTAUT theory are relevant to understanding teachers' perceptions of technology use in the context of this study. It will also help to determine whether or not the age, gender, experience, and qualification of ECE teachers influence their attitudes toward the use of technology in the classroom for young children.

## 3. Methodology

This study followed the quantitative research approach adopting an Ex post-facto research design to investigate factors that influence ECE teachers' perception of the use of technology in teaching children. The population of the study comprised all ECE centre teachers situated in Agege Local Government Area Lagos State, Nigeria. Out of the total number of the ECE centre; a simple random sampling technique was used to draw one hundred (100) sample sizes from 20 ECE centres. Self-structured questionnaires were used for the collection of data from teachers. The questionnaire was divided into two sections A and B. Section A was on demographic data while section B contains self-rated items on perceptions towards the use of technology adapted from Venkatesh et al. (2003). Responses were scored by indicating appropriate information with (√) by the respondents. The dependent variable is teachers' perceptions while the independent variable is teachers' demographic characteristics. The variable (teachers' perceptions) consists of 15 items rated on a five-point Likert scale 'Strongly agree', 'Agree', 'Neutral', 'Disagree' and 'Strongly Disagree'. The reliability of this scale was measured with a Cronbach alpha coefficient at a value of  $\alpha=.877$ . Data obtained were analysed using descriptive statistics (Mean) while the hypothesis was tested using linear regression analysis at a probability level of 0.05.

## 4. Results

This section presents descriptive results on teachers' demographic characteristics. Analysis of teachers' demographic data is presented in Table 1.

Table 1. Demographic data of teachers.

	Value labels	Frequency (%)	Mean	Std. Deviation
Gender	Male	30.0	1.70	.461
	Female	70.0		
Marital Status	Married	74.0	1.30	.541
	Single	22.0		
	Divorce	4.0		
Age	20-29	23.0	2.14	.766
	30-39	40.0		
	40 & above	37.0		
Educational Qualification	Secondary/High school certificate	22.0	2.23	.790
	OND/Diploma	33.0		
	Bachelor's degree	45.0		
Years of teaching experience	1 – 5 years	31.0	1.82	.642
	6 – 10 years	56.0		
	11 – 15 years	13.0		

Table 2 presents data for answering research question 1. Items 12, 15, 9, 11, 10 and 14 have mean scores of 1.90, 1.89, 1.74 and 1.72 respectively. This implies that teachers perceive these items to be relevant in their use of technology. Items 1, 2, 3, 4, 5, 7, 8, and 13 had mean scores of 1.53, 1.69, 1.66, 1.67, 1.57, 1.63, and 1.44 respectively. This means that teachers regard statements represented in these items as having a slightly high impact on their perceptions towards the use of technology in teaching young children. Table 2 shows that early childhood teacher in Nigeria generally has a positive perception towards the use of technology in teaching young children.

Table 2. Mean rating and standard deviation scores of teachers' perceptions towards the use of technology in teaching young children.

S/N	Questionnaire items	Mean	Std Deviation
1	I find the use of technology in teaching young children very essential	1.53	.629
2	The use of technology in teaching young children will enable me to enhance interaction with the children	1.69	.866
3	The use of technology in teaching young children will help me provide students with independence and active learning	1.66	.861
4	The use of technology in teaching young children will help increase their academic achievement	1.67	.809
5	It would be easy for me to become skillful at using technology for teaching young children	1.66	.861
6	I would find it easy to use technology for teaching young children	1.57	.674
7	Learning to use technology for teaching would be easy for me	1.63	.842
8	I believe the interaction with technology is clear and understandable	1.44	.627
9	I have the knowledge and skills to use technology	1.74	.945
10	When I need help using technology, someone is there to help me	1.72	.847
11	I have the resources to use technology in teaching young children	1.74	.923
12	My fellow teachers believe that I should use technology in teaching young children	1.90	.958
13	This school has been helpful with learning to use technology	1.66	.773
14	I believe that the use of technology in teaching young children will help increase their academic achievement	1.72	.835
15	People who are important to me think that I should use technology in teaching young children	1.89	.983

## Hypothesis

Table 3. Model Summary and Analysis of Variance (ANOVA) on the influence of demographic characteristics on teachers' perceptions towards the use of technology.

Model		Sum of Squares	df	Mean Square	F	Sig.	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Standard error of the estimate
1	Regression	1.695	5	.339	1.681	.147 <sup>b</sup>	.289 <sup>a</sup>	.084	.034	.449
	Residual	18.557	92	.202						
	Total	20.252	97							

Predictors: (constant), Gender, Age, Educational Qualifications, Work experience, and Marital status.  
Dependent Variable: Perception towards the use of technology.

Results from Table 3 show that the coefficient of determination is the proportion of the variation ( $R^2$  value) is .084, meaning 8.4% of variation in teachers' perceptions towards the use of technology in teaching young children is explained by the model. Result also shows that there is no statistically significant linear relationship between teachers' demographic characteristics and their perceptions towards the use of technology in teaching young children,  $F(5, 92) = 1.681$ ,  $p = .147$ . Thus, the null hypothesis ( $H_0$ ) is rejected. This implies that teachers' demographic variables as defined by their gender, age, educational qualification, work experience, and marital status do not significantly influence their perceptions towards the use of technology in teaching young children.

## 5. Discussion and conclusion

The value of technology in education has long been argued in the literature. As a result, understanding teachers' attitudes and perceptions towards technology use is critical in using innovative teaching practices across schools. It was found that teachers generally demonstrated a positive perception towards the use of technology in teaching young children (Ogebo & Aina, 2020). More importantly, teachers believe that using technology in the classroom to teach young children will help them achieve higher academic achievement, and they recognize the importance of having the knowledge and skills to use technology as an influential factor in how they perceive the use of technology. Teachers' positive perceptions toward the use of technology in the ECE classroom suggest that they are prepared to use technology in teaching young children. However, teachers' perceptions towards the use of technology are not influenced by demographic variables such as age, gender, work experience, marital status and educational qualification. When it comes to educational innovations, it is believed that teachers who are open to new ideas tend to have a higher success rate putting new theories and methods into practice than teachers who are not open to new ideas. The results of this study indicate positive developments in the use of technologies in early childhood education classrooms in Nigeria. Though this study focused on teachers' perceptions, more research into the actual use of technology in ECE classrooms in Nigeria is needed. This will aid in understanding the types of technologies used in ECE classrooms in Nigeria, how they are used and identify possible challenges facing teachers in using such technologies.

## References

- Abubakar, F. M., & Ahmad, H. B. (2013). The moderating effect of technology awareness on the relationship between UTAUT constructs and behavioural intention to use technology: A conceptual paper. *Australian Journal of Business and Management Research*, 3(2), 14-23.
- Aminu, M., & Samah, N. (2019). Teachers' perception on the use of technology in teaching and learning in associate schools Zamfara State, Nigeria. *Education, Sustainability & Society (ESS)*, 2(2), 1-4.
- Blackwell, C. (2013). Teacher practices with mobile technology by integrating tablet computers into the early childhood classroom. *Journal of Education Research*, 7(4), 231-255.
- Federal Republic of Nigeria. (2014). National Policy on Education. Lagos: NERDC Press.
- Garba, S.A., Alademerin, C.A. (2014). Exploring the readiness of Nigerian Colleges of Education toward Pre-service Teacher Preparation for Technology Integration. *International Journal of Technology and Inclusive Education (IJTIE)*.

- Kiboro, K. D. (2018). Influence of Teachers' Demographic Characteristics on Information Communication Technologies Integration in Instruction in Lower Primary Schools in Kiambu County, Kenya. Unpublished M. Ed. Thesis, Kenyatta University.
- Ogegbo, A. A., & Aina, A. (2020). Early childhood development teachers' perceptions on the use of technology in teaching young children. *South African Journal of Childhood Education*, 10(1), 1-10.
- Olowe P. K., (2012) "Information and Communication Technologies (ICTs) in Nigerian Early Childhood Education". In V. I. Alebure, B. T. Opoola, A. A. Adejumobi, M. A. Oladejo, F. I. Akinsowon and E. O. Gbadegesin (Eds). *Electronic Application in Nigerian Education*, vol/issue: 1(1),
- Onasanya, S.A., Shehu, R.A., Oduwaiye, R.O., Shehu, L.A. (2010). Higher Institutions Lecturers' Attitudes towards Integration of ICT into Teaching and Research in Nigeria. *Research Journal of Information Technology*, 1-10.
- Owate, I.O., Williams, C., Nnanna, L.A. (2014). Information and Communication Technology (ICT) Support Systems for Teaching and Learning Physics in Selected Secondary Schools in Eleme Local Government Area. *Education Journal*, DOI: 10.5923/j.edu.20140404.01.
- Safitry, T. S., Mantoro, T., Ayu, M. A., Mayumi, I., Dewanti, R., & Azmeela, S. (2015). Teachers' Perspectives and Practices in Applying Technology to Enhance Learning in the Classroom. *International Journal of Emerging Technologies in Learning*, 10(3).
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.
- Yusuf, M. O. (2010). Information and Communication Technology in The Nigerian Early Childhood and Primary Education. *The African Symposium: An Online Journal of African Educational Research Network*, Volume 7, No. 1, June 2010. Retrieved from <http://www.ncsu.edu/aern/TAS10.1/TAS10.1.pdf>

## A MULTIDISCIPLINARY TRAINING PROGRAM FOR SMART CITIES TECHNICIANS AND ENGINEERS

**Vasileios Gkamas, & Maria Rigou**

*Department of Management Science and Technology, University of Patras (Greece)*

### Abstract

A Smart City is a city where traditional infrastructures and services are made more efficient by exploiting digital solutions for the benefit of citizens and businesses. A Smart City aims to transform its infrastructure and services to offer smarter urban transport networks, upgraded water supply and waste disposal facilities, as well as more efficient ways to light and heat buildings. A Smart City also aims to have a more interactive and responsive city administration, safer public spaces, as well as to meet the needs of an ageing population. However, the lack of skills is a major barrier for the design and deployment of smart solutions for sustainable cities and thus to exploit the Smart Cities potential. In this work, we present a curriculum for the upskilling and reskilling of Smart Cities Technicians and Engineers. The curriculum adopts a student-centered and multi-disciplinary approach combining an adaptive blend of technical skills and competences for Smart Cities enabling technologies, as well as non-technical (soft, entrepreneurship and green) skills and competences. Moreover, the curriculum is modular and flexible, including a set of courses that are further split into training modules and sub-modules. The curriculum has been developed in the context of the Erasmus+ project SMACITE and will be supported by key stakeholder groups including SMEs and other labor partners, education and training providers, the public sector and last but not least, learners themselves.

**Keywords:** *Smart Cities, education & training, curriculum, MOOC, Virtual Worlds, ESCO job profiles, SC Technician, SC Engineer.*

---

### 1. Introduction

A Smart City is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects. Research and Market says that the global market of Smart Cities is expected to grow from \$511,6 billion in 2020 to \$1.024,4 billion by 2027 with 14,9% compound annual growth rate. This growth is driven by the increasing demand for public safety, rising urban population, and growing government initiatives. Smart Cities contribute to the EU objectives towards social fairness and prosperity, empowerment of people through digital technologies, as well as the objectives of the European Green Deal.

Smart cities utilize data and deploy services using advanced technologies, such as Cloud Computing, Artificial Intelligence, and Internet of Things to enhance existing services and offer new, as well as, to provide context-aware views on city operations. Their development is highly complex and challenging and requires technicians and engineers from the public sector and industry equipped with skills and competences that are currently in short supply. Thus, given the dynamic nature of Smart Cities, their workforce needs to be reskilled/upskilled by acquiring new and transferable skills and knowledge.

The lack of **digital skills** is the biggest barrier towards effectively deploying big data and other digital technologies for city management. According to a recent survey of 3.000 tech leaders, conducted by KPMG and IT outsourcers Harvey Nash, 65% of the responding companies declared challenges to hire professionals with data and analytics skills (Harvey Nash & KPMG, 2020). Another survey also showed that 76% of companies felt like they needed more higher-level Internet of Things specialists (Forbes, 2019). Moreover, the public sector's digital skills shortages put brakes on its digital transformation with 40% of public sector organizations not having the right digital skills in place.

Helping the Smart City face its economic, environmental, and social challenges also requires a continuous update of knowledge and skills that go far beyond the technical field and cover a wide range of non-technical/transversal areas. There is need for Smart Cities technicians and engineers equipped with

**soft skills**, like critical thinking/problem solving, communication, and leadership. Such skills are also in short supply with Cedefop emphasizing the need for a better match between education and training and what industry requires in the field of personal competences. Moreover, to seize the entrepreneurial opportunities generated by the infusion of technology into the urban space, the development of **entrepreneurial skills** is essential. Last but not least, developing **green skills** to meet the needs of the transition into a carbon-neutral and circular economy and design effective ways of tackling urban development issues (e.g. air pollution, congestion, sustainable living) is another challenge that the Smart Cities technicians and engineers are facing.

## 2. Problem and our contribution

Although there exist education and training programs on cutting-edge digital technologies (e.g. Artificial Intelligence, Internet of Things, Big Data) both at higher education and vocational education and training, **there is lack of education and training programs** specialized in the domain of **Smart Cities** that combine an adaptive blend of both **technical and non-technical skills and competences**, which are essential for the professionals designing, deploying and operating sustainable Smart Cities. Education and training providers, as well as the industry, research organizations and the public sector, need to address the skills gap in the Smart Cities domain, by cooperatively designing high quality, attractive and flexible curricula using well-known EU standards and frameworks.

We hereby present a training program for Smart Cities Technicians and Engineers that has been designed in the context of the Erasmus+ project “SMACITE - Boosting the technical and non-technical skills and competences of Smart Cities technicians and engineers” (<https://smacite.eu/>). The project aims to address the skills gap of Smart Cities technicians and engineers, by designing and testing a vocational education and training program that is based on a novel and multi-disciplinary curriculum combining digital skills on Smart Cities enabling technologies, with soft, entrepreneurship and green skills. The curriculum will be delivered using current technology-enabled learning tools: A MOOC for the technical competences and Virtual Worlds for the non-technical competences. The benefits of using VR technologies to teach non-technical competences have been proved to be numerous (PwC, 2020): (i) it is 4x faster to train using VR than in a traditional classroom, (ii) VR learners are 275% more confident to apply skills learned after training, (iii) VR learners are 3.75x more emotionally connected to content than classroom learners and (iv) VR learners are 4x more focused than their e-learning peers.

## 3. Related work

The curriculum is built on the results of past activities and projects carried out in the field of education and training at cutting-edge technologies (such as Big Data and IoT), competences development and Smart Cities training. The most relevant projects are the following:

a) **DevOps competences for Smart Cities** (Smart-DevOps, 2023): the project addresses the gap between today and future skills demands of municipal workforce by emphasizing on the exploitation of the DevOps emerging employment paradigms. Smart-DevOps identifies competences and corresponding job role profiles by resulting into DevOps modular VET curricula based on adult learning outcomes and lifelong training principles.

b) **MSc in Smart Cities and Communities** (SMACCs, 2023). The program is designed to educate the next generation of engineers and researchers in Smart Cities by teaching best practices from 4 of Europe’s most prestigious universities and by fostering collaboration with industry through research.

c) **Innovative Approach Towards a Master Program on Smart Cities Technologies** (SMARTCITY, 2023). The project aims to create a new breed of multidisciplinary ICT engineers in Smart City technologies by harmonizing Kazakhstan, Mongolian and Russian education with the EU.

There are also some recent research activities at the domain of Smart Cities training. (Kaufmann et al, 2020) address the shortage of both, digital and transferrable skills that are needed for the various Smart Cities’ sectors differentiated by more strategic roles of Smart City Planner and Chief Digital Officer, as well as the more operational IT Officer. (Adiego and Martín-Cruz, 2021) aim to explain the development of an online training curriculum to enable students to acquire the transversal competences needed to work on smart cities projects. In this curriculum, a modern approach to the teaching-learning process was applied, suitable for the interdisciplinary and multinational learning challenges that Smart Cities impose, but within the framework of a university-industry European partnership. Finally, (Fitsilis and Kokkinaki, 2021) present the results of the SmartDevOps project, which attempts to systematically define the required smart cities competences and to outline the curricula that can be used for the development of the required knowledge coherently and systematically.



SMACITE complements the aforementioned efforts by a) proposing 2 emerging Smart Cities job profiles for ESCO, b) developing a novel Smart Cities curriculum and a diagnostic tool for identifying personalized learning pathways and c) developing a MOOC and Virtual Worlds tailor-made to cover the training needs of Smart Cities technicians and engineers.

## 4. Curriculum

### 4.1. Methodology for curriculum development

The methodology adopted for the design of the SMACITE curriculum is based on the ADDIE model (Peterson, 2003). It is a flexible, systematic process used by instructional designers and training developers to break down the training development process into actionable steps and create effective learning experiences. The ADDIE model consists of 5 steps (analyze, design, develop, implement, and evaluate) that are described below together with their application in SMACITE curriculum.

The **analysis phase** is focused on the target audience and can be considered as the goal-setting phase. At this phase, a needs analysis was conducted to determine the requirements of the target audience, as well as standards and competencies to establish a foundation when determining what students need by the completion of the curriculum/training. The **design phase** translates all the information derived from the analysis phase into a learning design. At this phase we have defined for each course of the curriculum its aims, learning outcomes, modules and duration. For each of the two job profiles identified in the project, i.e. Smart Cities Technician and Smart Cities Engineer, and for each course of the curriculum, we designed a different set of learning outcomes, based on the description of the 2 profiles (including their functions aligned with ESCO and (essential and optional) knowledge and skills), as identified at a previous stage of the project (Pospelova et. al, 2023). The **development phase** is about the development of the training material and required technology for the delivery of the curriculum based on the design done at the previous phase. The main questions addressed at this phase are the following: How the training material will be delivered? Which is the format of the training material? How the quality of the training material will be evaluated? The **implementation phase** is about the delivery of the training. Key elements include communication with participants, collection, and running a train-the-trainers program for the roll-out of the piloting of the curriculum. Finally, the **evaluation phase** aims to evaluate whether the goals identified in the analysis phase were achieved. Common questions that should be addressed at this phase are the following: Did the learners learn what we wanted them to learn? Were they able to apply new skills? Were they motivated to learn?

The main resources we considered for curriculum design are among others, a) the guidelines for developing ICT Professional Curricula as scoped by EN16234-1 (e-CF) (European Committee for Standardization, 2022) and b) the CEDEFOP report for defining, writing and applying learning outcomes (CEDEFOP, 2017). The main challenges we faced for the design of the curriculum was the definition of different learning outcomes for the Smart Cities Technician and Smart Cities Engineer profile and their connection with the different modules of each course with the aim of providing personalized learning pathways.

### 4.2. Curriculum description

The SMACITE curriculum implies a shift from a narrow perspective, viewing the curriculum as a list of subjects to be taught, towards a broader perspective, characterizing it as the overall learning experience of individuals (and groups) not only in schools, but throughout their professional lives. The key characteristics of the SMACITE curriculum are 3: **multidisciplinary**, **modular** and **flexible**. The curriculum combines an adaptive blend of technical courses for Smart Cities enabling technologies (e.g. cloud computing and IoT) and non-technical courses for building the soft, entrepreneurship and green skills and competences of Smart Cities Technicians and Engineers. More specifically, the curriculum addresses soft skills for Smart Cities technicians and engineers through a set of training modules, such as Interpersonal Communication, Critical Thinking and Problem Solving, Leadership and Management and Managing Through Change. It also integrates entrepreneurial skills, such as Project Management, Entrepreneurship and Innovation to stimulate a sense of initiative and entrepreneurial attitudes, mind-sets, and skills in learners. Last but not least, it integrates green skills, such as Energy Conservation and Waste Management, that are linked to the transition to a circular and greener economy.

Thus, in addition to building the technical skills of the target profiles, the curriculum aims to stimulate a sense of initiative and entrepreneurial attitudes and mind-sets, as well as to foster social responsibility. This is in line with the “Smart cities and infrastructure” report of the Economic and Social Council of the United Nations that concludes that “*there is a need for curriculum reforms and promote multi-disciplinary learning at vocational education and training, in order to integrate the special skills requirements of smart infrastructure*” (United Nations, Economic and Social Council, 2016). Finally,

each course is divided into training modules allowing students to build their own personalized learning pathways based on their needs and the outcomes of a diagnostic tool which aims to promote student-centered learning. The curriculum gives emphasis on what an individual should know, understand and/or be able to do at the end of a learning process. Such curricula consist of an effective way to avoid potential mismatches between academia and industry, and furthermore to promote active learning and inclusive training. Moreover, it promotes problem-based learning, technology-enabled learning, as well as experience-based learning.

Table 1 provides an overview of the SMACITE curriculum. The curriculum includes 13 courses. 10 of them deal with technical knowledge and skills on Smart Cities enabling technologies that are applicable in different use cases, such as waste management, water management, energy management, traffic management and urban transportation. The rest 3 courses of the curriculum are focused on non-technical knowledge and skills for building the soft, entrepreneurship and green competencies of the learners. The total duration of the curriculum is estimated to 463 hours including self-study.

*Table 1. Overview of SMACITE curriculum*

	<b>Course</b>	<b>Estimated effort in hours</b>
Technical courses	Smart Cities	40
	Internet of Things	44
	Cybersecurity	50
	Cloud Computing	40
	Data Analytics and Visualizations	40
	Machine Learning with Big Data	40
	3D Printing	28
	Blockchain	28
	Drones	24
	Autonomous Vehicles	24
Non-technical courses	Soft skills	40
	Entrepreneurship skills	40
	Green skills	25
Total duration		463

The description of each course includes the following elements:

- The course summary and duration.
- The course objectives indicating its general direction or orientation in terms of its content.
- The learning outcomes for each of the identified job profiles.
- The teaching and learning methods to deliver the course.
- The assessment methods to evaluate the performance of the students.
- The recommended textbook(s).
- The outline of the course that includes the different modules, the target Smart Cities profile, the associated learning outcomes, the week(s) for the delivery of each module and the estimated effort in hours.

## 5. What is next?

The next steps include the development of the learning resources of the curriculum for the upskilling/reskilling of Smart Cities technicians and engineers. The learning resources will be short, relevant, contextualized and run both on desktops and mobile devices, meeting the need for micro-learning. The learning resources will cover different learning needs: learning resources for self-study (e.g. texts, short videos, and presentations), evaluation quizzes for learners to test their knowledge, and real-life projects/case studies to promote problem solving and skills building.

As a next step, we also plan to develop a diagnostic tool to identify the training needs of each learner and promote personalized learning pathways through the curriculum. The diagnostic tool will be designed based on the Smart Cities competences map developed at an earlier stage of the project. Furthermore, we will develop the MOOC for Smart Cities enabling technologies, as well as the Virtual Worlds for the online training of Smart Cities technicians and engineers aiming to build their soft, entrepreneurial and green skills.

The curriculum will be tested during 4 national pilots that will run in Greece, Bulgaria, Spain, and Italy. Prior to the beginning of the pilots, a “Train-the-Trainers” event will run, and a Trainer Handbook will be developed to support the trainers. The aim of the pilots is two-fold: on one hand to

ensure that the curriculum meets the needs and expectations of the key end-users (i.e. learners and education and training providers) and on the other, to evaluate the effectiveness of its different components (e.g. learning resources and learning tools). The main findings of the pilots will be used to make fine-tuning adjustments to the curriculum, learning resources and online learning tools.

## 6. Conclusions

We present a multidisciplinary, modular and flexible learning outcomes-oriented VET curriculum for the emerging job profiles of Smart Cities Technicians and Engineers. The curriculum combines technical and non-technical skills and competences and will be delivered using online learning tools (MOOC and Virtual Worlds). As curriculum development is a dynamic process that involves all relevant stakeholders (e.g. education and training providers, trainers and learners) the curriculum will be tested and evaluated in order to ensure that it meets the expectations of the target audience before being finalized at the end of the SMACITE project.

### *Acknowledgments*

The authors would like to thank all SMACITE partners for their contribution to the design of the curriculum. This research was co-funded by the European Union in the context of the Erasmus+ project SMACITE (Project Number 101052513). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or EACEA. Neither the European Union nor the granting authority can be held responsible for them.

### *References*

- Adiego J., Martín-Cruz N. (2021). Training competences in smart cities: an online program for higher education students. *International Journal of Sustainability in Higher Education*. 1630-1645. 22 (7).
- CEDEFOP. (2017). Defining, writing and applying learning outcomes. Retrieved 19 January 2023, from <https://www.cedefop.europa.eu/en/publications/4156>
- European Committee for Standardization. (2022). Guidelines for developing ICT Professional Curricula as scoped by EN 16234-1 (e-CF). Retrieved 19 January 2023, from <https://smart-city.center/>
- Fitsilis P., Kokkinaki A. (2021). *Smart Cities Body of Knowledge*. 25th Pan-Hellenic Conference on Informatics.
- Forbes. (2019). Return On IoT: Dealing With The IoT Skills Gap. Retrieved 18 January 2023, from <https://www.forbes.com/sites/danielnewman/2019/07/30/return-on-iot-dealing-with-the-iot-skills-gap>.
- Harvey Nash & KPMG. (2020). CIO Survey 2020. Retrieved 18 January 2023, from <https://www.nashsquared.com/>
- Kaufmann H., Bengoa D., Sandbrink C., Kokkinaki A., Kameas A., Valentini A., Iatrellis O. (2020). *DevOps Competences for Smart City Administrators*. REAL CORP.
- Peterson C. (2003). Bringing ADDIE to Life: Instructional Design at Its Best. *Journal of Educational Multimedia and Hypermedia*, 12(3), 227-241.
- Pospelova V, López-Baldominos I, Fernández-Sanz L, Castillo-Martínez A, Misra S. (2023). User and Professional Aspects for Sustainable Computing Based on the Internet of Things in Europe. *Sensors*. 23(1):529.
- Pwc. (2020). The VR Advantage: How virtual reality is redefining soft skills training. Retrieved 18 January 2023, from <https://www.pwc.com/us/en/tech-effect/emerging-tech/virtual-reality-study.html>
- SMACCs: MSc in Smart Cities and Communities ("n.d."). Retrieved 18 January 2023, from <https://www.smaccs.eu/>
- SMACTCITY: Innovative Approach Towards a Master Program on Smart Cities Technologies. ("n.d."). Retrieved 18 January 2022, from <https://smart-city.center/>.
- Smart-DevOps: DevOps competences for Smart Cities. ("n.d."). Retrieved 17 January 2023, from <https://smartdevops.eu/>.
- United Nations, Economic and Social Council. (2016). Smart cities and infrastructure, Retrieved 19 January 2023, from [https://unctad.org/system/files/official-document/ecn162016d2\\_en.pdf](https://unctad.org/system/files/official-document/ecn162016d2_en.pdf).

## ARTS EDUCATION IN COMBINED PRIMARY CLASSES IN THE REPUBLIC OF CROATIA

**Jelena Blašković Glaleković<sup>1</sup>, Svetlana Novaković<sup>1</sup>, & Zlata Tomljenović<sup>2</sup>**

<sup>1</sup>*Faculty of Teacher Education, University of Zagreb (Croatia)*

<sup>2</sup>*Faculty of Teacher Education, University of Rijeka (Croatia)*

### Abstract

The work in combined classrooms is very specific and demanding for primary education teachers because one teacher simultaneously performs lessons for more than one class. According to the official data from the Ministry of Education in Croatia, there are 148,233 students in the first four classes, wherein 9,879 (6,7%) students in composite classrooms classes. In combined, i.e. split-year classes, students are heterogeneous with regard to their age and abilities. Due to the nature of instruction that is complex, teachers need to be creative in the teaching methodology as well as in organizing overall lessons. Artistic subjects (music and visual arts) represent specific educational fields, and they are taught by class teachers in the first four grades of primary school. The goal of this work was to examine how primary education teachers conduct combined instruction in the artistic fields of music and visual arts with regard to age-diverse class composition. Besides, the advantages and drawbacks of such work and challenges teachers are faced with were also investigated. The research was conducted in 2023. Teachers working in two-, three- and four-year combinations participated in the study. The qualitative research method was applied, i.e. participants were interviewed in order to gain specific information, that is, a more in-depth insight into the work in combined classrooms within artistic fields. In their interview, female teachers underlined the beauty and challenge of such work with regard to peer mentoring, tolerance and mutual appreciation. The drawbacks of working in combined classes are connected to the organisation of teaching (planned and effective time use).

**Keywords:** *Combined classrooms, music, primary education, visual arts.*

---

### 1. Introduction

The combined classroom is an educational model in which students of different generations or classes are taught in the same class (Wachtel & Smyth, 2014; Nawab & Baig, 2011; Berry & Little, 2006; Lučić & Matijević, 2004; Pool et al., 2000). Recent research shows that the number of this form of instruction is increasing on a global scale, accounting for about one-third of all classes worldwide (Barbetta et al., 2018) and steadily rising (Khazaei et al., 2016). This teaching model is often used in smaller schools or in schools in rural areas where there are not enough students to form a class for each grade. The reason for such organization is the lack of favorable social and economic conditions. Numerous advantages, but also disadvantages can be seen in it (Varga & Sabljak, 2020).

Many authors emphasize the various advantages of teaching in combined classes. Research has shown that teachers in combined classes find a better connection between younger and older students, and that older students help younger students master subject matter. Younger students have access to broader content that older students learn, while older students often repeat what they have learned. Teachers can more easily see if some students are having difficulty mastering the material and intervene in time to eliminate or alleviate it. In general, students at all grade levels in a combined class become more independent through parallel instruction (Fagan, 2009; Mulryan-Kyne, 2004). Lopez (2018) states that some of the benefits of working in combined classes include flexibility, the ability to tailor curriculum to individual students, improving social skills and fostering collaboration among students of different ages, and increased opportunities to socialize and make friends.

There are two basic characteristics of the combined class - heterogeneity and simultaneity. Heterogeneity refers to the different ages and abilities of students, which requires differentiation and an individualized approach by teachers (Hyry-Beihaimmer & Haschter, 2015). Simultaneity refers to the simultaneous development of two or more different activities for which the teacher must spend time (Berry, 2002). Simultaneous delivery of different instructional content is almost always accompanied by

time constraints, which is why this is one of the main disadvantages of working in combined departments. The disadvantages are also reflected in the insufficient time for planning and implementing instructional activities, which requires more organization and planning by teachers who do not feel competent enough to work in this way (Lopez, 2018; Maulkeen & Higgins, 2009).

Working in combined classes has its advantages and disadvantages, which are examined in this paper with special reference to the artistic subjects. The teaching of artistic subjects at the primary level (music and visual arts) has its own peculiarities, because it differs from other subjects in terms of the character of the content, the creative processes, the relationships between students and teachers, and the evaluation of the results of the work. The main features of music and art classes are hands-on activities and creative expression. Therefore, teachers are expected to have a creative methodological approach based on knowledge of the peculiarities of music and visual arts. Special material conditions (instruments, audiovisual technology, various accessories and materials) are required for teaching in the field of arts, where the rationalization of time plays an important role in the quality of the teaching process. In such situations, the teacher combines indirect and direct forms of work, which allows him to perform the program tasks more efficiently. Correlation of teaching content and interdisciplinary connection are also important (Šuvar, 2011).

## **2. Research problem and aim**

In the school system, teaching can be combined. The reason for this kind of teaching organization is often the smaller number of children in a larger geographical area. The aim of the work is to explore the way of conducting artistic subjects (music and visual arts) in combined classes of Croatian elementary schools. The secondary objective is to investigate the teachers' opinion about the advantages and disadvantages of conducting art classes in heterogeneous groups.

### **2.1. Sample**

The research was conducted in 2023 in the Republic of Croatia. 13 primary school teachers working in combined departments participated. 11 of them teach in a two-grade combination, one in a three-grade combination, and one in a four-grade combination. Three teachers have been working in the combined classroom for up to 7 years, four of them between 12 and 20 years, two between 25 and 29 years, and three teachers have between 30 and 39 years of experience in combined classes. The total number of children they work with in the class at one time varies from four to eleven students.

## **3. Method and instrument of data collection**

A qualitative research approach was used. A structured interview with a well-defined scheme was used, in which all respondents were asked the same questions. The interview collected objective data related to years of service, working in departments with combined classes, current class combination in which they work, and number of students. The interview questions were open-ended (Mejovšek, 2005; Halmi, 2003). In terms of content, they referred to the teachers' views and opinions on the advantages and disadvantages of working in combined classes and on their personal way of teaching artistic subjects (music and visual arts). The participants received the interview questions via e-mail, which allowed for quick and detailed access to information (Creswell, 2002). The data obtained from the interview will be presented descriptively.

## **4. Analysis of the interviews and discussion**

The data obtained from the interviews are presented in terms of advantages and disadvantages. A more detailed and comprehensive description of the learning and teaching methods used by teachers in art classes is presented. The combined class is characterized by a smaller number of children compared to the single class section. Most teachers highlight the smaller number of children as an advantage of working in a combined class. In addition, they consider collaboration and peer mentoring as the most important advantage. Some other researches have shown that collaboration and peer mentoring is the best part of working in combined classes (Blašković, 2020; Lopez, 2018). This is related to the fact that students are more independent, disciplined and show more initiative (Šuvar, 2011), which is also highlighted as an advantage by participants.

The educational process requires a creative teacher who skilfully solves organizational and didactic situations. This is reflected in teacher ability to choose and apply different strategies and working methods. In the survey, teachers see this as an advantage of working in combined classes, while the possibility of rationalizing time through forms of indirect and direct work with students is somewhat less important for them. According to research by Šuvar (2011), younger students require more direct work

compared to students in higher grades who successfully complete their tasks in indirect ways. Teachers also see a great advantage in the possibility to choose strategies and learning and teaching methods. The usual system of teaching by the hour is partially abandoned, which is considered by teachers as one of the positive aspects because of the time distribution of the lesson content. This refers to the length of the lesson, which is flexible, and the teachers themselves determine the duration and schedule of the content in the day. Thus, it is an efficient ratio of lesson content and time.

The most important shortcomings of working with combined classes mentioned by the participants are the simultaneous processing of different contents in the class and the motivation of students, as well as the problem of attention of all students in following the contents of the class. Teachers working in small regional schools also state that they do not have adequate material conditions and they lack the didactic equipment necessary for simultaneous teaching of content. They consider the combination of different types of work, the maintenance of discipline, and the psychophysical differences between students as minor disadvantages. Lopez (2018) and Song et al. (2009) cite as disadvantages the greater burden placed on teachers to carry out the instructional process, the possibility that students in older classes may fall behind in mastering the material, and the possibility that students may not receive adequate support during instruction.

The last section of the study contains a description of the learning and teaching methods which are used by teachers during music and visual art lessons. Responses to questions related to the performance of artistic subjects were first categorized into content-independent units, which were then combined into content sets or categories. Results are presented descriptively using the following categories: lesson process, simultaneous instruction of music and/or visual arts for all ages in the combined classes, use of various teaching and learning methods. Of the 13 teachers, one teacher did not answer this set of questions, and one teacher does not teach music in the classroom, but is taught by the subject teacher (specialist in music).

All teachers divide the design of the lesson into three basic phases: introduction, main part and conclusion. In the introductory part of music lesson, teachers usually sing and repeat familiar songs that students have learned in previous music lessons. The main part includes learning a new song with various motivation (talking about the content of the new song), demonstrating the song by playing the recording, rarely by performing it themselves, reading the lyrics, followed by singing the song. When students are listening to music, they analyze it by determining the atmosphere, tempo, performer, often with the help of textbooks. The last part of the lesson consists of creative expression of the students (singing with movement, musical games, artistic reaction to music), for which, according to the two teachers, there is often no time. The visual arts lessons follow the similar pattern: an introductory part, in which the working material is prepared and artistic techniques are demonstrated, is followed by a motivational part of the lesson, in which the methodological approach depending on the motif and visual arts problem is determined. The central part of the lesson is students' artistic activity. The final assessment is done through the analysis of the students' artwork, talking about the understanding of visual arts problems and its implementation in artworks (learning outcome). Teachers in combined classes usually do not have enough time for this part of the lesson.

Regarding the possibility of teaching music or visual arts simultaneously to all classes in a combined department, respondents' answers differ depending on whether they work in a two-, three-, or four-class combination. Teachers in a two-class combination teach music and visual arts simultaneously, using specific forms of direct and indirect work with students. There is a description of a teacher leading a 3rd and 4th grade combination: "In music class, some students sing or listen to a song while others do quiet work with various tasks." Teachers who have a combination of 1st and 3rd or 1st and 4th grade in the music classes, the introductory and the final part of the lesson work together for all students, while learning new material is done first with the students of one class, then with the other class. The example of a teacher teaching a combination of 1st and 3rd graders shows how she repeats familiar songs with all students at the beginning of the lesson (the older ones know the song, but they sing together with the first and second grade), then they learn a new song, first with the first grade. While the third grade learns a new song, the first and second grades illustrate song that they've been learning. One teacher of a three-class combination of 1st, 2nd, and 3rd graders describes her music class as follows: "We repeat the songs we have previously learned, and then everyone sings all the songs together for all the classes. Then we listen to new songs for each class. While some listen, the others read the lyrics. They memorize the words and the melody and sing. Often, all students are singing all songs regardless to the class. As well, they dance together regardless of which class the songs are assigned to. Everyone listens to music and analyzes what they hear". Visual arts classes in the combination of the two classes are held simultaneously, with the older students often helping the younger ones prepare work materials. The teachers demonstrate the artistic technique to the younger students, while the older ones simply repeat the work with the technique. Motivation is done separately for each grade, as is the announcement of the

assignment. In classes with two grades, teachers usually provide a common motif for all students. The teacher who teaches a combination of 1st, 2nd, and 3rd grades conducts the introductory part equally; the higher the grade is, the task is more complex, so it is done separately for each grade; at the end, students evaluate art work together; she mainly tries to match all grades thematically. One teacher in the study has a four-class combination and her method of teaching music and visual arts is as follows, "Since I have a four-class combination, it is extremely difficult to run a music class with all classes at the same time. A major disadvantage of conducting classes with all classes is maintaining student attention and the difficulty of using didactic tools in all classes at the same time. To make it easier for the students and to allow the teachers to have an even engagement, this lesson is taught in combination with the visual arts lesson. Thus, two classes have music lessons and two classes have visual arts lessons".

Table 1. An example of parallel implementation of music and visual arts lessons in a quadruple combination.

<b>INTRODUCTION PART OF THE LESSON</b>	
<i>Students repeat previously learned songs through musical games.</i>	<i>Students prepare the necessary art technique for the work.</i>
<b>MAIN PART OF THE LESSON</b>	
<i>Students solve worksheets, create (draw, craft), or play games related to the new lesson.</i>	<i>I show the students how to work with the given art technique by describing how to do it. If they already know it, we repeat the working method orally. Using visuals, I explain the given art terms, and students actively participate in the conversation about the given topic. I describe and announce the task. The students repeat the same so that I can see if they have understood what is required of them.</i>
<i>In conversation, I announce to the students the song they will learn.</i>	
<i>This is followed by a demonstration of the song by playing the recording. After listening to the song, students express their impressions of it. With the help of the chase or echo game, students remember the lyrics of the song, the melody and the rhythm. Then we sing the learned song with the help of children's instruments (percussion/triangle/rattles made by the students).</i>	
<i>The students quietly put away the children's instruments.</i>	
<i>Then we listen to a piece by one of the famous composers. We determine the tempo, mood, and structure of the piece using the mind maps from the textbook.</i>	<i>I take time for students to see the progress of the artwork and guide them to achieve their goals.</i>
<b>FINAL PART OF THE LESSON</b>	
<i>Students perform musical games they have learned (e.g., musical chairs, hot and cold game), repeat counts through body percussion, and take care not to be too loud so as not to disturb the analysis of other students' work.</i>	<i>After the finished artwork, which I post on the board, we analyze it. I ask students to briefly review the content we have been dealing with. Review and connect concepts. I ask students to reflect on their activities and evaluate their satisfaction and effort.</i>

When teaching music and visual arts, teachers use different learning and teaching methods. In music lessons all teachers teach songs by ear, most of them often make singing and music didactic games (Guess the song, Who called?, Musical chairs, Hot-cold game...). Sometimes they also do analytical listening to music and play instruments (children's percussions). Two teachers sometimes do music dictation, the others rarely. In visual arts classes all teachers demonstrate artistic techniques, they often use the method of demonstration, the method of analytical observation and to a lesser extent the method of artistic-aesthetic communication.

## 5. Conclusion

The results of the study were obtained on a non-representative sample and cannot be generalized, but they show all the complexity of work in combined classes, especially the specificity of art teaching, which requires not only psychological-pedagogical and artistic competences, but also adequate spatial and material working conditions and didactic equipment of the classroom. The teachers (participants of the study) described their way of teaching in combined classes in a mutually similar way. They start the teaching process by first attracting the attention of the students, and after motivation they proceed to individual tasks for the students and thematic units, each related to one class. The problem of heterogeneity and simultaneity in combined classes can be reduced by good planning of the instructional process, use of a variety of teaching and learning strategies and methods, rationalization of time through special forms of indirect and direct work with students, flexible duration of instruction, and a classroom climate that fosters students' creativity, sense of discovery, and problem-solving approach to learning.

Recommendations for further research relate to the combination of qualitative and quantitative methods (method triangulation) of research on a larger sample, as well as the study of participants' attitudes and opinions regarding their ability to work in combined departments.

### References

- Barbetta, G. P., Sorrenti, G. & Turati, G. (2018). *Multigrading and Child Achievement*. Zurich: University of Zurich.
- Berry, C. (2002). Multigrade teaching: implications for the continuing professional development of teachers in the Caribbean. In E. Thomas, E. (Ed.) *Teacher Education: Dilemmas and Prospects*, 183-192. London: Koga
- Berry, C. & Little, A. W. (2006). Multigrade teaching in London, England. In A. W. Little (Ed.), *Education for all and multigrade teaching: challenges and opportunities*, 67-87, Dordrecht: Springer.
- Blašković, J. (2020). Izvođenje nastave glazbene kulture u kombiniranim razrednima primarnog obrazovanja. [The challenges of teaching music in mixed primary education classes]. In V. Svalina (Ed.), *Music Pedagogy in the context of present and future changes 6*, 149-164. Croatia, University of Osijek, Osijek.
- Creswell, J. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Merrill Prentice Hall.
- Cronin, Z. (2019). To mix or not to mix: A critical review of literature on mixed-age groups in primary schools. *Cambridge Open-Review Educational Research e-Journal*, 6, 165-179.
- Fagan, T. J. (2009). Younger and Older Together: Children's Interactions in a Mixed-Age Early Childhood Centre. Thesis Of Masters Education. New Zealand: Victoria University of Wellington.
- Halmi, A. (2003). *Strategije kvalitativnih istraživanja u primijenjenim društvenim znanostima [Qualitative research strategies in applied social sciences]*. Jastrebarsko: Naklada Slap.
- Hyry-Beihammer, E. K. & Hascher, T. (2015). Multigrade Teaching in Primary Education as a Promising Pedagogy for Teacher Education in Austria and Finland. In C. Craig & L. Orland-Barak (Eds.) *International Teacher Education: Promising Pedagogies (Part C)*. *Advances in Research on Teaching*, 89-113. Bingley: Emerald.
- Lopez, E. J. (2018). The Advantages and Disadvantages of Multiage Classrooms in the Elementary School. *Journal of Education and Practice*, 9(4), 23-28.
- Lučić, K. & Matijević, M. (2004). *Nastava u kombiniranim odjelima [Teaching in combined departments]*. Zagreb: Školska knjiga.
- Khazaei, L., Ahmadi, P., Momeni Far, S., Rahmani, F., Bakhshi, H., Ali Fat, A., Gholipour, J. & Hosseinpour, R. (2016). Challenges and Disadvantages of Multigrade Teaching. *Qualitative Research, Science and Education*, 12(1), 135-141.
- Mejovšek, M. (2005). *Metode znanstvenog istraživanja [Methods of scientific research]*. Jastrebarsko: Naklada Slap.
- Mulkeen, A. G. & Higgins, C. (2009). Multigrade Teaching in SubSaharan Africa. Lessons from Uganda, Senegal, and The Gambia. *World Bank Working (173)*. Africa Human Development Series. World Bank.
- Mulryan-Kyne, C. (2004). Teaching and Learning in Multigrade Classrooms: What Teachers Say, *The Irish Journal of Education*. 35(1), 5-19.
- Nawab, A. & Baig, S. R. (2011). The possibilities and challenges of multigrade teaching in rural Pakistan. *International Journal of Business and Social Science*, 2(15), 166-172.
- Pool, M., Bijleveld, C. & Tavecchio, L. (2000). The effect of same-age and mixed-age grouping in day care on parent-child attachment security. *Social Behavior and Personality: An International Journal*, 28, 595-602.
- Quail, A. & Smyth, E. (2014). Multigrade teaching and age composition of the class: the influence on academic and social outcomes among students. *Teaching and Teacher Education*, 43, 80 - 90. doi: 10.1016/j.tate.2014.06.004
- Song, R., Spradlin, T. E. & Plucker, J. A. (2009). The Advantages and Disadvantages of Multiage Classrooms in the Era of NCLB Accountability, *Educatio Policy Brief*, 7(1), 1-8.
- Šušar, V. (2011). Rad u kombiniranim razrednim odjelima [Work in combined classroom departments]. In A. Jurčević Lozančić & S. Opić (Eds.), *Zbornik 5.međunarodna konferencija o naprednim i sustavnim istraživanjima*, Zagreb: Učiteljski fakultet, Sveučilište u Zagrebu, 415-426.
- Varga, R. & Sabljak, M. (2020). Kombinirani razredni odjel: socioekonomska nužnost ili pedagoški izbor? [The combined classroom: socioeconomic necessity or pedagogical choice?]. *Acta Iadertina*, 17(2), 175-192.



## DESIGNING WITH MULTIPLE TOOLS – SUPPORTING YOUNG CHILDREN AGENCY IN EARLY CHILDHOOD EDUCATION

**Calkin Suero Montero, Kaisa Pihlainen, Niina Leppänen, Sanna Ikonen, & Eija Kärnä**  
*School of Educational Science and Psychology, University of Eastern Finland (Finland)*

### Abstract

Children's rights to participate designing their everyday activities and environments have been widely declared in international regulations. The practical implementation of these rights has also been advocated in educational research to support children's agency development. However, reported challenges such as young children's difficulties verbalising their thoughts, may discourage researchers to carry out investigations with children in early childhood education (ECE) environments. Tackling this issue, we present our exploratory work in Finland involving young children (9 girls, 5 boys, ages 4-6 years) designing a greenhouse space in their day-care using multiple tools. The design activity was carried out as part of the children's environmental education curriculum and was implemented through a participatory design (PD) framework to support and foster children's agency during the research. We gave the children low-tech tools (coloured pencils, paper) as well as with high-tech tools (drawing and augmented reality (AR) apps) to complete the design of their ideal greenhouse during four PD workshops: 2 workshops using an AR app, 1 workshop using a drawing app and 1 workshop using pencils and paper to draw. We explained the low-tech and high-tech tools to be used at the beginning of each workshop, allowing children to familiarise with them, if needed. Data were gathered through observations, videos, interviews and researchers' notes. Children had the freedom to spend as much time as they needed in the design activity and the ECE personnel accompanied two researchers with the children to provide familiarity and support. The workshops ended with a group interview where children were invited to describe their designs. Here we present how each tool type supported the children differently in their design activities by engaging and offering them suitable mechanisms to express their views and wishes, encouraging verbal expressions and interactions, and thus, fostering children's agency as well as assisting the researchers' work. Furthermore, the different affordances of the tools encouraged the production of diverse results through which children could record their "construction of meaning" during the design activities. Based on our experiences during this exploratory work, we advocate the use of multiple tools, particularly when carrying out participatory design activities with young children. Due to their different affordances, the provision of high- and low-tech tools for supporting young children's design can reflect better the children's individual skills, agency and interests and, therefore, offer researchers and designers a more efficient communication channel and a more holistic understanding of the design outcomes.

**Keywords:** *Participatory design, high-tech tools, low-tech tools, research in ECE environments.*

---

### 1. Introduction

The Convention on the Rights of the Child defines the child's right to be heard in things concerning themselves (United Nations, 1989). Children's opinions should not be only listened to but also considered in decision-making (United Nations, 1989; MacNaughton, Hughes & Smith, 2007). Therefore, giving all children the possibilities to share their opinions, views and dreams is crucial to support their skills and development from young age (Druin, 2002; Clasina Södergren & Suero Montero, 2022). It follows that in educational settings children benefit from participating in designing their everyday activities and the environments in which they act (see e.g., Dillon, Vesala & Suero Montero, 2015).

These views fall under the new sociology of childhood approach to research: children's agency is seen in their active involvement, participation, and social interactions (e.g., with teachers and peers) within their social environments and contexts (see for instance Bjerke, 2011; Katsiada et al., 2018). The new sociology of childhood (Oswell, 2013) proposes that children are active agents with the capacity to co-construct their "social realities" (Varpane, 2019). Within this framework, children's voices are heard through the implementation of participatory methods (Katsiada et al., 2018). In terms of the inclusive involvement of children in the design of technology and physical environments, a well-known practice is

the implementation of participatory design (PD) (Druin, 2002) also within educational research (Cumbo & Selwyn, 2022). However, challenges arise when involving young pre-school children in design activities, as they may not be able to verbalise their thoughts and ideas clearly, may have limited attention spans (Clasina Södergren & Suero Montero, 2022) or may not find the design activities fun or motivating (Scheper, Dreessen & Zaman, 2018). We pose that to face these challenges, one single tool for design in early childhood education (ECE) settings may not be enough to maximise the outcomes of the design activity. Furthermore, considering that young children need a variety of methods and tools to express and communicate their thoughts (see for instance Niemi & Ovaska, 2007; Papandreou, 2014), it is very important to understand the affordances that high- and low-tech tools might provide when involving young children in design activities within ECE environments. Hence, here we explore the use of multiple tools for engaging young children in the design of their physical ECE space in Finland, fostering their agency through supporting the expression of their thoughts and ideas. We expect our study to facilitate the understanding of young children's design ideas as well as their work with researchers and designers.

## 2. Background work

The concept of agency in early childhood is a contested one (Varpane, 2019). In our research, we take the new sociology of childhood perspective when doing research with children, that is, children have the capacity to influence the decisions taken regarding the development of their social context and environment. In Finland, this tenet is at the core of the ECE curriculum, where children are seen as active agents that must be allowed to “learn new skills and create meanings about themselves and the surrounding world” (Finnish National Agency for Education, 2022). Several participatory methodologies and frameworks have been developed for the purpose of involving children as active agents of research over the years. Through *cooperative inquiry*, for instance, intergenerational design teams work together applying a variety of techniques that facilitate the understanding of how children view, work, and develop technology (Druin, 2002). The *mosaic approach*, a framework for doing research with young children, capturing through observations and dialogues with care gives the different ways children have of communicating and allowing them to present their views of the environment through photos or drawings, has also been reported to support young children's expression and agency and to facilitate deeper insights from the collected multimodal data (Clark, 2001; Greenfield, 2011; Katsiada et al., 2018).

Participatory research methods' application to education research have also been well-documented (see e.g., Cumbo & Selwyn, 2022), and while the opportunities for young children to be involved in designing their learning experiences have been explored (e.g., in Finland, Leinonen & Venninen, 2012), further research and practical applications in ECE settings are still needed. Nevertheless, we find some examples of research in ECE contexts for instance involving young children in designing a science curriculum (Goulart & Roth, 2010), in designing solutions for reducing water-waste in their local community (Clasina Södergren & Suero Montero, 2022) and in researching topics of their interest related to environmental education (Green, 2017). From several of reported methodologies and frameworks, we learn that designing technologies or physical environments with children involves both low-tech tools, such as paper and pencils, as well as high-tech tools, such as mobile devices and apps. However, more often than not one specific tool is paired with one methodology, an approach that has proven efficient when working with school-age children (Walsh et al., 2013). Therefore, we investigate the application of multiple tools towards facilitating young pre-school age children's expressions and agency during a design activity in their ECE context.

## 3. Research design and methods

Table 1. Design groups – participants per workshop.

Group	No. Girls (age)	No. Boys (age)
AR app	3 (5), 1 (4)	1 (5)
AR app	-	1 (5), 1 (4)
Drawing with app	1 (4), 1 (6)	1 (5)
Pen & paper drawing	3 (4)	1 (6)

Children's awareness of the ecology wellbeing is introduced in ECE curriculum in Finland through environmental education (Finnish National Agency for Education, 2022, p. 46). We see greenhouses as presenting a physical and natural context for providing this awareness. In our exploratory work, hence, fourteen 4–6-year-old-children in ECE contributed to the design of a greenhouse for their day-care. Four 35–45 minutes-long participatory design workshops (Table 1) were organised to gather young children's expressions of their ideal greenhouses, to be physically implemented at a later stage. The children worked on designing their greenhouses using high- and low-tech tools, randomly distributed. The

design workshops started with informal introductory discussions between children and researchers to get to know each other and the topic. Through this, children acquired a general understanding of what a greenhouse was – a place where trees and vegetables grow. The children were then given the task to imagine and design what a greenhouse space could include in their day-care setting. The children were encouraged to use artistic representations through drawing and modelling, as these activities are widely used in ECE practices (Green, 2017; Finnish National Agency for Education, 2022). All children had used tablets to draw, take photos and play in their ECE settings before the workshops, however, the AR app (3DBear, <https://3dbear.io/>) was new to them. Researchers demonstrated the apps to be used at the beginning of the workshops, allowing children to familiarise with them.

Data were gathered through observations, videos, interviews, and researchers' notes. Children could use as much time as needed in the design activity. One or two ECE personnel accompanied two researchers with the children to provide familiarity and support. The adults' role was to scaffold, i.e., encourage and provide appropriate means throughout the children's engagement in the participatory encounters (Green, 2017), as well as to provide technical support. The design sessions ended with a group interview where children were invited to describe their designs as to record the child's "journey of their constructions of meaning" (Einarsdottir, Dockett & Perry, 2009, p. 219). Group interviews also facilitated communicating private experiences and expectations to others as well as to further develop design ideas together (Brooks, 2005). All sessions were video-recorded and transcribed for analysis. Participants were recruited through an open call in one municipality in Eastern Finland. Approximately 200 invitations, alongside consent forms, were distributed to children and their families in three day-care centres. We received 14 positive answers. Ethical aspects, including children's right to participate voluntarily, to withdraw from participation at any time, and the right to stay quiet during interviews were guaranteed.

#### 4. Results

*Figure 1. Examples of children's greenhouse designs. Left) coloured pencils drawing design, (6-year-old). Centre) AR app design (5-year-old). Right) Drawing app design (4-year-old).*



The video recordings were reviewed by the researchers and the transcriptions were analysed through content analysis. We observed that children could use all the provided tools to create their designs and they felt that the design activities were easy and pleasurable. The AR app allowed children to use a database of ready-made images including plants, rocks and playground equipment, which could be dragged and dropped into the design environment of the app - an empty room in the children's ECE environment (Figure 1, centre). Children chose not only plants and other common items found in greenhouses but also more surprising items, such as toilet seats, cars, or dinosaurs as well as playground equipment such as swings and slides. With a broad database of images, the app enabled the children to bring up diverse activities to be realised in a greenhouse, including sliding, swinging, and enjoying a merry-go-round. Many children also chose chairs or benches in order "to sit and watch the plants" or "eat berries" in the greenhouse. With the children that used a drawing app having their fingers as pencils, we observed that the app fostered the detailed drawing of single items in the greenhouse. For example, one four-year-old girl coloured the entire screen blue and called it a blueberry. Other drawings included a flowerpot with vegetables and berries (Figure 1, right). We observed that the children who made their designs in paper with coloured pencils mostly drew various fruits, berries, plants, and flowers, usually one of each. Some children also drew toys and other items such as a fridge "to store the edibles", a rocking chair, a light, a shelf, and a watering pot (Figure 1, left). Even though children were offered a big drawing paper for the group to share, each of them drew 'walls' to structure their own space for design.

#### 5. Discussion and conclusions

As per intuition, in our exploratory study the children's designs differed depending on the provided tool. This resonates with the ideas of DiSalvo and Roshan (2014) about medium probes, where

“the medium shapes the content that is expressed”. We could observe that design outcomes varied according to the affordances of the tool (medium) the young children used to produce their designs. Furthermore, different tools supported children to verbally express their thoughts and design ideas as well as agency, motivation and focus on the task in various ways, while producing rich data.

In terms of **affordances**, more fantastic spaces were designed using the *AR app* readily available database of images to drag/drop. This enabled children to build more playful designs and express their ideas faster. Comparatively, children’s designs with the drawing app or with pencils mostly reflected their previous experiences and socio-cultural contexts although with different abstraction levels. That is, because of the affordances that the *drawing app* provided and the children fine motor-skills development level, they sketched designs that were more abstract: a blue screen became a blueberry and one single flowerpot with roots and soil became an entire greenhouse. This also relates to the physical affordances of the tablet screen as its size could only offer limited space for the children’s designs. *Drawing with coloured pencils*, a tool that children were very familiar with, perhaps allowed them to create symbolic representations of their ideal greenhouses with ease, adding walls to frame their design spaces as a delimited room in the big drawing shared paper that was provided, adding new elements (e.g., a fridge, a shelf) to the greenhouse’s traditional functionalities (growing fruits and vegetables).

Regarding **agency**, we observed that children were eager to participate in the design tasks and were generally happy to express their views on their designs during the group discussions. We noted that the children were enthusiastic to explain their coloured pencils hand-made drawings and designs to the group at the end of the design activity, exercising their agency to voice their ideas during participation. However, they were a bit more hesitant to discuss their designs in other workshops, and many replied only yes/no to questions posed by researchers. This could be because the apps afforded more abstract representations of their ideas, which perhaps made it more difficult for the children to explain what their design was. We also noticed that children were **motivated** and **engaged** in the design activities as they were comfortable with, and interested in, the tools they were using. Also, children understood and anticipated the practical outcome that the design activity would bring to their everyday ECE environment – a new greenhouse would be built. We speculate that this further motivated them to engage and focus more closely on the task, since it had a concrete purpose, and it was meaningfully contextualised for them. For instance, we observed that even when children had difficulties using the AR app, they persisted until they succeeded, and reported that using the app “was easy and nice”. The AR app (high-tech) was new to the children and although it prompted the need for more scaffolding, its novelty also fostered interest and motivation. In addition, the tool also provided a wide variety of ready-made images that the children could explore and use to modify their physical environment and see it through a new lens. This playful affordance perhaps made the children overcome the difficulties using the app and the tablet without frustration (e.g., Couse & Chen, 2010). The children familiarity with the drawing app as well as pencil drawing (low-tech) made them comfortable to use these tools to express their ideas confidently.

In terms of **supporting children’s verbal expression** during the process of design and research, conversations and reflective interventions are important to scaffold and ground the means of meaning-making with young children, also supporting pedagogical strategies (Brooks, 2005; Green, 2017). That is, once the children concretise their designs through visual representations, they might be able to verbalise their thoughts and complex ideas easier as the process of drawing has been reported to promote higher mental functions and to facilitate communication and participation (Brooks, 2005). We noticed that particularly when drawing with pencils, children were very eager and inspired to describe their drawings and designs and share them with others. Therefore, although it is vital to maintain the delicate line between scaffolding and agency promotion throughout the design process (MacNaughton et al., 2007), conversations and reflective interventions are needed during and/or immediately after design sessions with young children, using their own designs as probes since these can be ambiguous and difficult to interpret otherwise. Moreover, the reflective interventions might reveal richer inputs and more complex insights from young children when their designs are produced using various tools that assist them in easily expressing their thoughts and ideas. We see these reflective interventions themselves also functioning as a *non-tech tool* that is very useful for supporting children’s verbal expression when coupled with children’s designs (probes).

Based on our experiences during this exploratory work, we advocate the use of multiple tools, particularly when designing with young preschool children. Due to their different affordances, the provision of various high-, low- and non-tech tools for supporting young children’s design process can reflect better the heterogeneity of children’s agency, skills and interests and, therefore, offer researchers and designers a more comprehensive view of the design outcome for different children and contexts. Although rarely described in the literature of designing with very young children, the use of multiple tools provides an exemplar way obtain rich data, when “we give them appropriate tools with which to express themselves” (Sanders, 2000).

## Acknowledgements

We like to thank the project Teknologiaa ekosti (Technologies, ecologically) and Liperi Municipality, Finland, for their collaboration.

## References

- Bjerke, H. (2011). 'It's the way they do it': Expressions of Agency in Child–Adult Relations at Home and School. *Children & society*, 25(2), 93-103. <https://doi.org/10.1111/j.1099-0860.2009.00266.x>
- Brooks, M. (2005). Drawing as a unique mental development tool for young children: Interpersonal and intrapersonal dialogues. *Contemporary Issues in Early Childhood*, 6(1), 80-91.
- Clark, A. (2001). How to listen to very young children: The mosaic approach. *Child Care in Practice*, 7:4, 333-341. <https://doi.org/10.1080/13575270108415344>
- Clasina Södergren, A., & Suero Montero, C. (2022). Pre-schoolers' Stewardship–Embracing Higgledy-piggledy Behaviours through Participatory Plaything. In *IDC'22* pp. 389-407. ACM, USA.
- Couse, L. J., & Chen, D. W. (2010). A tablet computer for young children? Exploring its viability for early childhood education. *Journal of research on technology in education*, 43(1), 75-96.
- Cumbo, B., & Selwyn, N. (2022). Using participatory design approaches in educational research. *International Journal of Research & Method in Education*, 45(1), 60-72.
- Dillon, P., Vesala, P., & Suero Montero, C. (2015). Young people's engagement with their school grounds expressed through colour, symbol and lexical associations: a Finnish–British comparative study. *Children's Geographies*, 13(5), 518-536. <https://doi.org/10.1080/14733285.2014.894962>
- DiSalvo, B., & Khanipour Roshan, P. (2014). Medium probes: exploring the medium not the message. In *Proceedings of the 2014 Conference on Designing Interactive Systems*, pp. 239-248.
- Druin, A. (2002). The role of children in the design of new technology. *Behaviour and information technology*, 21(1), 1-25.
- Einarsdottir, J., Dockett, S., & Perry, B. (2009). Making meaning: Children's perspectives expressed through drawings. *Early Child Development and Care*, 179(2), 217-232.
- Finnish National Agency for Education (Opetushallitus). (2022). National core curriculum for early childhood education and care in a nutshell. Retrieved 10 January 2023 <https://www.opi.fi/en/education-and-qualifications/national-core-curriculum-eccec-nutshell>
- Goulart, M. I. M., & Roth, W. M. (2010). Engaging young children in collective curriculum design. *Cultural Studies of Science Education*, 5(3), 533-562.
- Green, C. (2017). Four methods for engaging young children as environmental education researchers. *International Journal of Early Childhood Environmental Education*, 5(1), 6-19.
- Greenfield, C. (2011). Personal reflection on research process and tools: Effectiveness, highlights and challenges in using the Mosaic approach. *Australasian J. of Early Childhood*, 36(3), 109-116.
- Katsiada, E., Roufidou, I., Wainwright, J., & Angeli, V. (2018). Young children's agency: Exploring children's interactions with practitioners and ancillary staff members in Greek early childhood education and care settings. *Early Child Development and Care*, 188(7), 937-950.
- Leinonen, J., & Venninen, T. (2012). Designing learning experiences together with children. *Procedia-Social and Behavioral Sciences*, 45, 466-474. <https://doi.org/10.1016/j.sbspro.2012.06.583>
- MacNaughton, G., Hughes, P., & Smith, K. (2007). Young children's rights and public policy: Practices and possibilities for citizenship in the early years. *Children & Society*, 21(6), 458-469.
- Niemi H. & Ovaska, S. (2007). Designing spoken instructions with preschool children. In *IDC'07*, pp. 133–136. ACM, USA.
- Oswell, D. (2013). *The agency of children: From family to global human rights*. Cambridge Univ. Press.
- Papandreou, M. (2014). Communicating and thinking through drawing activity in early childhood. *Journal of Research in Childhood Education*, 28(1), 85-100.
- Sanders, E.B.N. (2000). Generative Tools for Co-designing. In: Scrivener, S.A.R., Ball, L.J., Woodcock, A. (eds) Collaborative Design. Springer, London. [https://doi.org/10.1007/978-1-4471-0779-8\\_1](https://doi.org/10.1007/978-1-4471-0779-8_1)
- Schepers, S., Dreessen, K., & Zaman, B. (2018). Fun as a user gain in participatory design processes involving children: a case study. In *IDC'18*, pp. 396-404.
- United Nations Human Rights. (1989). Convention on the Rights of the Child. Adopted on 20 November 1989 by General Assembly Resolution 44/25. Retrieved 1 December 2022 <https://www.ohchr.org/EN/ProfessionalInterest/Pages/CRC.aspx>
- Varpanen, J. (2019). What is children's agency? A review of conceptualizations used in early childhood education research. *Educational Research Review*, 28, 100288.
- Walsh, G., Foss, E., Yip, J., & Druin, A. (2013). FACIT PD: a framework for analysis and creation of intergenerational techniques for participatory design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 2893-2902. <https://doi.org/10.1145/2470654.2481400>

# USING AN INTERACTIVE WEB-BASED TOOL TO CONNECT FAMILIES, PRACTITIONERS, AND POLICY MAKERS

**Dawn Thomas<sup>1</sup>, Keith Hollenkamp<sup>2</sup>, & Catherine Corr<sup>1</sup>**

<sup>1</sup>*PhD, Department of Special Education, University of Illinois, Urbana-Champaign (United States of America)*

<sup>2</sup>*MS, School of Information Sciences, University of Illinois, Urbana-Champaign (United State of America)*

## Abstract

The Early Childhood Asset Map is an interactive, web-based tool that provides one state with a connective data pipeline between families, early childhood programs, advocates, researchers, and policy makers. The Asset Map provides transparency in resource allocation across the state in early childhood program funding.

**Keywords:** *Early childhood, data, practitioners, policymakers.*

## 1. Early Childhood Asset Map

The Early Childhood Asset Map is an interactive, web-based tool that provides one state with a connective data pipeline between families, early childhood programs, advocates, researchers, and policy makers. The Asset Map provides transparency in resource allocation across the state in early childhood program funding. The interactive tool enables the general public, administrators, policy makers, and researchers to obtain tabular data and interactive maps describing the current range of early care and education services by geographic regions. The geospatial data set includes all licensed childcare programs, licensed exempt childcare programs and family childcare programs, as well as Pre-K sites, Head Start, and infant toddler programs. The current locations of early education programs can be superimposed on thematic maps that show the population of preschool children, median family income, and employment levels, thus adding more comprehensive perspectives of particular regions. The Asset Map is a leading provider and expert on early childhood program and demographic data and works with state agencies to determine service gaps so legislature can be created to close any gaps based on poverty or race/ethnicity. The Asset Map work scope also includes hosting special features on the web site, providing mandated data for statewide funding, analyzing data for stakeholders and programs, developing rankings for the Capital Development Board, as well as preparing and geocoding early childhood and demographic data for display purposes.

The Early Childhood Asset Map is a part of data conversations at the state and national level. The Asset Map is a part of an enormous initiative for the state, involving agencies, organizations, universities, and computer scientists, for early childhood through adulthood. Our presentation will cover: the overarching purpose is to develop (1) standardized data elements and types across data sources, (2) integrated data sets to answer questions posed by researchers and educators, and to (3) provide unduplicated counts of children across funding streams.

## 2. Standardized data elements and types across data sources

IECAM is the public facing hub for early childhood education funded enrollment data from multiple agencies in the state of Illinois. This includes data from the Illinois State Board of Education (ISBE), the Illinois Department of Human Services (IDHS), the Illinois Network of Child Care Resource and Referral Agencies (INCCRRA), as well as data from the American Community Survey (ACS) from the United States Census. These data arrive annually and reflect either the previous Fiscal Year or School Year.

When these data arrive at IECAM they often require a large amount of cleaning and formatting before being considered ready for public view. Much of the data are submitted directly to agencies by

individual child education providers, so the chance of user input errors is high. There is also currently very little cleaning or standardization done to the data before being sent to IECAM. Cleaning involves name standardization, address checking, de-duplication, and more.

Once cleaned, data is geocoded and placed into where they fall into 14 geographies: County, Township, Municipality, Chicago Community Area, Elementary and Unit School district, Zip Code, Legislative District, and more. This allows users to find exactly how many early childhood education slots and providers they have in their desired geography.

### **3. Integrated data sets to answer questions posed by researchers and educators**

One of the most common requests IECAM handles is to assist in slot gap analyses across Illinois. These aim to determine the difference between the number of children who qualify for services based off of their federal poverty level (FPL) and the number of enrollment slots an area has. Researchers, school administrators, and legislators use these analyses to determine where additional funding should be going in the State. When we can get reliable and accurate race and ethnicity numbers, we try to include those.

IECAM data is also formatted and presented for those filling out Requests for Proposals (RFP) for additional early childcare education funding for their area. This often requires the combination of different programs that serve specific age groups, for example programs that serve 0-2 and those that serve 3-5. We combine these data with demographic information for a region to help paint a complete early childhood education landscape.

IECAM data is highly sought after for statewide reports focused on how well we are reaching children with state and federal services. These reports often take a look at the risks facing 0-5 year-olds and the state or federal programs designed to help combat those risks. Such reports by IECAM have been used to impact legislature and funding throughout Illinois.

#### **3.1. Provide unduplicated counts of children across funding streams**

Unduplicated counts of children receiving early childcare services are the holy grail of our field. The goal is to show the unique numbers of children receiving early childcare services, with emphasis on those children who receive multiple, simultaneous services. As lead developers of the Early Childhood Participation Dataset (ECPDS) as part of the brand new Illinois Longitudinal Data System (ILDS), IECAM is leading the way in creating this dataset to help provide a more accurate look at the early childhood landscape in Illinois. A big goal of the ECPDS is to ensure equitable services based on race and ethnicity.

Unduplicated counts across funding streams also help when determining unique providers in Illinois and the funding streams they receive. IDHS has asked IECAM to use our data to create a list of all unique early childhood providers in the state and what services they provide, to determine where funding is layered.

### **4. Collaborations**

The Asset Map also partners with other major state and private universities to develop “risk and reach” reports to be used for program and agency outreach and decision-making. Similarly, the project’s staff work with a large state agency to decode a “layering landscape” for more accurate counts and allocation across the state and serves as data stewards for this state agency.

# STANDARD OF FINAL YEAR STUDENT TEACHERS' MAIN SUMMATIVE ASSESSMENT PAPERS AT A UNIVERSITY OF TECHNOLOGY

**Mokete Letuka**

*Department of Educational and Professional Studies, Faculty of Humanities,  
Central University of Technology, Free State (South Africa)*

## Abstract

There are specific standards that are recommended for setting main summative assessment papers in accordance with Bloom's taxonomy of the cognitive domain. For final year student teachers, the recommendation is that eighty percent of the question paper must be pitched at Bloom taxonomy's upper cognitive levels, which are analyzing, evaluating, and creating. Only twenty percent of the question paper must be pitched at Bloom's lower cognitive levels, namely, remembering, understanding, and applying. This distribution is designed to assess higher order thinking and thus instill, promote, and reinforce independent and critical thinking, as well as problem-solving skills in final year students from the faculty of humanities as the final measure to prepare them for the envisaged world of work. To determine whether examiners comply with this recommendation, I analyzed ten question papers from the faculty of humanities through document analysis. The study found that some examiners pitch their question papers at Bloom's lower cognitive levels. Some spread the questions almost evenly throughout the paper, while only a few distribute the questions close to the required recommendations. Of concern was that some examiners inappropriately used action verbs belonging to Bloom's higher levels. This was evident through the posed questions and what the memorandum or marking guide revealed. It is imperative that questions are pitched at the recommended level, most significantly for final year student teachers. It is recommended that examiners be re-trained in setting question papers in line with the revised Bloom's taxonomy protocol. It is recommended also, that experts in assessment and Bloom's taxonomy be brought in to conduct workshops on the appropriate use of appropriate action verbs.

**Keywords:** *Assessment, Bloom's taxonomy, lower order thinking, problem solving skills, higher order thinking.*

---

## 1. Introduction

Fourth and final year students are at a very critical stage of their journey to becoming qualified school teachers. Their summative assessment must therefore be of a very high standard that prepares them for the eventual world of work. This essentially means that the quality of their summative assessment papers must be very good, i.e., the questions should mostly be pitched at Bloom taxonomy's high cognitive levels, namely, analyzing, evaluating, and creating (Anderson and Krathwohl, 2001).

At the Central University of Technology (CUT), summative assessments for fourth year Bachelor of Education (B-Ed) students, are conducted twice per annum; in the periods between May and June, as well as November and December. The Central University of Technology (CUT), in its assessment manual, prescribes that fourth-year summative assessment papers be pitched eighty percent at Bloom's high cognitive levels, and only twenty percent at Bloom's lower cognitive levels (Hay Et.al., 2004).

Senior management at the CUT has in recent times reiterated the importance of setting summative assessment papers at the correct levels in terms of Bloom's taxonomy of the cognitive domain. For this reason, this study sought to investigate whether examiners, when setting summative assessment papers, comply with the recommendations as outlined in the CUT's assessment manual.

## 2. Bloom's taxonomy of the cognitive domain

Granello (2001) asserts that Bloom's taxonomy is one of the first models created to provide teachers with a systematic classification of cognitive operations. Bloom's taxonomy of the cognitive domain is a six-level approach to the intellectual expectations of the classroom and classroom assessment (Booker, 2007).



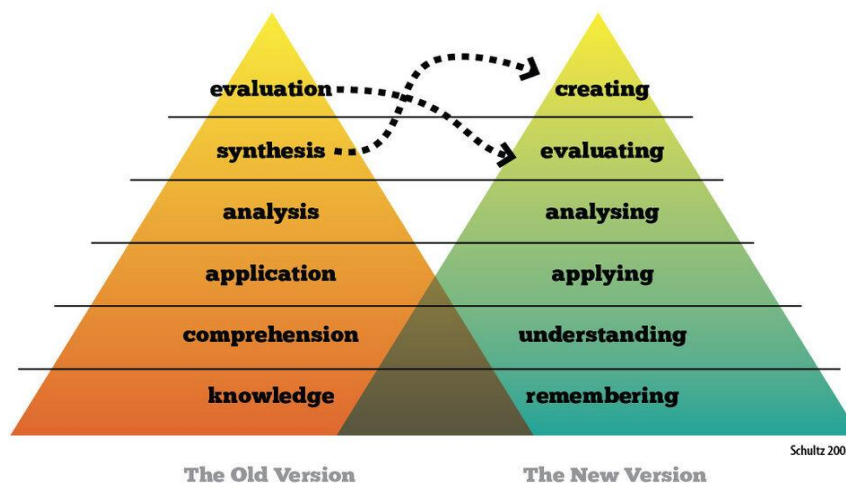
This taxonomy indicates six hierarchical levels of cognitive complexity that are ordered from the least to the most complex level as follows: knowledge, comprehension, application, analysis, synthesis, and evaluation (Granello 2001). A revision of these levels has been conducted to suit the demands of the modern-day assessment needs.

### 3. Revised Bloom's taxonomy

Bloom's taxonomy was revised and slightly modified to suit the needs of the constantly changing dynamics of teaching and learning around assessment, as follows:

The lowest level was changed from **knowledge** to **remembering**, **comprehension** was changed to **understanding**, **application** to **applying**, and **analysis** to **analysing**. **Evaluation** was moved a level down and renamed **evaluating**, and finally **synthesis** was moved to the top of the structure and changed to **creating** (Wilson, 2006). Below is a diagrammatical representation of the revised Bloom's taxonomy adopted from (Schultz, 2005).

Figure 1. Revised Bloom's taxonomy.



In this structure, the lower levels, remembering, understanding, and applying, are representative of lower-order thinking and according to the CUT's assessment recommendations, must constitute twenty percent of the B-Ed fourth year summative assessment paper. The upper levels, analysing, evaluating, and creating are representative of higher-order thinking, which is where eighty percent of the questions in a fourth-year B-Ed summative assessment paper should be pitched.

### 4. Lower order thinking (LOT)

The recall or remembering of facts as well as the application of knowledge to situations and contexts that are recognizable to learners or students, is what defines lower order thinking (Thompson, 2008). This alludes to learners, in their attempt to answer questions, reproducing the memorized concepts and mentioning facts word for word. This kind of thinking cannot be applied in unfamiliar situations or to solve unrecognizable problems.

Qasrawi and Abdelrahman (2020) opine that modern day education must take students far beyond memorizing and reproducing the content but bring them to a place where they are able to solve unfamiliar problems using the knowledge and insight that they have gained. Abosalem (2016) reiterates the notion that the assessment of lower order thinking entails asking learners questions that prompts simple applications and routine steps to arrive at the answer.

According to Khan and Inamullah (2011), lower order questions in a question paper seem to always take the shape of closed questions for which the response or answer is already known. A typical example could be, "who is the president of South Africa?". Such a question does not require learners to think deeply about the answer, but to go into their memory banks to try and recall the answer. Such questions do not require students to think critically as they do not pose a problem to be solved.

## 5. Higher order thinking (HOT)

Assessing higher order thinking involves posing questions that allow students to express their opinions and explore their experiences on the content in manner that demonstrates understanding of the content (Stayanchi, 2017). Abosalem (2016) asserts that higher order questions request students to interpret, analyze, manipulate information as well as substantiate facts. All of these action verbs prohibit students from following routine steps to get to the answer as they must think deeply and critically to provide answers that convince the teacher that they have a deeper understanding of the content.

Thompson (2008) is of the perception that assessing for higher order thinking in a summative assessment paper insinuates that the questions may have information that is similar to what students dealt with during teaching and learning but present an element of newness and unfamiliarity for them. Sagala and Andriani (2019) classify HOT into four main categories, namely, problem-solving, critical thinking, creative thinking and decision making. To assess students' competence in applying these categories, teachers must challenge students tackle questions that are contextual but unfamiliar and not requiring routing steps to answer.

## 6. Methodology

The aim of this study was to investigate whether examiners for B-Ed final year students comply with the CUTs stipulations (80% higher order thinking and 20% lower order thinking) when they compile summative assessment papers. To carry out this investigation I analyzed ten B-Ed fourth year summative assessment papers set by ten lecturers at the Central University of Technology.

A qualitative intrinsic case study research design used in this study was intended to address the aim of this study. Suresh (2015: 1) reports that a case study involves a thorough observation of any social phenomenon, be it an individual, a family unit, an ethnic group or an institution. This study is a case study conducted at the University of Technology, which is an institution of higher education. A case study is a research approach that makes the investigation of a phenomenon within its context easy, using different sources of data.

## 7. Data collection

Document study was used in this study to investigate the compliance of examiners to Bloom's taxonomy. Karpinen and Moe (2012) describe documents as sources of information that can divulge the intentions and interests of their authors, and also reveal facts about the processes they describe.

There are documents in companies and institutions, such as minutes of meetings, agendas and newspapers, which are never compiled for the purpose of research (Strydom and Delpont 2005: 315). As soon as these documents are collected and evaluated or analysed for the purpose of research, then the method of document study comes to the fore. The main data gathering strategy that the researcher chose was the collection of documents, specifically summative assessment instruments in the form of examination papers.

In this study, the documents in question are ten summative assessment papers, and the information they are meant to provide is the extent to which they assess higher order thinking and lower order thinking. I collected ten 2022 summative assessment papers from ten lecturers in the faculty of humanities at the CUT for analysis and named the papers A, B, C, D, E, F, G, H, I and J.

## 8. Findings

After the analysis of all ten summative assessment papers was completed, the following results were obtained:

It was discovered that all ten question papers addressed the lowest cognitive level (remembering) and none addressed the highest level (creating). All ten question papers required students to mention, name, state or outline, which are, according to Bloom's taxonomy, used to test students' ability to recall information. A typical example was question 2.1 of paper B in which students were required to "Mention two other factors on which a force on a current-carrying conductor depends".

*Table 1. Paper A: Five cognitive levels addressed.*

Paper	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
	52%	30%	7%	7%	4%	0%

Paper A addressed remembering, understanding, applying, analyzing and evaluating were addressed. The highest level, namely, creating, was not addressed in this paper.

Table 2 is a summary of the summative assessment papers that had the highest percentage of questions assessing lower order thinking levels, namely remembering, understanding and applying.

*Table 2. Examination papers with highest weights in the lower band.*

LOWER BAND			
PAPER	REMEMBERING	UNDERSTANDING	APPLYING
A	52%		
B			47%
C		70%	
D			49%
G		63%	
H		74%	
J			79%

Seven out ten papers that were analyzed, as shown in Table 2 had most of the questions assessing lower order thinking levels.

Table 3 illustrates the weights of questions in terms of percentages across the examination papers.

*Table 3. Distribution of questions in terms of percentage across the lower and higher bands.*

PAPER	LOWER ORDER THINKING BAND (%)	IN HIGHER ORDER THINKING BAND (%)
A	100%	0%
B	84%	16%
C	82%	18%
D	90%	10%
E	59%	41%
F	41%	59%
G	80%	20%
H	82%	18%
I	28%	72%
J	100%	0%

Out of the ten papers that were analyzed, only one paper (I) had over seventy percent of the whole paper pitched at one of the higher levels, namely analyzing. Paper F came close with 59% in the higher band and 41% in the lower band. Papers A and J were the two papers that were pitched only in the lower band in that paper A addressed remembering and understanding while paper J addressed all three lower levels. None of the higher levels were addressed by papers A and J.

The overall average percentage of questions pitched at Bloom’s lower cognitive levels, assessing lower order thinking for all ten papers was 24.9%, while that of the higher levels was only 8.5%.

## 9. Discussion of results

This study found that examiners do not take Bloom’s taxonomy into account when they compile summative assessment papers for B-Ed fourth year students. Evidence shows that most examiners tend to ask lower order thinking questions that outweigh higher order thinking questions. This has the challenge that students are not equipped to think critically and independently, neither are they able to solve unfamiliar and unprepared problems.

The study highlighted the need for examiners to constantly and consistently consult and comply with the recommendations of the CUT regarding the distribution of questions when compiling summative assessment papers.

## References

- Abosalem, Y. (2016). Assessment Techniques and Students' Higher-Order Thinking Skills. *International Journal of Secondary Education*, (4)1, 1-11.
- Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy of learning, teaching and assessment: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.
- Booker, J. T. (2007). A roof without walls: Benjamin Bloom's taxonomy and the misdirection of American education. *Academic Questions*, (20)4, 347-355.
- Granello, D. H. (2001). Promoting cognitive complexity in graduate written work: using Bloom's Taxonomy as a pedagogical tool to improve literature reviews. *Counselor Education and Supervision*, (40)4, pp. 292-307.
- Hay, H. R., Mahlomaholo, M. G., Van der Merwe, B. C., Brüssouw, S. M., Friedrich-Nel, H. S., Lamprecht, G., & Badenhorst, J. J. C. (2004). *The difference between assessment and evaluation*. Manual for Teaching and Learning 1. Bloemfontein: Central University of Technology, Free State.
- Karppinen, K., & Moe, H. (2012). What we talk about when we talk about document analysis. In N. Just, & M. Puppis (Eds.) *Trends in Communication policy Research: New Theories, Methods and Subjects* (pp. 177-194). Intellect.
- Khan, W. B., & Inamullah, H. M. (2011). A Study of Lower-order and Higher-order Questions at Secondary. *Asian Social Science*, (7)9, 149-157.
- Qasrawi, R., & Abdelrahman, A. B. (2020). The higher and lower-order thinking skills (hots and lots) in unlock english textbooks (1st and 2nd editions) based on bloom's taxonomy: An analysis study. *International Online Journal of Education and Teaching*, (7)3, pp. 744-758.
- Sagala, P. N., & Andriani, A. (2019). Development of Higher-Order Thinking Skills (HOTS) Questions of Probability Theory Subject Based on Bloom's Taxonomy. *Journal of Physics: Conference Series* 1188, 012025.
- Schultz, L. (2005). *Bloom's taxonomy*. Old Dominion University.
- Stayanchi, J. (2017). Higher Order Thinking through Bloom's Taxonomy. *Kwansei Gakuin University Humanities Review*, 22, 117-124.
- Strydom, H., & Delpont, C. L. S. (2005). Information collection: Document study and secondary analysis. In A. S. de Vos, H. Strydom, C. B. Fouché, & C. L. S. Delpont (Eds). *Research at Grass Roots*. Pretoria: Van Schaik.
- Suresh, D. (2015). *Case Study: Research Method for Social Sciences*. Kopargaon Taluka Education Society.
- Thompson, T. (2008). Mathematics teachers' interpretation of higher order thinking in Bloom's Taxonomy. *International Electronic Journal of Mathematics Education*, (3)2, 96-109.

# MEANINGFUL TEACHER CHILD DIALOGUE - RESPONDING TO EMOTIONAL NEEDS OF CHILDREN IN CRISIS SITUATIONS

Teresa Lewin<sup>1</sup>, Samar Aldinah, & Barbara Shapir

<sup>1</sup>Dr.

*Kaye College of Education- Early Educational Department (Israel)*

## Abstract

In recent years, there has been an increased awareness around the world as to mental health risks to children in crisis situations, the COVID-19 pandemic is one example of this. When examining resilience and vulnerability factors amongst children, significant figures such as teachers, parents and friends' reactions will determine the child's ability to cope. Their reactions can provide open spaces for meaningful communication with children while responding to their needs. This may contribute to their resilience and coping skills (Soejima, 2021, Sprang, & Silman, 2013).

The purpose of this lecture is to describe a discourse program that teachers used in order to provide emotional support during the pandemic, when conducting dialogue with children.

The research method is a discourse analysis of data collected through 30 videos of teachers' conversations with children. The videos were transcribed and then analyzed, using a coding scheme that was developed by the researchers. It was based on a tool designed by Birenbaum et. al., (2004), and adapted to the needs of the study.

The findings showed that as teachers created open spaces and allowed for different perspectives to be heard, the children felt free to speak of their family members, the toys they liked to play with as well as family pets and other interests. The interactions were more symmetrical, meaning that one did not dominate the dialogue, leading to active listening and personal responses. In addition, the findings showed that teachers perceptions and beliefs of their role was that of a pedagogical figure, teaching them and having the children learn. It is important to help teachers develop new role perceptions that consist of providing emotional and social support as well as being a pedagogical figure.

**Keywords:** *Teacher child dialogue, emotional needs, resilience.*

---

## 1. Introduction

This study has grown out of the Early Childhood Educational Department at the Kaye Academic College of Education (Beer Sheva, Israel). As mentors and pedagogical advisors to Early Childhood teachers, we have great responsibility in designing an environment that will provide meaningful communication with children. In recent years, there has been an increasing awareness of the processes that children go through when dealing with crisis situations and disasters, similar to the crisis of the covid 19 pandemic

## 2. Theoretical background

The global COVID-19 pandemic has changed our lives in countless ways. This included, among other things, the transition to online learning in all educational settings as well as other aspects of daily living.

A significant part of the general population and in particular, the children's population showed a high emotional vulnerability to the consequences of the pandemic. Younger children (3-6 years old) showed signs of fear and anxiety about the health status of their family members, while older children (6-18 years old) showed more signs of lack of attention and concentration and often asked their parents repeated questions about the pandemic. In both groups, a higher level of distress was found in geographical areas that were more severely affected by the spread of the virus (Jiao et al., 2020). It was found that when dealing with traumatic experiences related to disaster and emergency situations, social support from the child's

immediate environment, such as: parents and teachers, became especially important (Soejima, 2021; Sprang, & Silman, 2013).

In the college training program, we realized that there needs to be a shift from a teacher's perception that their main role is to teach lesson plans, to a role that would create personal interactions through dialogue where children's voices will be heard. This is known as authentic dialogue (Strickland, & Marinak, 2016).

Authentic dialogues can occur only if the different perspectives given by the children are accepted and not judgmentally rejected. When a teacher withholds the urge to control the child's thinking or reprimand their behavior, they can actively listen and be attentive to the children's needs. Respectful and responsive interactions that respect cultural beliefs and values will strengthen the teacher's relationships with the children and their families (Strickland & Marinak, 2016). Nystrand and his colleagues defined this space as a "positive interaction area" in which many children participate in the dialogues because they feel accepted, they build on each other's ideas and ask questions enthusiastically out of interest (Nystrand et al., 2003).

### 3. Objectives

The purpose of this lecture is to describe a discourse program that teachers used when conducting dialogue with children during the pandemic, in order to provide emotional support.

The research questions are:

1. What are the characteristics of the teachers verbal and non-verbal discourse?
2. What navigation strategies does the teacher use to promote dialogue?
3. What was the contribution of an authentic and emotional dialogue with children as reflected in the words of the children?

### 4. Methods

The research methodology was a discourse analysis i.e., analyzing the use of language while carrying out an act of communication in a given context. The work is grounded in the sociolinguistic approach, emphasizing the functionality of language (Vardi-Rath, Teubal, Aillenberg & Lewin, 2014).

The Participants were 20 Israeli student- teachers in their third and final year of training in a teacher's college as well as 30 Jewish and Arab kindergarten children, ages 3-6 years. Dialogues were conducted between the teachers and the children.

Data was collected through 30 videos taking through Zoom of teacher-child dialogues. Video is a tool that is used to document authentic situations and additionally, to help teachers learn to critically reflect on their classroom interactions (Borko, Jacobs, Eiteljorg, & Pittman, 2008). The videos were transcribed and then analyzed, using a coding scheme that was developed by the researchers. It was based on a tool designed by Birenbaum et. al., (2004), and adapted to the needs of the study. The coding scheme categorizes qualitative analysis teachers' discourse characteristics and the ways they navigated the conversations with the children.

### 5. Findings

Online conversations via Zoom require deep listening from the teachers part as well as providing empathetic responses that meets the child's needs. Due to the young age of the children, there was a need for technical support from family members in the household.

#### 5.1. Example 1: April 2, 2020 – Jewish society

6-year-old girl. Duration of the dialogue: 11 minutes

1. Teacher: Would you like to tell me how you feel on these days, when we're all at home and can't go to the kindergarten? (Followed by several seconds of silence).
2. Girl: Umm... I don't really know.
3. Teacher: What does that mean – "I don't know"?
4. Girl: Umm... It means that I don't know how I feel these days... (Followed by several seconds of silence).
5. teacher: Do you feel happy, or do you feel sad or something else?
6. Girl: Umm... Maybe I feel happy.
7. Teacher: Happy? Are you having fun at home? How are you keeping yourself busy at home? What are you doing that is so much fun?
8. Girl: Umm...I watch TV with my family, play 'Emergency Rescue games ...

This is an example of the teacher shows interest and encourages the girl to talk about her feelings. She opens the dialogue with a question relevant to the situation and time period and is interested in what the girl is going through. At first the girl does not know how to describe her feelings; the teacher does not prompt her and allows her to describe her experience in her own words. The girl explains that she feels "happy" and the teacher supports her by asking her a follow up question that enables her to describe what makes her "happy".

### **5.2. Example 2: May 6, 2020 – Jewish society**

5-year-old girl. Duration of the dialogue: 9 minutes. Context: Political tension leading to missile strikes on Israel from Terrorist groups

8. Girl: [...] I have a cat, Billy; it has a red head and has a white belly.

9. Girl: It has a bed but it sleeps on the couch. You know that a siren went off.

10. Billy got scared and ran away and my father went to look for him but he didn't find him.

11. Teacher: Really? did you find him at the end?

12. Girl: It was an alarm and we were in the bomb shelter and a day after I mean tomorrow Sapir brought Billy.

13. Teacher: Did Billy run away to Sapir's house?

14. Girl: Yes. Billy always goes there; he hides under their steps.

15. Teacher: How cute.

16. Girl: He is afraid of the alarm but I know that the alarm protects us, it is a good thing.

17. Teacher: That's right, my dear, the alarm tells us to go to a safe place and be protected.

This dialogue was conducted with a girl that lives in a small settlement in the Gaza Strip, where many sirens go off, both day and night. The teacher is attentive to the girl and allows her to talk about her experiences at home. It is interesting to see that the prolonged lockdown that the girl experiences remind her of similar experiences that she has from emergency war situations when alarms go off during the war.

The interest and empathy expressed by the teacher is clear. Throughout the dialogue, she listens to the girl, supports her and encourages her to express her feelings and talk about her experiences. That is way the girl could talk about the incident that happened and express herself in a relaxed environment that encouraged her to continue the conversation, helping the teacher get insights as to what she is going through.

### **5.3. Example 3: May 6, 2020 – Arab-Bedouin society**

5-year-old-boy. Duration of the dialogue: 8 minutes. Context: The Muslim holiday of Ramadan, where people fast every day from sunrise to sunset.

17. Teacher: Why did you pick that picture in particular? (Boy showing her a picture through computer screen)

18. Boy: This is a photo taken during the month of Ramadan last year, when we had visitors for dinner. But this year, no one came to visit us because of the Corona (Boy showed a sad face).

19. Teacher: I can certainly relate to your feelings. Like you, I didn't visit anyone and nobody came to a festive supper with us either, so you're not alone. All this will be over soon; never fear.

20. Boy: I also wanted to talk about how we decorate for Ramadan. Can you see the hilal [crescent moon) and the Ramadan star? (Boy smiling).

21. Teacher: Yes, I can see (confirming with her head).

22. Boy: Every night, I help my mother light the Ramadan lights.

23. Teacher: It's lovely to hear that you help your mother (Teacher smiling).

In this dialogue, one can see how the teacher encourages the child to talk about his feelings, his sadness and longing for his extended family that couldn't come because of social distancing. The teacher responds empathetically "I also relate to your feelings" and says that she didn't celebrate with her extended family either. The child shares an experience close to his world related to the custom of hanging decorations and lights as part of the holiday celebrations. He shares how he is waiting to turn on the "Ramadan" lights with the mother.

## **6. Conclusions**

The findings show the main characteristics and strategies that made it possible to promote an optimal and authentic dialogue online between teachers and children. They are:

1. Personal opening statements that arouse excitement and motivation and encourage the children to converse in topics of their own interest.

2. The teacher's ability to suspend control of bringing in their own topic of interest and rather open space for the child to initiate topics, providing a more equal atmosphere.

3. The more reciprocity there is in the dialogue between the participants through listening, genuine consideration and showing interest, the dialogue was more meaningful for the children and promoted a relaxed atmosphere.

The findings show that as teachers created open spaces, allowing for different voices to be heard, the children spoke of their family members, their pets, and other interests. The interactions were more symmetrical, active listening and curious responses were achieved. In cases where closed questions were asked and the teacher's voice was dominant, the children's expressions were limited.

The research offers a unique opportunity for teachers to learn together with children on how to improve their dialogic skills.

### References

- Birenbaum, M., Yoad, C., Katz, S., & Qimron, H. (2004), *In Continuous Construction - An Environment for the Professional Development of Teachers on the Subject of the Culture of HL, which cultivates self-direction in learning*. Jerusalem: Ministry of Education, Culture and Sports. (In Hebrew).
- Borko, Hilda & Jacobs, Jennifer & Eiteljorg, Eric & Pittman, Mary. (2008). Video as a tool for fostering productive discourse in mathematics professional development. *Teaching and Teacher Education*, 24, 417-436.
- Jiao, W. Y., Wang, L. N., Liu, J., Fang, S. F., Jiao, F. Y., Pettoello-Mantovani, M., & Somekh, E. (2020). Behavioral and emotional disorders in children during the COVID-19 epidemic. *The Journal of Pediatrics*, 2. doi: <https://doi.org/10.1016/j.jpeds.2020.03.013>
- Nystrand, M., Wu, L., Gamoran, A. Zeiser, S., & Long, D. (2003). Questions in time: investigating the structure and dynamics of unfolding classroom discourse. *Discourse Processes*, 35(2), 135-198.
- Soejima, T. (2021) Impact of the Coronavirus Pandemic on Family Well-Being: A Rapid and Scoping Review. *Open Journal of Nursing*, 11, 1064- 1085. <https://doi.org/10.4236/ojn.2021.1112085>
- Sprang, G. and Silman, M. (2013) Posttraumatic Stress Disorder in Parents and Youth after Health-Related Disasters. *Disaster Medicine and Public Health Preparedness*, 7, 105-110. doi: <https://doi.org/10.1017/dmp.2013.22>
- Strickland, M., & Marinak, B. (2016). Not Just Talk, But a “Dance”! How Kindergarten Teachers Opened and Closed Spaces for Teacher–Child Authentic Dialogue. *Early Childhood Education Journal*, 43(6), 1-9.
- Vardi-Rath, E., Teubal, E., Aillenber, H. & Lewin, T. (2014). “Let’s pretend you’re the wolf!”: The literate character of pretend-play discourse in the wake of a story. In A. Cekaite, S. Blum-Kulka, V. Grover, & E. Teubal (Eds.), *Children’s peer talk: Learning from each other* (pp. 63-87). Cambridge: Cambridge University Press.



## ONLINE DISCUSSION FORUM TASKS IN ESP COURSES: SPACE FOR DEVELOPMENT OF INTRALINGUISTIC MEDIATION SKILLS

**Pavel Brebera, & Zuzana Bezdickova**

*Language Centre, University of Pardubice (Czech Republic)*

### Abstract

The aim of the paper is to analyze the potential of particular blended learning tasks with regard to the development of students' intralinguistic mediation skills in a foreign language. In accordance with the current trends in designing higher education language curricula, the paper deals with the issues of English Medium Instruction (EMI, as summarized e.g., by Macaro 2018 or Lasagabaster 2022) and draws on newly formulated categories of the updated Common European Framework of Reference for Languages (CEFR). Our primary perspective is represented by the category of mediation, which has significantly broadened its scope owing to the analyses carried out by North and Piccardo (2016) and now constitutes a very important part of the updated version of CEFR. Our focus is on the so-called intralinguistic mediation, i.e. mediation within the same language, deliberately implemented into the university curricula of English for Specific Purposes (ESP) in order to establish conditions for subsequent EMI teaching. The empirical part presents a thorough description of an integrated blended learning assignment consisting of an online discussion forum in LMS Moodle and the follow-up classroom presentation task, in terms of the key theoretical constructs, namely mediation activities, and mediation strategies. Based on that, the paper presents the results of a small-scale empirical investigation carried out by means of a semi-structured questionnaire and aimed at identifying the students' perceptions of key aspects of mediation implemented into the integrated ESP learning tasks. The research outcomes are interpreted in relation to our previous studies on the potential of ESP online discussion forums and the specifics of establishing the EMI teaching contexts. The main implication is that the concept of mediation seems to be highly meaningful for the successful integration of the most relevant learning and communication modes, i.e. written and spoken language interaction and production in both online and classroom learning environments.

**Keywords:** *EMI, ESP, CEFR, Moodle, mediation.*

---

### 1. Introduction

Online discussion forum represents a valuable task widely used both in distance learning and blended learning schemes. The field of English for Specific Purposes (ESP) in higher education offers numerous possibilities for its implementation aimed at the complex development of students' language skills. As presented in the previous empirical investigations carried out by the authors of this text, ESP online discussion forums can constitute a very effective component of longer integrated blended learning tasks (Brebera, Bezdickova 2019) as well as provide valuable opportunities for students' active language use within the so-called microlearning schemes (Brebera 2021). Based on these findings, it seems to be highly desirable to apply other relevant perspectives on online discussion forums extending the primary ESP viewpoint so that the current discourse in the area of foreign language education might be enriched and potentially further developed.

Firstly, the potential of ESP online discussion forums needs to be perceived according to the position of ESP language courses defined within the continuum ranging from purely language-dominant goals towards content-dominant course objectives (Macaro 2018, p.29) that represent the so-called English Medium Instruction (EMI). From this perspective, ESP online discussion forums should be designed with the aim of achieving an appropriate level of integrating the subject-specific content with the language-focused one so that it could prepare the students for studying their special subjects in the English language, i.e., in the EMI format (Brebera, Bezdickova 2022). Moreover, the expected students' language use within the professionally related discussion forums needs to cover both the aspects of BICS, i.e., Basic Interpersonal Communicative Skills, as well as CALP, i.e., Cognitive Academic Language Proficiency (Cummins 2008). A significant contribution to establishing conditions for meaningful

implementation of ESP online discussion forums with regard to EMI purposes has been provided by recent attempts to establish the particular EMI typologies (e.g. Richards, Pun 2021) or by comprehensive studies focused on analyzing the potential of EMI in higher educational contexts (e.g. Lasagabaster 2022). The format of an integrated online discussion forum thus finds its proper justification at the level of formulating current educational policies in various contexts across the globe.

Another useful perspective outlining the potential future uses of ESP online discussion forums is the concept of linguistic mediation, as defined by the revised Common European Framework of Reference for Languages (CEFR). In mediation, “the focus is on the role of language in processes like creating the space and conditions for communicating and/or learning, collaborating to construct new meaning, encouraging others to construct or understand new meaning, and passing on new information in an appropriate form (Council of Europe 2020, p.90). Undoubtedly, this concept carries many implications in terms of its inevitable use in international professional communities, where one’s knowledge of discipline-specific content together with a sufficient foreign language competence can be seen as the basic pre-condition for achieving common communicative goals. In previous years, several highly inspiring analyses of mediation were conducted e.g., by Chovancova (2016) with a focus on Legal English, where the mediation of information plays a crucial role within professionally related communicative situations, or by Dendrinis (2013) with the aim of pointing out the existence of mediation as a skill that deserves deliberate teaching and testing. However, the current accents on mediation are mainly due to the recent studies carried out by North (e.g. North, Piccardo 2016; Piccardo, North, Goodier 2019) and the subsequent implementation of their outcomes in the updated version of CEFR. As a result, mediation is sometimes directly referred to as a skill belonging to 21st-century education (Díez 2019). Thus, it is highly desirable that the current ways of designing tasks such as ESP online discussion forums draw on the broadly accepted classification and definition of mediation activities and strategies, as presented in the revised CEFR (Council of Europe, p. 90).

Similarly to a recent study carried out by García-Sánchez (2022), which is based on applying the approach of collaborative computer-assisted language learning, the intention of the authors of this text is also to focus on the so-called “intralinguistic mediation” in an online environment. In our text, this concept is used in accordance with Chovancova’s definition of the so-called “intra-language mediation” in terms of processing and transmission of information “between different levels of expertise” (Chovancova 2016, p.23) and not only between “different language systems”, which is valid for the so-called interlanguage mediation (ibid). The following description and subsequent analysis are therefore based on the specific indicators of mediation activities and strategies as listed in the updated CEFR and demonstrated in the specific integrated online discussion forum task presented below.

## **2. Online discussion forum as a part of an integrated blended learning task**

Teaching ESP as a second language makes demands on language teachers who face the challenge of not having the same level of expertise within the target area as the students. Teachers can no longer be the primary source of information. They become rather informed guides on the students’ way towards language skills improvement. Bearing in mind the generally accepted four Cs (critical thinking and problem-solving, communication, creativity & innovation, and collaboration) as 21<sup>st</sup>-century skills with the aim to bring more of the newest professional content and students’ involvement to the course, the authors introduced a special task called the discussion forum. The following description will be illustrated using the example of English for Health Sciences.

The LMS Moodle environment, with the module “forum”, proves to be the ideal tool for designing the task. The ESP courses have an online form that enables students to access it at any time and helps enhance their mutual communication outside the contact lessons. Before the course content had been made available for students, the authors designed a discussion forum to facilitate intralinguistic mediation among students. Students were expected to choose authentic material (document, video, link, etc.) relating to their field of study. The choice was not narrowed to their particular study field (for example, midwifery) but broadened to the whole area of expertise (for example, health sciences). This freedom to decide brought a colorful variety of topics ranging from general ones (for example, hand hygiene) to specific ones (for example, bone marrow transplant). At the same time, the students had to apply their critical thinking when deciding which source was reliable, trustworthy, and relevant to their audience. The students were also required to briefly explain their choice and post three open questions for their colleagues to start a discussion. The forum participants were given a month to prepare their discussion forums and the same amount of time to answer their colleagues’ discussion forum questions.

While working with the discussion forums took part outside the class, their presentations were an essential part of the contact lessons. The students were supposed to give presentations of their findings to the audience formed by their colleagues. The presentation had to consist of three essential parts, the

discussion forum introduction, the answers reflection, and the summary. This way, the students practiced their ability to communicate specific topics to the informed but not expert audience. At the same time, the audience was involved in the pre-presentation research, which made the content easier to follow and more attractive.

The authors have successfully used the discussion forums for several years. The freedom to choose the topics guarantees their relevance and reflects current trends in the field of study (for example, COVID-19, vaccination, and mental health issues). The task helps students to be inspirational to their peers. It improves not only their language skills but their collaboration, communication, critical thinking and intralinguistic mediation competencies.

### **3. Research**

#### **3.1. Research design**

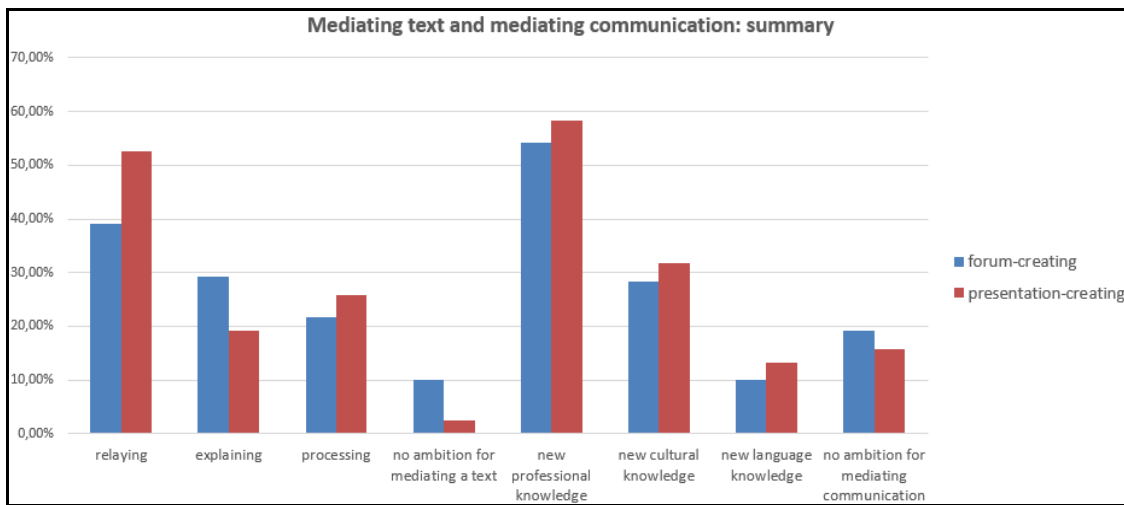
Based on the scales developed for the category of mediation in the updated CEFR, the authors of this text decided to operationalize the relevant concepts so that they might be used in a small-scale empirical pilot study focused on mediation within the previously described integrated blended learning assignment. The study was designed as a questionnaire survey of the students' subjective perceptions of individual components of the assignment, i.e., productive, and interactive parts of both online discussion forums and classroom presentations. The investigation was conducted from December 2022 to January 2023 within a group of 120 respondents, representing 3 university faculties, namely the Faculty of Health Studies (N=72), Faculty of Transport Engineering (N=33) and Faculty of Economics and Administration (N=15). The semi-structured questionnaire was primarily designed in order to generate quantitative data, but it also provided space for the respondents' longer answers for additional qualitative analysis.

The primary focus was on the students' mediation skills, especially in the category of mediation strategies to explain a new concept (linking to previous knowledge, adapting language, and breaking down complicated information) as well as strategies to simplify text (amplifying a dense text, streamlining a text). Within the category of mediation activities, the accent was on the selected ESP-relevant sub-categories of mediating the text, i.e., relaying specific information, explaining data and processing text. Besides, there was a minor attempt to operationalize the concepts of mediating communication in relation to the aspects of pluricultural space as well as the specifics of the discipline-specific professional culture. The data gathered within the category of mediating concepts (leading group work, collaborating in a group) are not considered to be relevant for this analysis as the response was pre-determined by the pre-defined characteristics of the student participation in the individual components of this integrated blended learning assignment, i.e. a leading role when formulating one's text into the forum and conducting presentation vs. a collaborative role when formulating written responses in other forums and expressing oral responses during the classroom presentation sessions.

#### **3.2. Research results**

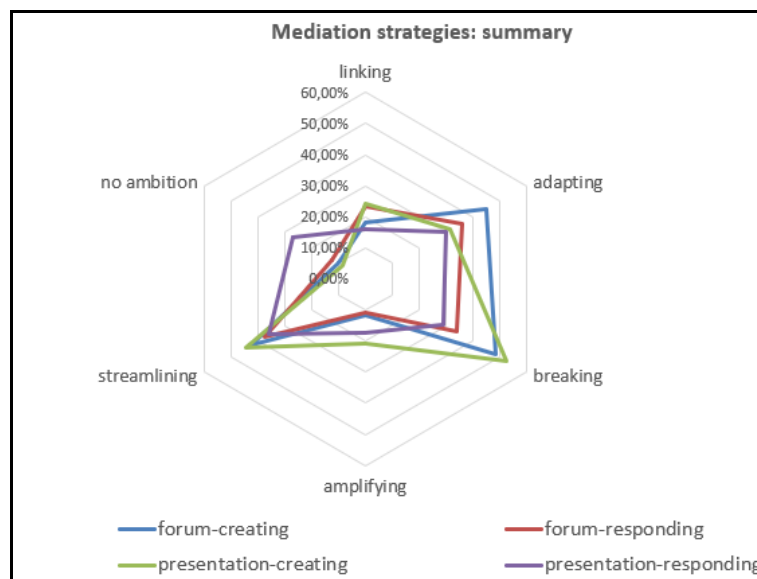
The results of this empirical study indicate some general trends in the students' perceived choices of specific mediation activities and strategies within the individual stages of integrated blended learning tasks containing an online discussion forum as its e-learning component. In terms of text mediation activities (see Figure 1), a stronger focus on relaying information was observed in the follow-up classroom presentation task rather than in the preceding online discussion forum. On the other hand, participation in the online discussion forum was more strongly based on the perceived need to explain one's own perspective clearly and properly. As regards the issues of mediating communication, there appeared a tendency of students to formulate both parts of this integrated blended learning task so that it would represent primarily discipline-specific enrichment for the members of the specific professional community in contrast to a minor focus on cultural or language learning issues.

Figure 1. Mediating a text /Mediating communication.



Also, the mediation strategies used both within the task of preparing the introductory discussion forum text as well as the classroom presentation (see Figure 2) are most strongly associated with the need to break down the complicated information while adapting the language seems to be prioritized more during the process of writing into an online discussion forum. On the other hand, amplifying a dense text seems to be associated more with the classroom presentation component than with the performance in the online discussion forum.

Figure 2. Mediation Strategies.



The results of the analysis, however, also imply the existence of some discipline-specific differences in using mediation activities and strategies as well as their dependence on the overall task design. For example, the lowest degree of the perceived need for adapting the language for the target audience of an online discussion forum (37.5%) as well as in a classroom presentation session (27.78%) was expressed within a relatively homogeneous community of bachelor’s degree students of health sciences. On the other hand, bachelor’s degree students of economics and administration expressed their primary interest in using the mediation strategy of adapting the language in all stages of this integrated blended learning task (e.g. 80% for forum creation, and 53.33% for creating a presentation). Compared to other researched groups, the community which placed the highest emphasis on pluricultural issues in terms of mediating communication was the “professionally mature” group of master’s degree students of transport engineering (41.67% for forum creation, and 50% for creating a presentation). As regards the specifics of the overall task design, the most general and personalized assignment based on sharing one’s

own work-related experience, which was used in the group of bachelor's degree students of transport engineering, demonstrated the highest degree of the perceived need to explain the content properly in the discussion forum (52.38%) and later also in the classroom presentation (57.19%). This group of students also manifested the highest focus on using the strategy of streamlining the text when creating the introductory forum text (52.38%) and also on linking the content to the previous knowledge of the target audience at the stage of preparing a classroom presentation (52.38%). The category with the fewest differences identified within the comparison of all 4 researched groups was the students' use of the mediation strategy of adapting the language when formulating responses to their colleagues' classroom presentations, oscillating between 25.5% and 33.3%.

#### 4. Conclusion

In conclusion, the highly complex task of designing ESP courses with the aim of preparing students for EMI formats of education proved to be considerably facilitated by the implementation of online discussion forums and the related follow-up classroom presentation tasks. Besides, for the authors of this text, the findings of their small-scale investigation constitute a valuable starting point for further research and innovative efforts in the field of mediation in ESP. A planned validation of the empirical material presented above will concern especially the content analysis of the students' language input in all parts of this integrated blended learning task as well as the interaction analysis related to the specific topics representing various viewpoints within the respective professional communities. Thus, new insights might be gained into various types of mediation in ESP, including finding new effective ways of interconnecting written and spoken interaction modes used by university-educated professionals for genuinely communicative purposes.

#### References

- Brebera, P. (2021). Microlearning Formats: "Spicing Up" the Distance Teaching Modes During the Lockdown Period. In *INTED2021 Proceedings*, pp. 1487-1493. Madrid: IATED.
- Brebera, P. & Bezdicikova, Z. (2019). Supporting Blended Learning in ESP Courses: Switching Between "Online", "Offline" and "Onstage". In Ørngreen, R.; Buhl, M.; Meyer, B. (eds.) *Proceedings of the 18th European Conference on e-Learning. ECEL 2019* (pp. 93-101). Reading: Academic Conferences and Publishing International Limited.
- Brebera, P. & Bezdicikova, Z. (2022). Language Focus and Discipline-Specific Content in ESP Courses: Complementarity or Fusion? In Vyhnalikova, Z.; Stefkova, J.; Luptak, M.; Danihelova, Z. (eds.) *Aplikovane jazyky v univerzitnom kontexte IX*. (pp. 33-43). Zvolen: Technical University in Zvolen.
- Chovancova, B. (2016). Mediation in Legal English Teaching. *Studies in Logic, Grammar and Rhetoric*, vol. 45, n.1, pp. 21-35.
- Council of Europe (2020). *Common European Framework of Reference for Languages: Learning, Teaching, Assessment. Companion Volume*. Retrieved December 21<sup>st</sup>, 2022, from <https://www.coe.int/en/web/common-european-framework-reference-languages>
- Cummins, J., (2008). BICS and CALP: Empirical and theoretical status of the distinction. *Encyclopedia of language and education*, 2(2), pp.71-83. New York: Springer Science + Business Media LLC.
- Dendrinou, B. (2013). Testing and Teaching Mediation. *Directions in English Language Teaching and Testing*, 1 Retrieved December 21<sup>st</sup>, 2022, from [http://rcel.enl.uoa.gr/directions/issue1\\_1f.htm](http://rcel.enl.uoa.gr/directions/issue1_1f.htm)
- Díez, A. P. C. (2019). La mediación lingüística y las otras mediaciones. Aspectos clave para las escuelas del siglo xxi. *Supervisión 21: revista de educación e inspección*, (52), 5. 1 Retrieved December 21<sup>st</sup>, 2022, from <https://dialnet.unirioja.es/servlet/articulo?codigo=7816250>
- García-Sánchez, S. (2022). ESP intralinguistic mediation and professional knowledge building through collaborative CALL. *Computer Assisted Language Learning*, pp. 1-23.
- Lasgabaster, D. (2022) *English-Medium Instruction in Higher Education*. Cambridge: CUP.
- Macaro, E. (2018). *English Medium Instruction*. Oxford: OUP.
- North, B. & Piccardo, E. (2016). *Developing Illustrative Descriptors of Aspects of Mediation for the CEFR*. Strasbourg: Education Policy Division, Council of Europe.
- Piccardo, E.; North, B. & Goodier, T. (2019). Broadening the scope of language education: Mediation, plurilingualism, and collaborative learning: The CEFR companion volume. *Journal of e-Learning and Knowledge Society* 15(1).
- Richards, J. C., & Pun, J. (2021). A typology of English-medium instruction. *RELC Journal*. Retrieved December 21<sup>st</sup>, 2022, from <https://doi.org/10.1177/0033688220968584>

# CAN THE ANALYSIS OF THE PLAY *THE STREETCAR NAMED DESIRE* BY TENNESSEE WILLIAMS THROUGH THE SOCIAL MODEL OF DISABILITY, ENCOURAGE THE DEVELOPMENT OF CRITICAL THINKING?

**Izabela Potnar Mijić**

*Education and Teacher Training Agency (Croatia)*

## Abstract

Teaching and developing students' ability to think critically is highlighted as one of the tasks of modern education and a part of curricular documents in various countries. Teachers are expected to teach the students how, and not what to think, emphasizing the change of focus in modern education, whose demand becomes a critical reflection on the content of teaching, and not exclusively its adoption and reproduction.

Tennessee Williams's play *The Streetcar Named Desire* although written in 1947 is frequently staged in theatres all over the world. The plot depicts family and social relations and, among others, the destiny of Blanche, a character with anxiety disorder, an alcoholic, labelled sexually deviant, older, who instead of being supported by her family, ends up in a mental institution.

The goal of this paper is to analyse the presentation of characters in the play through the social model of disability, the central thesis of which is: disability, that is physical or mental impairment, is undoubtedly a limitation of functionality for each individual; however, disability also arises because of social processes. The way the disability is presented in the play can be a basis for teaching understanding, empathy and tolerance as well as correct decision-making as the foundation of critical thinking.

**Keywords:** *Tennessee Williams*<sup>1</sup>, *drama*, *The Streetcar Named Desire*<sup>2</sup>, *social model of disability*, *critical thinking*.

---

## 1. Introduction

Teaching and developing students' ability to think critically is highlighted as one of the tasks of modern education and a part of curricular documents in various countries, including Croatia. Teachers are expected to teach the students how, and not what to think, emphasizing the change of focus in modern education, whose demand becomes a critical reflection on the content of teaching, and not exclusively its adoption and reproduction. In his paper, *The Challenge of Teaching for Critical Thinking*, Portelli (1994) asks several questions considering critical thinking, including: Can critical thinking be taught? Is critical thinking generalizable or is it directly related to specific subjects? Should it be taught on its own or incorporated throughout the entire curriculum? When should it be taught? Are children capable of dealing with critical thinking situations? How can critical thinking be evaluated? Should critical thinking be based on problem-solving or on problem-seeking? Are the critical and creative opposed or two sides of the same coin? Why is critical thinking deemed important for teaching? To what extent can critical thinking help resolve ethical and political issues, which arise in teaching? Considering these and other questions, it is necessary to expose students to different contexts, which arise from their immediate and indirect environment, but also from history, art or literature. Reading literature works from different perspectives engages the participants in analysis, synthesis and evaluation that leads to the development of critical thinking (Duron, Limbach, & Waugh, 2006). For the purpose of this paper, Tennessee Williams's play *The Streetcar Named Desire* and the characters of Blanche DuBois, Stella and Stanley Kowalsky were analysed through the social model of disability. This analysis could be a basis for teaching about stigmatization and discrimination, but also about understanding, empathy and tolerance as well as correct decision-making as the foundation of critical thinking.

---

<sup>1,2</sup>Translation from Croatian language is the work of the author.

## 2. Critical thinking

Critical thinking includes the component skills of analysing arguments, making inferences using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems. Background knowledge is a necessary but not a sufficient condition for enabling critical thought within a given subject. Critical thinking involves both cognitive skills and dispositions. These dispositions, which can be seen as attitudes or habits of mind, include open and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints. There are both general- and domain-specific aspects of critical thinking. Empirical research suggests that people begin developing critical thinking competencies at a very young age and, in theory, all people can be taught to think critically. Teachers are urged to provide explicit instruction in critical thinking, to teach how to transfer to new contexts, and to use cooperative or collaborative learning methods and constructivist approaches that place students at the centre of the learning process (Lai, 2011).

Critical thinking skills are related to several other important learning outcomes, such as metacognition, motivation, collaboration, and creativity. Metacognition supports critical thinking in that students who can monitor and evaluate their own thought processes are more likely to demonstrate high-quality thinking. In addition, the ability to critically evaluate one's own arguments and reasoning is necessary for self-regulated learning. Motivation supports critical thinking in that students who are motivated to learn are more likely to persist at tasks that call for critical thinking. In turn, learning activities and assessment tasks that call for critical thinking may spark students' motivation because they represent something new and are more challenging or interesting. Students possessing critical thinking dispositions, such as a willingness to consider diverse perspectives, may make better collaborators, and opportunities for collaboration may promote higher-order thinking. Finally, creativity requires the ability to critically evaluate intellectual products, and critical thinking requires the open-mindedness and flexibility that is characteristic of creative thinking (Lai, 2011).

## 3. Disability studies

Disability studies within the framework of the humanities is a relatively new discipline. Until the end of the eighties and the beginning of the nineties of the twentieth century, discussions about disability were mostly conducted within the fields of medicine, psychology and social work, and today the social model of disability has been adopted, where the status of persons with disabilities as a minority comes to the fore. Current research does not define disability as a disease, nor does it advocate its treatment or correction. It points out the meaning, position and role of disability that exists in a particular society, linked to stigmas about a disability, to mechanisms of social exclusion of persons with disabilities, and to the mechanisms of their representation in artistic practices, including literature (Pternai Andrić, 2019).<sup>3</sup>

### 3.1. Models of disability

Disability was studied, observed and shaped according to different models throughout history, but for the purpose of this paper, two models are relevant, the medical and the social model. The medical model requires that a person with a disability should adapt to society through operations, medical treatments, rehabilitation and the like, whereby individual conditions or needs are generally not taken into account. The person primarily tries to fit into the existing social norms and moulds, in the family or in an institution, where the institution is often seen as the best, if not the only possible, position for a person with a disability. (Pternai Andrić, 2019).

Martin Oliver, a disabled activist and lecturer, who coined the phrase 'social model of disability', (Oliver, 1983) stresses the need to focus on the social aspects of disability. (Retief, & Letšosa, 2018). Society "disables" individuals by excluding or discriminating and creating affective, sensory, cognitive or architectural barriers. The social model demonstrates that the problems disabled people face are the result of social oppression and exclusion, not their individual deficits. (Pternai Andrić, 2019). In the analysis, it will be shown how Blanche DuBois was treated through both models. Related to the mechanisms of disability representation in artistic practices, literature is revealed as an interesting medium for literary representation because it is a "mediated" way of experience, it represents a "possible world" and a potential mirror of reality, it constitutes a world suitable for the imaginary practice of empathy. (Pternai Andrić, 2019).

---

<sup>3</sup>Translation from Croatian language is the work of the author.

#### 4. *The Streetcar Named Desire* and models of disability

In the Pulitzer-winning play *The Streetcar Named Desire* by Tennessee Williams elements of social and medical models of disability can be observed. Blanche DuBois, a woman of about thirty, whose homosexual husband committed suicide and the family plantation was ruined and eventually lost because of financial problems, finds comfort and escape in alcohol and promiscuous behaviour. After the improper relationship with a seventeen-year-old student was revealed, she loses her position as a schoolteacher and comes to New Orleans to stay with her younger sister Stella and her husband Stanley Kowalski. Blanche's disability is "invisible" in a way; she is an alcoholic and suffers from some sort of psychological issues that lead to a nervous breakdown. In her struggles, she seeks help from the family: *BLANCHE: Well-anyhow-I brought nice clothes and I'll wear them. I guess you're hoping I'll say I'll put up at a hotel, but I'm not going to put up at a hotel. I want to be near you, got to be with somebody, I can't be alone! Because as you must have noticed-I'm-not very well ...* • [Her voice drops and her look is frightened.] *BLANCHE: Yes. [During the pause, she looks up 'at the sky] There's so much-so much confusion in the world ... [He coughs diffidently] Thank you for being so kind I I need kindness now.* (Williams, 1947). Her sister Stella left the family estate when she was very young and later married Stanley Kowalski, a handsome working-class man of Polish origin, but born and raised in the USA, who possesses financial and emotional control over her. He is physically abusive and compensates for it with passion and money. *STELLA [crossing to bureau]: Stanley doesn't give me a regular allowance, he likes to pay bills himself, but this morning he gave me ten dollars to smooth things over.* (Williams, 1947).

The ideas promoted by the social model were preceded by Goffman's study on stigma. (Goffman, 2009). All those subjects who possess some character trait that sets them apart from the environment and portray them as different are stigmatized: their difference comes to the fore, other characteristics of that subject are ignored due to their difference, and the individuals themselves are isolated or abandoned. As Goffman states: there is only one complete man in America who has nothing to be ashamed of - young, married, white, urban, northern, straight, Protestant, father, democratically educated, employed, fair complexion, ideal weight and height, with good sports results (Goffman, 2009), and Stanley Kowalsky fits almost completely into this image. On the other hand, Blanche represents the deviation from the norm, she is an unmarried woman, unemployed, who loses her position as a teacher due to her improper behaviour and will probably never get a new teaching position. Her coming to New Orleans didn't help her change her perspectives and start over, because her attempts to begin a new life with Mitch, Stanley's friend, were ruined by Stanley, who reveals the secret about Blanche's behaviour to him so he decides not to marry her. *MITCH: I don't think I want to marry you anymore. BLANCHE: No? MITCH [dropping his hands from her waist]: You're not clean enough to bring in the house with my mother.* (Williams, 1947). Stanley's position of power was jeopardized by Blanche's coming, she is expressing her honest opinion of him to Stella: *BLANCHE: In my opinion? You're married to a madman I STELLA: No! BLANCHE: Yes, you are, your fix is worse than mine is! Only you're not being sensible about it. I'm going to do something. Get hold of myself and make myself a new life!* On the night Stella gives birth to their child, Stanley violates Blanche and pushes her into a mental breakdown. Her future is determined through the medical model of disability; she is institutionalized, and removed from the family and society. Stella was not able to help her. By ignoring the fact that her husband molested her sister and choosing not to trust her, she tried to keep her own family from falling apart. If we consider the social model of disability, where disability is created by the environment and social relations, Stanley was the executioner of Blanche's final exclusion from society.

##### 4.1. *The Streetcar Named Desire* and teaching critical thinking

In order to use this play or any other literary text in teaching critical thinking it is necessary for the teacher to prepare and gain insight into what he/she wants to achieve with it. The development of critical thinking is a process and teachers can choose various strategies and approaches. In their paper, *Critical Thinking Framework for any Discipline* Duron, Limbach and Waugh suggest a 5-Step model to move students toward critical thinking. (Duron, Limbach, & Waugh, 2006). For the purpose of this paper, this model will be used to provide an example of using *The Streetcar Named Desire* in teaching critical thinking. Step 1 is to determine learning objectives. One of the objectives can be to analyse the treatment of women according to the social model of disability. The teacher should provide information about the model and give students the opportunity to get to know it. Step 2 suggests teaching through questioning. Questioning is a vital part of the teaching and learning process. It allows the teacher to establish what is already known and then extend beyond that to develop new ideas and understandings. Questions can stimulate interaction between teacher and learner and challenge the learner to defend his or her position, (i.e., to think critically). The students will form their views on the treatment of women in the play, and make conclusions about the differences in the approaches toward women. Questions about prejudices and



stereotypes can be raised, because, if the students can recognize them, they can evaluate them critically. When teachers plan, they must consider the purpose of each question and then develop the appropriate level and type of question to accomplish the purpose. All students need experience with higher-level questioning once they become familiar with a concept. Thoughtful preparation on the part of the teacher is essential in providing that experience. Step 3 suggests practising before assessment. In order to make learning more active, teachers need to learn how to enhance the overall learning experience by adding some kind of experiential learning and opportunities for reflective dialogue. Open-ended questions about the existence and lack of empathy shown to Blanche could be raised. The students can engage in a reflective dialogue with themselves by writing a journal or portfolio, or with other students, which will provide the opportunity to hear different points of view and learn to respect other students' opinions, even if they do not agree with them. In step 4 the teachers should review, refine, and improve their classroom approaches. Teachers should strive to continually refine their courses to ensure that their instructional techniques are in fact helping students develop critical thinking skills. To accomplish this, teachers should monitor classroom activities very closely. Step 5 suggests providing feedback and assessment of learning. (Duron et al., 2006). According to Fink in *A Self-Directed Guide to Designing Courses for Significant Learning* (Fink, 2003) teacher feedback, like assessment, compares criteria and standards to student performance in an effort to evaluate the quality of work. However, the purpose of feedback is to enhance the quality of student learning and performance, rather than to grade the performance, and, importantly, it has the potential to help students learn how to assess their own performance in the future. Development of critical thinking, as a result, is difficult to assess, but the way students present, explain and give arguments to support their opinions could be assessed.

## 5. Conclusion

The analysis of the well-known literary text as the play *The Streetcar Named Desire* to encourage the development of critical thinking can be useful because using a literary text might provide the distance necessary to observe the issues from different perspectives. Literature is, even when it seeks inspiration from the real world, only an image or a mirror of it, and discussing and critically observing the problems from the text provides the students with the opportunity to analyse, use reasoning, evaluate and draw conclusions. Literary characters can encourage identification and understanding or provoke empathy. Encouraging students to analyse literary texts from different angles and observe the world around them broadens their horizons and prepares them to analyse, synthesise and evaluate information from various sources, and justify their points of view, which is the foundation of the development of critical thinking.

## References

- Duron, R., Limbach, B., & Waugh, W. (2006). Critical Thinking Framework for any Discipline. *International Journal of Teaching and Learning in Higher Education*, 17(2), 160-166.
- Fink, L. D. (2003). *A Self-Directed Guide to Designing Courses for Significant Learning*. San Francisco: Jossey-Bass. Retrieved May 16, 2023, from <https://www.bu.edu/sph/files/2011/06/selfdirected1.pdf>
- Goffman, E. (1990). *Stigma. Notes on the Management of Spoiled Identity*. London: Penguin Books.
- Hall, A. (2016). *Literature and Disability*. London: Routledge
- Lai, E. (2011). Critical thinking: A literature review. Retrieved May 16, 2023, from [https://www.researchgate.net/publication/297782058\\_Critical\\_thinking\\_A\\_literature\\_review](https://www.researchgate.net/publication/297782058_Critical_thinking_A_literature_review)
- Leksikon svjetske književnosti: Djela. (2004). Zagreb: Školska knjiga.
- Leksikon svjetske književnosti: Pisci. (2005). Zagreb: Školska knjiga.
- Oliver, M. (1983, April 15). *The Politics of Disability*. Paper given at the Annual General Meeting of the Disability Alliance. Retrieved May 16, 2023, from <https://disability-studies.leeds.ac.uk/wp-content/uploads/sites/40/library/Oliver-dis-alliance.pdf>
- Peternai Andrić, K. (2019). *Pripovijedanje, identitet, invaliditet*. Zagreb: Meandarmedia.
- Portelli, J. P. (1994). The Challenge of Teaching for Critical Thinking. *McGill Journal of Education*, 29(2), 137-151.
- Retief, M., Letšosa, R. S. (2018). Models of Disability: A brief overview. *HTS Theologiese Studies/Theological Studies*, 74(1), a4738. <https://doi.org/10.4102/hts.v74i1.4738>
- Williams, T. (Copyright 1947). *A Streetcar Named Desire*. New York: New Directions Publishing Corp.

## **RESEARCH ON FOREIGN LANGUAGES TEACHING IN MEXICO: A DECADE OF WORK**

**José Luis Ramírez-Romero<sup>1</sup>, & Fabiola Gómez-Baldenegro<sup>2</sup>**

<sup>1</sup>*Department of Foreign Languages, University of Sonora (Mexico)*

<sup>2</sup>*Ministry of Education, Sonora State Government (Mexico)*

### **Abstract**

In this presentation, the authors discuss the methodological design and main results of a national study, coordinated by the first author, aimed to generate a state of the art of research in the field of foreign language teaching and learning conducted in Mexico from 2012 to 2021. The study's objective was to collect, document, and analyze research reports generated on this topic. The study was carried out by 148 researchers from 34 universities who collected, concentrated, and analyzed data from 28 states, which represent 88% of the total number of states in the country. Data was collected through interviews with university authorities and academics, visits to institutions and libraries, and a review of institutional websites and documents of a sample of higher education Mexican institutions from the 28 states.

Some of the main issues to be discussed in the results section are the type of institutions where research projects were conducted; the language, subjects, and topics studied; the research objectives pursued in the studies; the methodology and instruments employed for the collection and analysis of data; and the main findings reported in the studies.

The presentation closes with an analysis of the main characteristics, contexts, agents, and conditions of the research projects conducted in the field of foreign language teaching in Mexico and with some recommendations for the improvement of the area.

**Keywords:** *State of the art, research, foreign languages teaching (FLT).*

---

### **1. Introduction**

The production generated in terms of research on foreign languages teaching (FLT) in Mexico has been the subject of several studies. Among the main ones are those by McLean (1978); Da Silva and Gilbon (1993); Gilbon and Gomez (1996); Chasán, Rall, and Valdez (1997); Brambila Rojo et al., (2007); Ramírez Romero (2007, 2010, 2013); and Ignatieva et al., (2016). The present paper seeks to give continuity to these efforts through the documentation and analysis of the academic production of the second decade of the 21st century, seeking to generate a state of the art of research in the field of foreign language teaching conducted in Mexico from 2012 to 2021.

### **2. Method**

The approach that we followed was a systematic review of research that aimed to obtain a comprehensive view or understanding of a field of study at a particular point or moment of its development, based on the recommendations from the Mexican Council of Education Research.

For that purpose, we invited academics from around the country that held recognition in the field of foreign language teaching to collect, concentrate, and analyze research production on FLT from their home states. As a result, 148 researchers, from 28 states (which represented 88% of the total number of states in the country), from 34 higher education institutions, accepted the invitation and conducted interviews with university authorities and academics of their home states, visited their institutions and libraries, and reviewed institutional websites and documents.

The main requirements to select a document or product were that the studies in which the products were based should have been conducted in Mexico from 2012 to 2021 on any topic related to foreign language teaching or learning. In addition, the products had to have been published or presented as thesis or dissertations.

Data concentration and analysis were carried out in two levels. For the first one, each group of participating researchers collected and analyzed data from their own home states. For the second one, data was compared and analyzed at a national level. In both levels, basic descriptive statistics and content analysis techniques were used.

### **3. Findings & discussion**

This section will be organized in four subsections, namely: characteristics of the production, characteristics of the authors, characteristics of the context,

#### **3.1. Characteristics of the production**

A total of 869 research-related products were selected. Broadly speaking, the products addressed a wide variety of topics. Among the topics most studied were those related to beliefs, expectations and perceptions of teachers and students; skills and knowledge of teachers and students; teaching materials, including ICT; and, emotions, attitudes, motivations and identity of teachers and students. The vast majority of the documents (more than 80%) focused on studying the English language; most of them were interested primarily on higher education (67%) and the study of students (48%) and teachers (37%) from urban areas (92%). Although a high percentage of the papers (89%) included some type of theoretical foundation, theoretical frameworks presented different levels of complexity, depth, and rigor; 56% of the studies were qualitative and 22% used mixed approaches (22%); the most commonly used data collection instruments were questionnaires (40%), interviews (20%), or both (34%); and, a large number of studies showed insufficient knowledge of the characteristics, nature and traditions of research paradigms.

Compared with the production of the previous decade, even though the selection criteria were more demanding in the current one, the number of selected products was greater than before. The designs and theoretical approaches of some documents evidenced a higher level of maturity and quality. Several studies were conducted collaboratively by researchers from various institutions, states, or countries; involved individual or joint participation of undergraduate or graduate students; and used inter or multidisciplinary frameworks. The previous quantitative advances also suggest an improvement in the production quality. Some thematic lines considered emerging in the previous decade, advanced in their consolidation, new ones emerged, and it was found a slight increase in the percentage of studies focused on educational levels other than higher education.

However, some challenges and pending issues were also detected, among which stand out in the theoretical-conceptual field the need to stop depending from the epistemology of Eurocentric influence and start developing our own theoretical frameworks. In the methodological field, one of the challenges is to design more sophisticated and well-founded strategies independent of the hegemonic ones and capable of capturing the complexity and specificity of our subjects and contexts. Finally, in the social sphere, some challenges and pending issues are the implementation of projects that seek to study issues that are hardly or not at all attended to by the research agenda promoted or sponsored by dominant political, economic, or ideological pressure groups.

#### **3.2. Characteristics of the authors**

Regarding the traits or characteristics of the authors who publish in the field, it was found that most of them are attached to a Mexican higher education institution; work collaboratively with other colleagues, particularly in small teams; they have graduate degrees, especially in the area of languages, education or applied linguistics; they have obtained their degrees in national institutions, especially public ones. In addition, few have received any type of funding to do research or belong to an academic body or to a network of researchers in the field, and only a small percentage of them are in the National System of Researchers or are the authors or co-authors of ten or more papers. Finally, higher productivity seems to be associated with factors related to the institutional contexts where the authors work or study and to factors associated with the own researchers.

### 3.3. Characteristics of the context

When comparing the current state of the field with that of a decade ago, we find some positive changes related to the context, especially in relation to a greater plurality in the areas of the country where the institutions of those who carry out research in the field are located and with their size; a higher number of papers and research-oriented events; and a moderate growth in the field in terms of specialized publications related to FLT. Some problems persist, however, among which are the low growth of graduate programs, organizations and associations; the lack of support for teachers interested in doing research; and the little importance granted to research.

### 3.4. Pending agenda

As expected, there are still many pending issues in the field of FLT research, which can be clustered into three groups: what we still need to know, what we still need to do, and what we still need to overcome. Regarding the former, the agenda of unknown issues is quite extensive, however, some of the priority ones are be the characteristics, ways of learning, problems and conditions of Mexican students, especially those who live in rural or marginalized areas. Knowing these issues would make possible to develop more consistent teaching-learning strategies instead of continuing to import methodologies and materials that are unsuitable for our schools from dominant countries. As for the second one, although some progress has been made, there is still a long way to go, and although we are aware that the list is quite long, we could summarize it in a single sentence: we need to conduct more and better research. Regarding the main problems and obstacles that would have to be overcome, the following stand out: the working conditions of those who do or intend to do research in the field and the weak institutional support they receive; the belief that research and theory are unimportant and irrelevant to practice; the existing misconception that privileges the foreigner or "native speaker" and their productions over what is done in the country or by Mexican authors; the deficient theoretical knowledge and research methodology training of language teachers; the favoring of research topics relevant to hegemonic countries; the lack of spaces to publish and present research papers; and insufficient knowledge and use of the results of studies carried out in Mexico.

## 4. Conclusions

By way of closing, we want to emphasize that in this paper we have tried to document, from a critical perspective, what has been done in the field of research on FLT in Mexico in order to contribute to overcome the pending issues detected and to collaborate to some extent to ensure that we do more and better research. However, it is necessary to recognize that there are still many unfinished issues, especially those related to what we still need to know, what we still need to do and what we still need to overcome. Let's hope we don't have to wait another decade for the necessary changes to take place.

### References

- Brambila Rojo, O. F., Prieto Marín, L. E. & Sule Fernández, T. (2007). *La enseñanza de lenguas en la UNAM*. Mexico: CAAHYA UNAM. [https://www.caahya.unam.mx/files/diagnostico\\_coele\\_jun-08.pdf](https://www.caahya.unam.mx/files/diagnostico_coele_jun-08.pdf)
- Chasan, M., Rall, D., & Valdez. J. (1997). Las tesis de maestría en lingüística aplicada, 1983-1997. *Estudios de Lingüística Aplicada*, 15(25), 125-172.
- Da Silva, H., & Gilbón, D.M. (1993). Procesos de aprendizaje y enseñanza de lenguas extranjeras. In E. Matute, S. Camean, G. E. Bernal, H. Da Silva, A. E. Eguinoa, D. M. Gilbón, D. Jackson-Maldonado, A. Pellicer, S. Rojas-Drummond, J. Suro y S. Vernon (Eds.). *Lenguaje, lecto-escritura y lenguas extranjeras: estados de conocimiento*, cuaderno 9. (pp. 26-29). Mexico: Consejo Mexicano de Investigación Educativa.
- Gilbón, D.M. & Gómez, M.E. (1996). Desarrollo de los centros de lenguas en las instituciones de educación superior de México: Una primera aproximación a su estudio. En D.M. Gilbón, y M.E. Gómez (Eds.). *Antología del 8º Encuentro Nacional de Profesores de Lenguas Extranjeras*. (pp. 231-258). Mexico: UNAM.
- Ignatieva Kosminina, N., Silva, H., Iakovleva, S., Meagher, M. E., & Jurado, M. (2016). *La investigación en el área de lenguas extranjeras en la UNAM: diagnóstico y perspectivas*. Mexico: CELE UNAM.

- McLean, L. (1978). Research in Applied Linguistics in México. En C. Holcombe (Ed.). *English Teaching in Mexico* (pp. 186-226). Mexico: Instituto Mexicano-Norteamericano de Relaciones Culturales A.C.
- Ramírez-Romero, J. L. (Coord.) (2007). *Las investigaciones sobre la enseñanza y el aprendizaje de lenguas extranjeras en México*. Mexico: Plaza y Valdés-UNISON-UABC-UNACH-UQROO-UAT-UCOL-UDAL.
- Ramírez-Romero, J.L. (Coord.) (2010). *Las investigaciones sobre la enseñanza de lenguas extranjeras en México: una segunda mirada*. Mexico: Cengage Learning -Universidad de Sonora-Universidad Autónoma de Hidalgo-Universidad Autónoma del Estado de Morelos.
- Ramírez-Romero, J. L. (Coord.) (2013). *Una Década De Trabajo: Las Investigaciones Sobre la Enseñanza de Lenguas Extranjeras en México*. Mexico: Pearson-Universidad de Sonora Universidad Nacional Autónoma de México-Universidad de Colima.
- Ramírez Romero, J. L., Reyes Cruz, M. R. & Roux, R. (Coords.) (2022). *Las investigaciones sobre la enseñanza y el aprendizaje de las lenguas extranjeras en México (2012-2021)*. Mexico: Comunicación Científica-Universidad de Sonora. México. <https://doi.org/10.52501/cc.073>

## NON-JUDGEMENTAL ATTENTION WITH INTENTION: MINDFULNESS IN THE CURRICULUM AT HOME AND ABROAD

**Ana Fonseca Conboy<sup>1</sup>, & Kevin Clancy<sup>2</sup>**

<sup>1</sup>*Department of Languages and Cultures, College of Saint Benedict and Saint John's University (USA)*

<sup>2</sup>*Center for Global Education, College of Saint Benedict and Saint John's University (USA)*

### Abstract

Extensive research has been conducted on the effects of mindfulness on the human brain and psyche, demonstrating that stress, rumination, and anxiety can decrease, as creativity and attentiveness increase in subjects who practice mindfulness regularly (Kabat-Zinn 1982, 2009; Hölzel et al., 2011). Mindfulness has been shown to have multiple benefits across fields such as medicine, psychology, and business. According to proponents, living mindfully, with an unobstructed availability to experience, allows us to exercise greater awareness and emotional self-regulation, can foster transformative learning (Barner & Barner 2011), and can increase well-being (Singleton et al., 2014). These outcomes have supported the exploration of mindfulness in the field of education where it has been shown to increase focus and concentration, promote creative thinking and mental flexibility, and decrease distractedness (Berkovich-Ohana et al., 2017; Zeidan et al., 2010). Moreover, mindfulness shifts the focus from a self-referential narrative to one that is more open to and accepting of others. Its practice can improve social cooperation, through more altruistic and compassionate decisions and behavior (Donald et al., 2019; Iwamoto et al., 2020; Condon et al., 2013). In this hands-on presentation, using the vehicle of study abroad, we suggest ways in which mindfulness can be successfully incorporated into education at multiple levels. The presentation will include a brief theoretical framework to illustrate the principles of mindfulness and contemplative pedagogy (Barbezat & Bush 2014; Palmer & Zajonc 2010; Owen-Smith 2018), followed by specific praxis, such as *statio*, visualization, or loving kindness meditation. Attendees will be guided in simple techniques that they can use in their respective classrooms or institutions. A time for individual and collective reflection will follow each practical activity.

**Keywords:** *Mindfulness, contemplative pedagogy, higher education, study abroad.*

---

### 1. Introduction and objectives

Following the recent Covid-19 pandemic, levels of student anxiety and depression have increased dramatically and perceptibly for their educators, hindering the academic experience and student engagement in and out of the classroom. Extensive research has been conducted on the effects of mindfulness on the human brain and psyche, demonstrating that stress, rumination, and anxiety can decrease, as creativity and attentiveness increase in subjects who practice mindfulness regularly (Kabat-Zinn, 1982, 2009; Hölzel et al., 2011). Mindfulness-based Stress Reduction (MBSR, Kabat-Zinn, 2009) and Mindfulness-based Cognitive Therapy (MBCT, Segal et al., 2013), have become commonplace in medical centers, as interventions for improving mental and physical health, and to encourage positive behavior changes (Britton et al., 2021). According to proponents, living mindfully, with an unobstructed availability to experience, allows us to exercise greater awareness and emotional self-regulation, can foster transformative learning (Barner & Barner, 2011), and can increase well-being (Singleton et al., 2014).

Mindfulness, as an experiential method of the discipline of contemplative pedagogy, has also been shown to have productive effects on the student population. Recent exploration of mindfulness in the field of education has revealed an increase focus and concentration in students. The use of mindfulness in education has also been shown to promote creative thinking and mental flexibility, and decrease distractedness (Berkovich-Ohana et al., 2017; Zeidan et al., 2010). Moreover, mindfulness shifts the focus from a self-referential narrative to one that is more open to and accepting of others. Its practice can improve social cooperation, through more altruistic and compassionate decisions and behavior (Donald et al., 2019; Iwamoto et al., 2020; Condon et al., 2013). This aligns with the 21<sup>st</sup> century learning

skills of collaboration, communication, creativity, and critical thinking, as well as the 21<sup>st</sup> century life skills of flexibility, productivity, and social skills (Partnership for 21<sup>st</sup> Century Skills, 2009).

Contemplative pedagogy in the higher education classroom is considered both a process (practice) and an outcome (awareness) (Barbezat & Bush, 2014). In a holistic approach, contemplative pedagogy uses introspective forms that bring together third-person study and critical first-person reflection, where third-person approach implies the study of the underlying philosophy and psychology of the human contemplative experience (Roth, 2006), and through a first-person approach, students experience contemplative techniques directly (Roth, 2014).

Metacognition is a central learning goal for students in higher education, as they become critical thinkers and discern a vocation for the future. Specifically in the study abroad context, extensive research into learning gains has demonstrated that developing student metacognition, or one's ability to be intentionally self-reflective, can inspire transformative learning (Vande Berg et al., 2012; Zull, 2012). Consequently, it is important to continually search for pedagogical practices that facilitate metacognitive learning both on campus and in study abroad programs. The discipline of contemplative pedagogy and the associated practice of mindfulness provide multiple strategies and a framework for an experiential and facilitated approach to guide student metacognitive reflection (Bai et al., 2009; Zajonc, 2013). The teacher plays an indispensable role in guiding students through the contemplative practice and helping them link the practice to mindful awareness, reflection, and learning.

Mindfulness, as one experiential method within contemplative pedagogy, is defined as "moment-to-moment awareness," reached through a "systematic approach to developing new kinds of control and wisdom in our lives, based on inner capacities for relaxation, paying attention, awareness, and insight" (Kabat-Zinn, 2009, p. 2). While the specific classroom approaches to mindfulness may vary, most applications of contemplative pedagogy involve forms of meditation and introspection. For Barbezat and Bush (2014), classroom introspective and contemplative exercises have four main goals: (a) Focus and attention building, mainly through focusing meditation and exercises that support mental stability; (b) Contemplation and introspection into the content of the course, in which students discover the material in themselves and thus deepen their understanding of the material; (c) Compassion, connection to others, and a deepening sense of the moral and spiritual aspect of education; (d) Inquiry into the nature of their minds, personal meaning, creativity, and insight (p. 11).

Exposure to techniques in contemplative pedagogy helps students be active participant observers in their surroundings. Mindfulness practice in the classroom encourages students to engage with their whole mind and body, to refine and cultivate the use of their senses (more fine-tuned perceptive acuity), and to cultivate the ability to be present in the moment. It provides a vehicle for students to be more aware, attentive, and in wonder with their surroundings and with the material they encounter in and out of the classroom, as they construct knowledge. In turn, a greater sense of awareness, focus, and clarity can supplement necessary 21<sup>st</sup> century learning skills, such as critical thinking, creativity, flexibility, or productivity, and aid in the students' discernment of vocation and purpose in life post-degree.

This presentation will provide the opportunity to learn about and experience first-hand some contemplative pedagogies that can be used in the classroom.

## 2. Methods

The purpose of this presentation is to equip educators with a few tools to incorporate contemplative pedagogies into their classrooms. We employed five specific methods suggested by the mindfulness literature: *Statio*, Breathing exercises, Visualization, Loving kindness meditation, and the Raisin meditation. The presentation was formulated as a workshop, so this paper will describe each of the techniques. The methods were practiced both in the domestic U.S. higher education setting, and in study abroad programs, specifically 13 students in a study abroad seminar in the fall 2018 and from two sections of an introductory survey course of francophone literature (fall 2021—3 women—and fall 2022—2 men and one woman). Students responded to anonymous qualitative questionnaires regarding the experience. Some student feedback and comments are integrated in the Results and Conclusion section.

### 2.1. *Statio*

*Statio*, a Benedictine monastic practice, is defined as a sacred pause, a moment to stop before beginning the next thing. Traditionally, the practice is done before the beginning of community prayer: Members of the monastic community gather together outside of Chapel to practice the "virtue of presence" and pause a few minutes prior to entering the space and praying together (Chittister, 1990). It is a way to enter fully into the moment and proceed intentionally and mindfully to the next step ahead. How to do it: In the classroom, the practice of *statio* translates as taking one or two minutes at the

beginning of class period to simply be, without phones, without the textbook, and breathe before engaging with the new material. It brings mind and body into the same space and asks the practitioners to be intentionally present to the moment. It can be signaled by a singing bowl or simply by the voice of the teacher, until it becomes common practice and students engage in it independently without any necessary signal.

## 2.2. Breathing exercises

While an activity that we all do continuously, breathing is taken for granted and often overlooked. Controlled breathing can decrease blood pressure and heart rate, and inspire ease and a sense of peace and grounding. Simple breathing exercises can benefit students' wellbeing and their focus at the beginning of class, or before an exam or public presentation. Simple breathing shifts one's focus to the breath and therefore to the here and now. How to do it: Breathe in, aware of the tip the nose and how the lungs expand as you do so. Breathe out, noting how the body slowly relaxes when the air leaves the lungs. As you breathe, notice how your abdomen and your chest gently expand and then release. An easy and effective breathing exercise is four-part breathing, or square breathing. This consists of completely emptying the lungs and then inhaling for a count of four, holding the breath for a count of four, exhaling for a count of four and holding for the count of four. One may repeat the exercise a few times, until feeling more relaxed.

## 2.3. Visualization

One of the simplest ways to practice letting go, and therefore greater openness and availability to new experiences and transactions with the environment (learning) is to quiet the mind and to imagine all our worries, anxieties, and concerns gently dissipating. How to do it: To practice visualization, one sits or lies in a comfortable position, with the palms of the hands gently posed on the knees. With eyes closed, one focuses on the breath for a few instants. Once relaxed and focused in the moment, one imagines oneself in a room where one enjoys being. Sit there, or lie there, comfortably, for a few moments, noting the surroundings. Then, gently imagine all frustrations, all anxieties, worries, resentments, and fears. Gather them together and bring all stressors into a tight bundle: Tie a big knot around it. Grab the bundle and make your way to the closest window, or door, in the room. Open the window, and purposefully throw the bundle out the window with all the energy you can muster. Return to your sitting or lying position for a few moments before returning to focus on your breath and to contact with reality around you.

## 2.4. Loving kindness meditation

This meditation, where one visualizes someone progressively becoming happier by sending them love, is a meditation focused outward, in connection with others. How to do it: This meditation starts by looking inward, and imagining ourselves growing increasingly happy. One may repeat the words: *May I be safe, may I be happy, may I be healthy. May I live my life with ease.* The meditation progresses to imagining someone who is close to us, someone who we love dearly, also growing increasingly happy. We can send them our love, imagine a little circle of light and love growing steadily from the center of their bodies, until it surrounds them fully. One can send them the same words repeated for oneself. In a next step, one can imagine someone whose relationship to us is fairly neutral, like the bus driver, the fish monger, or the cashier at the supermarket. Imagine them growing increasingly happy. One can send them love, imagine a little circle of light and love growing steadily from the center of their bodies, until it surrounds them fully. One can send them the same words you repeated for oneself. The meditation continues as one imagines someone with whom it has been more difficult communicating, someone who has caused pain in some way, following the same steps outlined above. Finally, one can expand the field of awareness to include a larger group of people, the community, or the world, and imagining it filled with that same growing light, sharing with it the same words as before.

## 2.5. The raisin meditation

The raisin activity, adapted from Jon Kabat-Zinn (2012), consists of mindfully interacting with a raisin with all five senses. How to do it: Bring some raisins to class and distribute one to each student. Have the students spend a few minutes observing it, feeling it, smelling it, hearing it, and then finally taking a small bite to savor it slowly. The activity is followed by journaling, or free writing.

## 3. Results and conclusion

Overall, student response to the use of contemplative pedagogy and mindfulness in the curriculum has been positive. As expected from previous research conducted on the impact of



mindfulness on decreasing anxiety and stress, one student mentioned that “we learned different grounding techniques that I still use to combat my anxiety today [...] I'm much better at reminding myself that the only thing I have to care about is the 'now', the present moment. This mindset has really been helpful in *stopping patterns of rumination and catastrophizing in my life, which is incredibly valuable.* (authors' emphasis) (Student 9).

In regard to the use of *statio*, one student commented, “I have really enjoyed doing the *statio* before class. I find that it helps me become more centered and focused for the day's class and, therefore, has helped me learn better” (Student 11). Other students confirmed the greater focus allowed when practicing mindfulness techniques associated with the curriculum: “I think it helped me focus in class more and keep me grounded in taking advantage of all the resources I had available around me [...] I felt that I was more present in the moment of learning and had a stronger desire to use books, professors and other tools to help me learn more. It kind of helped me be more curious about other topics than just my major interest” (Student 10).

Thanks to the continuous reinforcement of contemplative practices and the encouragement of student agency, students can remember not only the tools, but consciously opt to continue using them, even after the class is completed. Student 10 noted, “I will forever and always incorporate mindfulness into my everyday life, long term. Whether that means when I'm eating, when I'm working with patients, or when I get the chance to travel again. If I feel it slipping and need a mindfulness refresher, I will take out the *Gifts of Imperfection* [Brené Brown] book or Thich Nhat Hanh or even a raisin.” This same student recalls the power of paying attention and engaging mindfully with the surroundings: “I so vividly remember breathing the fresh air and just feeling a sense of freedom and peace high up in the clouds.” Another student substantiates the importance of contemplative pedagogies in daily life, even after the end of classes: “I am still applying what I learned. When I'm outdoors, I allow myself to connect with nature whenever it feels right. I allow myself to do that no matter if I'm observing something as small as an ant or as large as the sky. When I eat meals, I focus on food alone. In other words, I don't go on my phone or watch TV.” (Student 2)

Students have reported that learning about and practicing mindfulness allowed for connections with and for others at a deeper level, in their personal, academic, and professional spheres: “At the very least, I talk with members of my family. I practice active listening with others. I journal more than I used to and value connecting with myself in addition to the world around me. I still like to do a few of the meditations we practiced, such as the loving-kindness meditation” (Student 2); “it will [have an impact in future]. I envision it benefiting every aspect of my life. Patience, appreciation, and respect are what I've learned and continue to learn from mindfulness. These things are valuable in relationships, in activity, and in general existence” (Student 7)

In the context of a liberal arts education, contemplative pedagogy is well aligned with the goals of educating the whole person, or *cura personalis*. Moreover, it integrates well with the 21<sup>st</sup> century learning and life skills. While highly applicable in the classroom in a domestic setting, the setting of study abroad programs, is especially conducive to students' vulnerability and openness to engagement with their surroundings. Thus, the study abroad space, out of students' comfort zone, is also advantageous for the integration of contemplative pedagogy in experiential teaching and learning. In line with recent literature on integration of contemplative perspectives within teaching and learning at higher education institutions (Barbezat & Bush, 2014; Owen-Smith, 2018; Zajonc, 2013), and in post-pandemic times, we strongly recommend that educators consider the inclusion of contemplative practices in the classroom, both at home, and in the study abroad context.

## References

- Bai, H., Scott, C., & Donald, B. (2009). Contemplative pedagogy and revitalization of teacher education. *Alberta Journal of Educational Research*, 55 (3), 319–334. Retrieved on March 4, 2022, from: <https://doi.org/10.11575/ajer.v55i3.55330>
- Barbezat, D. P., & Bush, M. (2014). *Contemplative practices in higher education: Powerful methods to transform teaching and learning*. San Francisco, CA: Jossey-Bass.
- Barner, R. W., & Barner, C. P. (2011). Mindfulness, openness to experience, and transformational learning. In C. Hoare (Ed.), *The Oxford Handbook of Reciprocal Adult Development and Learning* (pp. 347–362). Oxford, UK: Oxford University Press.
- Berkovich-Ohana, A., Glicksohn, J., Dotan Ben-Sussan, T., & Goldstein, A. (2017). Creativity is enhanced by long-term mindfulness training and is negatively correlated with trait default-mode-related low-gamma inter-hemispheric connectivity. *Mindfulness*, 8 (3), 717-727.

- Britton, W., Desbordes, G., Acabchuk, R., Peters, S., Lindahl, J., Canby, N., Vago, D., Dumais, T., Lipsky, J., Kimmel, H., Sager, L., Rahrig, H., Cheaito, A., Acero, P., Scharf, J., Lazar, S., Schuman-Olivier, Z., Ferrer, R., & Moitra, E. (2021). From self-Esteem to selflessness: An evidence (gap) map of self-related processes as mechanisms of mindfulness-based interventions. *Frontiers in Psychology*, *12*, Retrieved March 4, 2022, from: <https://doi.org/10.3389/fpsyg.2021.730972>
- Chittister, J. (1990). *Wisdom distilled from the daily: Living the Rule of St Benedict today*. San Francisco: Harper & Row.
- Condon, P., Desbordes, G., Miller, W. B., & DeSteno, D. (2013). Meditation increases compassionate responses to suffering. *Psychological Science*, *24*(10), 2125–2127. Retrieved March 4, 2022, from: <https://doi.org/10.1177/0956797613485603>
- Donald, J., Sahdra, B., Van Zanden, B., Duineveld, J., Atkins, P., Marshall, S., & Ciarrochi, J. (2019). Does your mindfulness benefit others? A systematic review and meta-analysis of the link between mindfulness and prosocial behaviour. *British Journal of Psychology*, *110*(1), 101-123.
- Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science*, *6*, 537-559.
- Iwamoto, S. K., Alexander, M., Torres, M., Irwin, M., Christakis, N., & Nishi, A. (2020). Mindfulness meditation activates altruism. *Scientific Reports*, *10*. Retrieved March 4, 2022, from: <https://doi.org/10.1038/s41598-020-62652-1>
- Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry*, *4*(1), 33-47.
- Kabat-Zinn, J. (2009). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness* (15<sup>th</sup> Anniv). New York, NY: Bantam Dell.
- Kabat-Zinn, J. (2012). *Mindfulness for beginners: Reclaiming the present moment – and your life*. Boulder, CO: Sounds True.
- Owen-Smith, P. (2018). *The contemplative mind in the scholarship of teaching and learning*. Bloomington, IN: Indiana University Press.
- Palmer, P. J., & Zajonc, A. (Eds.). (2010). *The heart of higher education: A call to renewal*. San Francisco, CA: Jossey-Bass.
- Partnership for 21<sup>st</sup> Century Skills. (2009). *P21 Framework Definitions*. Retrieved on May 10, 2023, from: <https://www.oecd.org/site/educeri21st/40756908.pdf>
- Roth, H. D. (2006). Contemplative studies: Prospects for a new field. *Teachers College Record*, *108*(9), 1787–1815. <https://doi.org/10.1111/j.1467-9620.2006.00762.x>
- Roth, H. D. (2014). A pedagogy for the new field of contemplative studies. In O. Gunnlaugson, E. Sarath, C. Scott, & H. Bai (Eds.), *Contemplative learning and inquiry across disciplines* (pp. 97–115). Albany, NY: State University of New York Press.
- Segal, Z. V., Williams, J. M., & Teasdale, J. D. (2013). *Mindfulness-based cognitive therapy for depression* (2<sup>nd</sup> ed.). New York, NY: Guilford Press.
- Singleton, O., Hölzel, B., Vangel, M., Brach, N., Carmody, J., & Lazar, S. (2014). Change in brainstem gray matter concentration following a mindfulness-based intervention is correlated with improvement in psychological well-being. *Frontiers in human neuroscience*, *8*. Retrieved March 4, 2022, from: <https://doi.org/10.3389/fnhum.2014.00033>
- Vande Berg, M., Paige, R. M., & Hemming Lou, K. (2012). Student learning abroad: Paradigms and assumptions. In M. Vande Berg, R. M. Paige, & K. Hemming Lou (Eds.), *Student learning abroad: What our students are learning, what they're not, and what we can do about it* (pp. 3-28). Sterling, VA: Stylus Publishing.
- Zajonc, A. (2013). Contemplative pedagogy: A quiet revolution in higher education. *New Directions for Teaching and Learning*, *2013*(134), 83–94. Retrieved March 4, 2022, from: <https://doi.org/10.1002/tl.20057>
- Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition: Evidence of brief mental training. *Consciousness and Cognition*, *19*, 597-605. Retrieved March 4, 2022, from: <https://doi.org/10.1016/j.concog.2010.03.014>
- Zull, J. E. (2012). The brain, learning, and study abroad. In M. Vande Berg, R. M. Paige, & K. Hemming Lou (Eds.), *Student learning abroad: What our students are learning, what they're not, and what we can do about it* (pp. 162-187). Sterling, VA: Stylus Publishing.

## ANALYSIS OF THEORETICAL AND METHODOLOGICAL ASPECTS IN RESEARCH WORKS WITH SCIENTIFIC DISSEMINATION

**Leticia Kurihara, & Gildo Giroto Junior**  
*Institute of Chemistry, UNICAMP (Brazil)*

### Abstract

This work aimed to do a survey and analysis of Scientific Dissemination main-themed research works of the last 5 years. The selected materials were divided, categorized and analyzed for its theoretical and methodological basis. The central goal was to recognize how Scientific Dissemination is referenced and which are the main methodologies used in the found texts. It has been noticed, as a result, a group of texts with well-defined methodologies, that, however, present an incipient theoretical basis, showing the need of actions in that perspective, if we consider Scientific Dissemination as a potential area for science teaching researches.

**Keywords:** *Scientific dissemination, text analysis, science teaching.*

---

### 1. Introduction

Within the Scientific Dissemination (SD) field and considering current subjects, the concern about the crescent wave of disinformation that started to circulate, especially in social media, was one of the highlights so that different groups could start scientific dissemination and popularization works. Actually, SD has been gaining interest in academic researches (Fernandes et al, 2020; Recuero, Gruzd, 2019; Recuero et al, 2020; Soares et al, 2021; Oliveira, Martins, Toth, 2020). Furthermore, during 2020 and 2021, SD groups and projects evolving fact-checking agencies intensified or initiated their jobs trying to demystify the massive amount of fake news, emerged during the pandemic.

In spite of the creation and spread of fake news not being recent, (Mcintyre, 2018), its high increase, especially due to digital technologies (D’Ancona, 2018) draws attention. Because of a divided media environment, an increase of the distrust in the conventional media occurred, leading the audience to search for information in alternative sources, such as social media, websites and blogs that do not present accuracy in respect to the content disseminated (Chapman, 2017).

It is in this context that SD begins to gain more importance and massiveness. However, as many authors point out, the combat strategies against the fake news dissemination cannot be naive, based on the exclusive dichotomy between “fact or fake” (Oliveira, Martins, & Toth, 2020). A more deep understanding of the scientific and social aspects that compose the intentionality of fake news dissemination is needed and that must be done under the optics of documental analysis, searching for the comprehension of the social phenomena involved.

We highlight, for example, issues focused on the dissemination of information and aspects of post-truth. This term and its concernings with the fake news have gained relevance in a time that included Donald Trump’s, former president from the United States election campaign and the Brexit process, in 2016 (English Oxford, 2016). The massive propagation of fake news that influenced (and still does) people’s opinions are neither the cause nor the beginning of post-truth, but a result (Mcintyre, 2018). Some consequences of situations like these are pointed out by authors and, as synthesized by Cruz Jr (2021, p. 277), there is the favoring of “(...) a kind of collective resignation: when people give up (consciously or unconsciously) on understanding the reality rationally, its nuances and contradictions, settling for preconceptions, personal experiences and fragmentary narratives” (our translation).

Still, the comprehension of the typologies of denialist discourses enables the development of more robust SD actions. Cohen (2001) categorizes the kinds of denialists in literal, interpretative and implicatory terms, the first one being the one that explicitly denies the fact, claiming, for example, “that never happened” or “that is not true”. The interpretative one does not present a denial to the fact, but looks for an own interpretation, giving the event a different meaning. The implicatory one does not deny the fact, nor its conventional interpretation. It is their moral, psychological or political implications that are denied or, at least, minimized.

It is in front of this vast context and its possibilities of comprehending the mechanisms of SD promotion that this work fits in. We aim to interpret SD meanings, including the research about SD. We justify this proposal considering that finding ways to do so, so we can contribute to the expansion of the knowledge produced in different areas is briefly important so it can be possible to articulate SD as a scientific and mediatic lecturing, considering perspectives to formal and non-formal education.

## 2. Objectives

This research's main objective is to analyze texts that involve research about Scientific Divulcation in science and math teaching areas published in the past five years in Brazil and overseas. The analysis aimed to recognize their goals, theoretical basis and methodologies applied. Our intention with this analysis is to identify elements that allow us to recognize how SD themed research has been done and what are the possibilities within this field to promote scientific literacy.

## 3. Methods

This paper is guided by a qualitative data analysis obtained from systematic reviews from the literature (Galvão; Pereira, 2014). As research sources, we used data bases from Google Scholar, Scielo and Web of Science to look for the words “divulgação científica”, “scientific divulgation” e “scientific dissemination”, limiting the works from 2018 to 2022. The selection criteria were these words’ presence in the key-words or in the abstract. It was selected and separated for analysis articles with scientific divulgation as main theme. The reading and analysis by a posteriori categorization followed the methodological aspects defined by data codification according to Creswell (2012).

## 4. Results

After analysis of the titles, abstracts and key-words, 15 articles in Portuguese and 7 in English were selected and fully analyzed. The abstracts’ reading enabled the following a posteriori categories: 1) articles pandemic-centered, 2) articles with social media-focus, 3) articles with health area-focus and 4) articles that bring a SD project as theme. In these works, we aimed to identify their i) objectives; ii) theoretical basis; iii) methodological aspects. Table 1 shows the number of papers in each one of the categories, by year and language. We highlight that some works were placed in more than one category, so that the final total of the articles in the table is higher than the previously said.

Table 1. Articles categorized.

Category	Articles in Portuguese	Articles in English	Publication Year
Articles pandemic-centered	3	4	2020 (5) 2021 (2)
Articles with social media-focus	5	3	2019 (2) 2020 (3) 2021(2) 2022 (1)
Articles with health area-focus	1	4	2019 (1) 2020 (1) 2021 (3)
Articles that bring a SD project as theme	5	3	2019 (1) 2020 (2) 2021 (5)
Others	6	-	2018 (1) 2019 (1) 2021 (2) 2022 (2)

Source: Copyright

## 5. Discussion

### 5.1. Works’ general structure and objectives

Concerning the first category, were selected articles whose structures rely directly on the pandemic, having it as their main theme and/or their basis. On the other hand, the second category includes papers that focus on the SD done in social media, and/or social media as a way to do it, depending on the media used. Almost all the articles reference at least one social media and its peculiarities, also the

characterization of some media were used as a criteria to classify the papers under this topic. The third category holds works with the main (or only) theme being the SD of subjects in the health area, with some of the texts from the first category were included under this classification depending on whether they contained or not information about COVID-19. The fourth category comprehends texts that describe some project, magazine, paper with data analysis, reach and/or its development. So, it was selected works that, unattached to whether they present references concerning SD, have some SD project as the main theme of the text. Then, we created the category “Others” for texts that did not match any of the previous categories, but that presented potential to be used as future query or theoretical foundation.

Throughout the selected articles, we noticed that texts in English, in general, are papers focused on the pandemic time or health related (not necessarily limited to COVID-19). As shown in **Table 1**, 4 out of the 7 articles in English have the pandemic as its theme. Regarding the Brazilian articles, this statistic drops to 3 in 15.

From the article’s readings, it was observed that the international texts start from a problem or a specific project to talk about SD (like prostate cancer, radioactive oncology, APJTM), while this is less frequent in the Brazilian ones, present in 5 out of the 15 found texts. Therefore, we were able to find a higher number of Brazilian texts that talked about SD in a more embracing way.

Articles written in English health-themed also prevail in number: 4 out of 5 articles. We noticed that while there are 4 international texts in this area, there is only 1 Brazilian text for the same theme. This subtopic concerning the works may be the main difference between Brazilian and international articles. We also noticed another difference concerning the text sizes; texts in Portuguese are, in general, longer than texts in English, most of them being short publications without the structure of a scientific article and containing a brief analysis of a certain project, as is the case with the text "Twitter-based Prostate Cancer Journal Club (#ProstateJC) Promotes Multidisciplinary Global Scientific Discussion and Research Dissemination".

## 5.2. Works’ theoretical basis

About the theoretical references discussed in a deep way in the texts, only 7 out of the 22 selected works presented them in their structure. This is a fundamental aspect to consider when we think of SD as a strategy, not only of a translation of concepts in a more technical language to a more informal one, but also as a strategy regarding teaching and learning content (Oliveira, Martins e Toth, 2020).

We highlight the text analysis “As ambivalências da divulgação na era digital” written by Lucia Santaella, which brings out a wider discussion about different aspects related to SD, such as topics related to social media credibility, filter bubbles, trust and perception of science and controversies in it, connecting them to classic science sociology authors like Thomas Kuhn and contemporary authors like Bruno Latour. This work is a theoretical work that has the matter to be used as reference to other researches and, for that, deserves emphasis in our analysis.

Another highlight work in this theme is the one written by Lorenzetti, Raicik and Damásio (2021), who did a SD-themed texts review, interpreting them under the optics of Science History and Philosophy and Science Epistemology, so that to recognize methods for which SD is done, why is done, and to whom. In this material, there is an important reference crossover, trying to bring together SD and Science teaching.

The other works that point to theoretical references brings out, in general, SD definitions, quoting, in its majority, Massarani, L. and Dias, E. (2018), Bueno, W. (2010), and Albagli, S. (1996). Some correlations are made in a summarized way with aspects from Science, Technology and Society and with Science Epistemology aspects, however, for not being study and investigation subjects, these references are not deepened.

One interpretation for the fact those works don’t rely enough on theoretical references is that, in our survey, most part of the papers fit in a analysis profile of how a certain theme shows up in the SD materials (how COVID was treated; how science public perception appears; in which and how many materials SD has been done, for example). In that regard, the works’ structure presents a robust methodological case, but the analysis restrain themselves to groundless theoretical basis quantifications or interpretations.

Another term that can be highlighted is the recent characteristic of SD themed research and the complexity of establishing parallels with different references. The texts from Santaella (2019) and Lorenzetti, Raicik and Damásio (2021) make that connection, becoming potential references for new proposals. Notably, aspects from Science Nature, Science History and Philosophy, scientific learning and teaching, among others, can be worked together with SD. However, as it represents a more recent area that involves media communication aspects and, also, in a deeper scenario, scientific journalism issues and its derivations (media training, semiotics, multimodality, etc), the theoretical basis in those articles is, yet, to be developed.

Another example of these aspects mentioned above, despite the absence of a theoretical deepening in the references, only 5 out of the 22 works do not present any references. However, excluding the 7 articles previously mentioned (which bring out a bigger discussion about the references), the other works present a theme of variability without a connection to data or the analysis made, such as SD definitions, fake news, social media and misinformation categorizations, cyberspace definitions, among others.

### 5.3. Methodological aspects' analysis

Among the found articles, 9 do not present a methodology or data analysis based on the qualitative or quantitative research area. Those texts, sometimes, search for an access' data systematization or the frequency number of a certain theme or a brief action classification. We noticed that the other 13 texts present a well-defined methodology and, in general, the texts are based in bibliographic and documental researches and in a couple of cases there is an additional with interviews (*"Blogs institucionais como ferramenta de divulgação científica em universidades públicas: análise do Blogs de Ciência da Unicamp e do UFABC Divulga Ciência"* [Institutional blogs as scientific dissemination tool in public universities: Unicamp Science Blogs and UFABC Disseminates Science analysis]) or analysis of other aspects (watch the videos, extract subjects from them, then analyze the moral density)].

As discussed in the theoretical basis topic, despite only 7 texts, although only 7 texts present a deep discussion on theoretical subjects, 13 of them describe methodological aspects. This fact, as quoted above, is connected to the kind of research (documental and bibliographic). However, it is an aspect that draws attention and must be considered as a discussion topic.

As said by Lorenzetti, Raicik and Damásio (2021), understanding how, why and to whom SD is done is crucial. To comprehend the SD texts and the produced materials' reach is important, but to interpret those facts grounded by SD and teaching and learning theoretical references can increase ways to the SD understanding and use as a strategy to the lecturing (formal or non-formal) and also to strengthen that new investigation theme.

Recapturing some of the issues discussed in our theoretical mark, there are, in the science teaching field, countless matters that can be linked to the SD work. Concepts' hiperparticularization aspects, post-truth related issues, Science Nature and even aspects related to the media training are possible to be under studies. However, debating those propositions under the optics of appropriate references and making connections among theoretical and methodological references and the data from researches, that being documental, empirical or from another nature is primal to strengthen the works.

## 6. Conclusions

Despite SD being done since the beginning of the past century in Brazil, in the past 5 years the publications related to it had a huge impact (in the past 2 years in particular due to the pandemic), as well as misinformation practices and fake news circulating in social media.

The analysis done in this work points out that international and national articles have differences in their structures and themes, in the references and in the depth of discussions. With respect to the deepening, part of the found works, in spite of presenting diverse themes, do not present a deep discussion about SD nor its relation to other concepts of references in the distinct areas. However, the other works that do present it can become theoretical contributions in future texts.

We do not have, as a goal in this work, to criticize SD actions. We understand, although, that recognizing the SD field as a potential area for research and for the development of science teaching and learning activities and also in the promotion of a media lecturing, it is primal that a robust theoretical basis is associated with those activities, recognizing the area's specificities. Thus, to recognize that there are, still, ways to the construction of a theoretical basis, as well as to adjust appropriate methodologies to the field, is a task that needs to be developed with bigger intensity in the articles.

Finally, this work highlights the importance of the continuity of SD research so that deeper discussions about that can be generated and more SD theoretical contributions can be developed. The sharing of our reflections and analysis is, therefore, a way for us to reflect collectively about the area's potential in future perspectives.

## References

- Albagli, S. (1996). *Divulgação científica: Informação científica para cidadania* [Scientific Dissemination: Information for citizenship]. *Ciência da Informação*, [S. l.], v. 25, n. 3. DOI: 10.18225/ci.inf.v25i3.639. From URL: <https://revista.ibict.br/ciinf/article/view/639>

- Bueno, W. (2010) *Comunicação científica e divulgação científica: aproximações e rupturas conceituais* [Scientific communication and scientific dissemination: conceptual approximations and ruptures]. *Informação & Informação*, Londrina, v. 15, n. 1 esp, p. 1-12, 2010. From URL: <https://www.uel.br/revistas/uel/index.php/informacao/article/view/6585>.
- Chapman, M. (2017) *Fake news, echo chambers and filter bubbles: what you need to know*. Better Internet for Kids. From URL: <https://www.betterinternetforkids.eu/web/portal/practice/awareness/detail?articleId=1990814>
- Cohen, S. (2001) *States of Denial: Knowing about Atrocities and Suffering*. Cambridge: Polity.
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson.
- Cruz Jr, G. (2021). “Ver o que temos diante do nariz requer uma luta constante”: A pós-verdade como desafio à educação na era digital [“See what we have against our noses requires a constant fight”: post-truth as a challenge to the lecturing in digital era]. *ETD - Educação Temática Digital*, 23(1), 273-290. From URL: <https://doi.org/10.20396/etd.v23i1.8656236>
- D’Ancona, M. (2018). *Post-Truth: The New War on Truth and How to Fight Back* (Carlos Szlak). Barueri: Faro Editorial.
- English Oxford. (2016). *Word of the Year 2016 is*. From URL: <https://languages.oup.com/word-of-the-year/2016/>
- Fernandes, C. M.; Oliveira, L. A. De; Campos, M. M. De; & Coimbra, M. R. (2020). A Pós-verdade em tempos de Covid 19: o negacionismo no discurso de Jair Bolsonaro no Instagram [Post-truth in the Covid 19 era: the denialism in Jair Bolsonaro’s Instagram discourse]. *Liinc em Revista*, [S. l.], v. 16, n. 2, p. e5317. DOI: 10.18617/liinc.v16i2.5317. From URL: <https://revista.ibict.br/liinc/article/view/5317>
- Galvão, T. F.; & Pereira, M. G. (2014). Revisões sistemáticas da literatura: passos para sua elaboração [Literature’s systematic reviews: steps for their elaboration]. *Epidemiol. Serv. Saúde, Brasília*, v. 23, n. 1, p. 183-184. From URL: [http://scielo.iec.gov.br/scielo.php?script=sci\\_arttext&pid=S1679-49742014000100018](http://scielo.iec.gov.br/scielo.php?script=sci_arttext&pid=S1679-49742014000100018)
- Lorenzetti, C. S.; Raicik, A. C.; & Damasio, F. (2021). *Divulgação Científica: Para quê? Para quem? — Pensando sobre a História, Filosofia e Natureza da Ciência em uma Revisão na Área de Educação Científica no Brasil* [Scientific Dissemination: What for? For whom? — Thinking about the History, Philosophy and Nature of Science in a Review of the Scientific Education in Brazil]. *Revista Brasileira de Pesquisa em Educação em Ciências*, [S. l.], p. e29395, 1–27, 2021. DOI: 10.28976/1984-2686rbpec2021u14871513. From URL: <https://periodicos.ufmg.br/index.php/rbpec/article/view/29395>.
- Massarani, L.; & Dias, E. (2018) *José Reis: reflexões sobre a divulgação científica* [José Reis: reflections on scientific dissemination]. Rio de Janeiro: Fundação Oswaldo Cruz.
- Mcintyre, L. (2018). *Post-truth*. Cambridge: The MIT Press.
- Oliveira, T. M., Martins, R. Q. R., & Toth, J. P. (2020). Antivacina, fosfoetanolamina e Mineral Miracle Solution (MMS): mapeamento de fake sciences ligadas à saúde no Facebook [Anti-vaccine, phosphoethanolamine and Mineral Miracle Solution (MMS): health fake science’s mapping in Facebook]. *Reciis*, 14(1), 90-111. From URL: <https://doi.org/10.29397/reciis.v14i1.1988>
- Recuero, R., et al. *Desinformação, Mídia Social e COVID-19 no Brasil: Relatório, resultados e estratégias de combate* [Social Media and COVID-19 in Brazil: Report, results and combat strategies]. From URL: <https://wp.ufpel.edu.br/midiars/files/2021/05/Desinformac%CC% A7a%CC%83o-covid-midiars-2021-1.pdf>
- Recuero, R., Gruzd, A. (2019). Cascatas de Fake News Políticas: um estudo de caso no Twitter [Politics Fake News Waterfalls: a case study in Twitter]. *Galáxia*, n. 41, p. 31-47. From URL: <https://doi.org/10.1590/1982-25542019239035>
- Santaella, L. (2019). *As ambivalências da divulgação científica na era digital* [The ambivalences of scientific dissemination in the digital age]. *Boletim Gepem 75 - Educação Matemática e Científica na Ciberultura*, n. 75. From URL: <http://costalima.ufrj.br/index.php/gepem/article/view/205>.
- Soares, B. R., et al. (2021). *Jogo “Vida na Lagoa da Mata”: Entrelaçando ensino de ciências e divulgação científica na Floresta Nacional de Carajás (PA)* [Game “Vida na Lagoa da Mata”: Interweaving science education and science communication in the Floresta Nacional de Carajás (PA)]. *Anais do XIII Encontro Nacional de Pesquisa em Educação em Ciências*. Campina Grande: Realize Editora. From URL: <https://editorarealize.com.br/artigo/visualizar/76046>.

## A STUDY REGARDING LEARNING AND INNOVATION SKILLS (4Cs) IN A PORTUGUESE HIGHER EDUCATION INSTITUTION

**Isabel Ribau**

*CICS.NOVA, NOVA School of Science and Technology, FCT NOVA, NOVA Lisbon University (Portugal)*

### Abstract

Doctoral education is the pinnacle of the education system but is also the link between the education system and the research area. To work, as a researcher, in a 21<sup>st</sup>-century society, learning and innovation skills, like critical thinking, creativity, collaboration, and communication are important. In Portuguese law to have a PhD degree, is necessary that students among others must have scientific skills, critical thinking, and communications skills. Creativity and collaboration skills are not mentioned. But these skills are very important as scientific research usually occurs in research teams where collaboration and cooperation are crucial to concretize the research project. Also, creativity is important once it can drive to new areas of knowledge or new solutions to the research problem. In this context, it is important to know what PhD students fill about these four skills that are among the 21st-century skills. This research work is a study case, with the characteristics of quantitative research, which aims to perceive the doctoral students' perception regarding critical thinking, creativity, collaboration, and communication (understanding and development). The data were collected, through a questionnaire applied in Jun 2022, via institutional email to the Population of the Science and technology school at NOVA Lisbon university. This survey was based on others, already published, but adapted to the Doctoral population. Among other things, it captured the students' perception regarding their trust in their capabilities regarding critical thinking, collaboration, communication skills, and creativity. The meaning of creativity, how to develop it, regarding doctoral supervision practices, research environments, and development were explored, and PhD students' perceptions were collected. Data analysis revealed that students are very confident regarding their ability to use critical thinking (77%), work collaboratively (84%), communicate with peers or with society (81%), and be creative (73%). Considering the supervision practice (and teaching practice at this level) that promotes them, there is a lower agreement regarding it. The meaning of creativity that emerges in this research implies thinking out of the box, seeing the world in different ways/perspectives, creating new things/concepts/ideas, and making unusual connections between things/concepts/ideas. The personal characteristic associated with creativity is curiosity. In the view of doctoral students, the practices that promote the development of creativity are to participate in seminars/ debates or cycles of study (80%), followed by research work in a research group (79%). It is possible with the research results to conclude that these four important skills are being developed and deepened in doctoral education at this institution.

**Keywords:** *Doctoral education, critical thinking, creativity, collaboration, communication.*

### 1. Introduction

Doctoral education is the highest level of education in the education system around the world. It is linked to the research area and is the “pool” and resource of researchers and the backbone of research and innovation. Innovation is one requisite to a developed society and needs highly qualified people but also innovative and fearless. Doctoral education must prepare doctors to be not only qualified people in a certain area, but also innovators, fearless, accurate, critical thinkers, communicators and responsible.

At the end of the twenty century and the beginning of the 21<sup>st</sup> century, some work groups, with persons from different areas of knowledge, started to think about what should be the most important skills for people in the 21<sup>st</sup> century. The traditional 3Rs (Reading, writing and arithmetic) proposed in the 20 century were misfit, unsuitable, and restricted in the face of the challenges of the new century, where artificial intelligence is emerging and evolving and will be deeply developed. Networking, decision-making skills, Project, time and stress management, attention to detail, teamwork, and adaptability/flexibility, were some skills that were proposed. In this research, the framework used, as the starting point was the P21 framework for 21<sup>st</sup>-century learning (from the P21 group a coalition of the US different organizations related to education and development). (Demystifying Learning Frameworks:



The P21 Framework | Remake Learning). In this frame (<http://www.p21.org/about-us/p21-framework>), the bases are standards and assessments, curriculum and instruction, professional development, and learning environments, and the learning and innovation skills for the 21<sup>st</sup> century presented are critical thinking, creativity, collaboration, and communication (<https://files.eric.ed.gov/fulltext/ED519462.pdf>). The P21 framework document challenge students not only to learn content knowledge but also to learn how to use it to engage in critical thinking, problem-solving and analysis, to make informed and reasoned decisions, this is, be literate people. But it also appeals to the development of learning and innovation skills, which they define as critical thinking, creativity, collaboration, and communication. As they are the key to interacting with others (skills of communication and collaboration are needed), but also promote innovation (and critical thinking and creativity play an important role).

In the context of higher education, these skills may be the difference between being a qualified worker or a researcher. A qualified worker may have a master's or doctoral degree, but it is the person who follows the leader(boss) and, do what the "boss" propose. A researcher can be a leader, but he is a project constructor who proposes solutions, do innovations, and have a critical but creative mind. Constructing a researcher is not an essay job, it implies knowing how to supervise PhD students, having as a goal develop not only scientific and research skills, but also soft skills like critical thinking, creativity, collaboration, and communication. And this implies putting the PhD student in specific environments that are appropriate for it. Supervision practices are important, as strategies to allow the development of the academic self by the student, to help it to fit into the research environment, and to create a sense of belonging to the research team and the academy (Ribau, 2019, 2020a, 2020b, 2020c, 2021a, 2021b). In this sense, looking to practice and the degree of confidence of the students regarding a task can give information regarding the development of the skill.

Why these 4 learning and innovation skills are so important in a doctorate? First, it is necessary to understand what they mean and what are the implications of each one. It should be underscored that, on one hand, critical thinking and creativity are related to the construction of the self and can be related to the social and educational environment where people where a person is inserted. On the other hand, collaboration and communication are related to the socialization process.

Critical thinking is the ability to analyze in detail and with accuracy something (idea, solution, process, product, fact, and so on) in particular circumstances, and make an interpretation or make conclusions regarding the thing that was been analyzed. It implies the use of an analytical mindset and putting the right questions and, seeking correct information to do the analytical dissect of the problem/thing that is being viewed critically. As Kivunja refer (2015), citing the California National Council for Excellence, critical thinking is "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action" (Kivunja, 2015). To have the critical thinking, a person must know deeply the area of analysis, be aware of the field frames and be assertive. This skill is relevant to be an independent, autonomous person.

Creativity was defined by Guilford as a multipurpose cognitive ability that implies fluency, flexibility, accuracy, and originality. Other researchers such as Torrance, Maslow, Csikszentmihalyi, Roger or Simonton among others, also gave meaning to creativity by looking at it from different perspectives. As Hallmann (1963), cited by Matraeva and collaborators (2020), states in their paper entitled "The necessary and sufficient conditions of creativity. (Journal of Humanistic Psychology, 1963)" " Creativity is a fusion of perceptions implemented in a new way (McCullar), the ability to find new connections (Cubie), the emergence of new relationships (Rogers), the predisposition to make and recognize innovations (Lassuelle), the activity of the mind, leading to new insights (Gerard), transformation experience in a new organization, the imagination of new constellations of meanings (Giselin)". (Matraeva, Rybakova, Vinichenko, Oseev & Ljapunova, 2020). Creativity also depends on the area being context-dependent (Hu & Adey, 2002; Wiyanto, Saptono & Hidayah, 2019). Creative thinking is the ability to, based on the same permission, think differently from most of the persons, switching perspectives and seeing an idea, solution, process, product or fact in different ways. It implies having flexible and adaptable frames of mind, to achieve a goal (<https://files.eric.ed.gov/fulltext/ED519462.pdf>). A creative-thinking person must know deeply the field, be resilient (as others may not easily accept the proposed solutions) and be able to adopt different solutions in a different context. This skill is important in a society that wants to be developed and innovative. This is what makes the difference between a deep-thinking machine (that works based on algorithms) or artificial intelligence (that works based on algorithms but can create its own) and humans.

Communicating consisted of someone sending a message and someone understanding it. First, it is essential to know what is to communicate (the message's aims) and how to do a clear and concise message. Secondly, have clear goals, and targets to achieve. The message can be written, or oral, and the targets can be specialists in the field or ordinary people. This skill is relevant in a developed society,

where communication via networks is essential. Communication skills walk hand in hand with collaboration (<https://files.eric.ed.gov/fulltext/ED519462.pdf>).

Collaboration is the art of working with others, pursuing some goals, and having common outcomes but being different. Often collaboration requires negotiations, flexibility, adaptability, and compromises. This skill is very important in teamwork, as communication with the different partners in the team group. Other skills related to collaboration are social, leadership skills and conflict management. (<https://files.eric.ed.gov/fulltext/ED519462.pdf>)

In Portuguese law, regarding the doctorate, creativity or collaboration skills are not explicitly referred to. In the Decree Law n.º 216/92 (13 October) CHAPTER III, Article 17, states in the first point that “The doctor's degree proves the achievement of an innovative and original contribution to the progress of knowledge, a high cultural level in a given area of knowledge and the ability to perform independent scientific work.” Due to the implementation of the Bologna process, the Decree-Law No. 74/2006 of March 24, of the Portuguese Republic was published. This Decree-Law (No. 74/2006, 24 March) that present the legal regime of academic degrees and diplomas of higher education under the Bologna process, in chapter IV, article 28, regarding the Doctor's Degree in point 1 states that "1 - The doctor's degree is conferred on those who demonstrate: a) ability to understand systematically in a scientific field of study; (b) Competencies, skills and research methods associated with a scientific field; (c) the ability to conceive, design, adapt and carry out meaningful research in compliance with the requirements imposed by academic quality and integrity standards; (d) have carried out a significant set of original research work which has contributed to the widening of the frontiers of knowledge, part of which merits national or international dissemination in publications with a selection committee; (e) be able to critically analyse, evaluate and synthesize new and complex ideas; (f) be able to communicate with their peers, the rest of the academic community and society in general about the area in which they are specialised; (g) be able, in a knowledge-based society, to promote, in an academic and/or professional context, technological, social or cultural progress (translation of the author). The most recent decree-law regarding higher education, the Decree-Law No. 65/2018, of 16 August, intended to accept the recommendations of the Organization for Economic Cooperation and Development (OECD) on Portuguese higher education and science, technology, and innovation systems, continues not to refer clearly to creativity or collaboration skills. In this context, it is important to know if these skills are being developed during the doctorate as, critical thinking and communication (explicitly refer in the decree-law), as they are essential nowadays.

The present research work is part of a project that aims to characterize the doctoral supervision practices and the doctoral education process at NOVA Lisbon University. Research results had already been published, regarding the supervisors' lens (Ribau, 2020b, 2021a) and PhD students' perception (Ribau, 2019, 2020a, 2021b). This research work intends to bring light to the practices used to develop and empower students regarding creativity, critical thinking, collaboration and communication during the doctorates. It also intends to reduce the gap in knowledge about the development of creativity, critical thinking, collaboration and communication, during doctoral research.

## 2. Methods

This project aimed to evaluate the degree of development of four skills: collaboration, communication, creativity, and critical thinking. This data was reflected in the confidence of the PhD Student regarding tasks related to the skill. It is a study case, with the characteristics of quantitative research, which aims to perceive the doctoral students' perception regarding critical thinking, creativity, collaboration, and communication (understanding and development). To collect data, a survey was applied and disseminated, via institutional email, similar to others (Kelley, Knowles, Han & Sung, 2019; Matraeva, Rybakova, Vinichenko, Oseev & Ljapunova, 2020) already applied to higher education institutions in another country. Some changes have been made in the survey to adequate it for doctoral education. The survey had two parts, the first one had close questions regarding the sample characterization the second part, had close questions, aimed to collect data regarding creativity, communication, collaboration, and critical thinking. A four-point Likert scale ranging from strongly disagree to strongly agree was used to measure confidence in skills regarding creativity, communication, collaboration, and critical thinking. The survey was applied in Portuguese, to PhD students at NOVA School of Science and Technology | FCT NOVA, NOVA Lisbon University, in June 2022.

## 3. Discussion

All the respondents were doing a PhD at NOVA School of Science and Technology, 52% of the respondent population was female and 48% male. 75% of the respondent population had between 25 and 35 years old, and the rest, of the respondents, had between 36 years to more than 56 years old.

To collect data from collaboration, doctoral students must reflect on their confidence regarding their ability to do tasks/activities related to the skills being evaluated. PhD students had to apply a Linkert scale on 14 statements concerning collaboration. Regarding communication skills doctorate had to evaluate 10 sentences, and to perceive the use of critical thinking had to analyze 18 statements finally, they had to examine 10 sentences using.

*Table 1. Doctoral perception regarding their confidence in the ability to use the 4C skills.*

<b>Dimension</b>	<b>Average</b>	<b>frequency (%)</b>
Collaboration	3,4	84%
Communication	3,2	81%
Critical thinking	3,1	77%
Creativity	2,9	73%

It makes sense for collaboration, and communication to be the skills doctoral students feel competent in using since these competencies are usually inserted in a research group and many of them have seminars where they see presentations and/or make presentations, of the work that they are developing. In the data collected in this research students assign that in meetings with their supervisor, they are encouraged to express their ideas (more than half of the respondents appoint) and to seek new pathways for their research work, if something is not well in the research project.

The meaning of creativity skill was investigated, as this concept can differ from person to person and may differ from the knowledge area. So, in the survey, a close question was proposed, to perceive the significance of creativity in this population. The students had fifteen options and could choose 5 options. The options that had more assigns, are presented in Table 2.

*Table 2. Dimension evaluated in the survey.*

<b>Creativity means...</b>	<b>Percentage of respondents (%)</b>
think "outside the box".	70%
see unusual links/connections between existing concepts, ideas, or things.	69%
seeing the world in different ways.	66%
being curious.	56%
generate new ideas.	54%
inventing, innovating, and producing new things.	54%

The most chosen option to complete the sentence "Creativity means..." was "Thinking "outside the box" and the second option was "seeing unusual links/connections between existing concepts, ideas, or things". Interestingly, the two personal characteristics that are in these top five means of creativity are "seeing the world in different ways" and "Being curious". All the others are related to the process ("think "outside the box".; "...see unusual links/connections between existing concepts, ideas, or things") or product ("...generate new ideas.", "...inventing, innovating, and producing new things). In conclusion, for the survey respondents, the process is the best form to define creativity.

To understand what practices could be used, to develop creativity during the doctorate, a close question was presented: "What forms of work at the university are most conducive to the development of creativity?". The students had twenty options and had to choose 7 options. The options assigned for more than 50% of the respondents are presented in Table 3.

*Table 3. Percentage of doctorates that choose the option to answer the question "What forms of work at the university are most conducive to the development of creativity?".*

<b>What forms of work at the university are most conducive to the development of creativity?"</b>	<b>Percentage of respondents (%)</b>
Participate in seminars, round tables, plenaries, and debates.	80%
Carry out research activities (laboratory or not) in a research group.	79%
Participate in meetings between PhD students and teachers/supervisors.	64%
Develop projects throughout the course (project activities in master and doctorate)	62%
Conduct laboratory work within the course (project activities)/study cycles.	51%

It should be stressed that taking part in seminars, round tables, plenaries and debates in university are forms of work that, for the respondents (PhD students), may conduct the development of creativity, but also "Carry out research activities (laboratory or not) in a research group". These activities also promote the development of communication, collaboration, and critical thinking, as "be an active participant" in seminars, round tables, plenaries, and debates, which implies that all participants know how to expose, explain, and exchange ideas - have communication skills. Collaboration skills are implicit

in research teamwork so conducting research activities (laboratory or not) in a research group is a basic skill. These activities may also promote the scientific skills developed by researchers, and open new horizons for others as they exchange ideas with others. “Participate in meetings between PhD students and teachers/supervisors” can be very useful if techniques like “Brainstorm” are used to discuss the data or the research process. So, what happens during the meetings can influence positively creativity or kill it, if the supervisor doesn’t allow a true discussion of data or research process or doesn’t promote autonomy and critical thinking and teach students to deal with uncertainty and failure.

#### 4. Conclusions

From the data collected in this research, it is possible to conclude that, the learning and innovation skills for the 21st century proposed in the P21 framework, critical thinking, creativity, collaboration, and communication are, from the PhD students' point of view, being developed in doctoral education at this institution.

It should be underscored that research that has been taken since 2017, in this institution regarding doctoral education, allows a view through doctoral supervision practices and their change in time. If in the beginning, the data indicated that generally supervision practices were not open to soft skills development and were focused on scientific skills. In the present data, PhD students present a new image, as they fill comfortable with soft skills. A hypothesis that emerges, is that the doctoral school at NOVA Lisbon University (a structure that offers different short courses regarding soft skills, for the PhD students and supervisors), is changing the profile of a doctorate and may be a crucial institutional support to develop soft skills. Although this study has a sample limitation, a new pathway of research was opened, to perceive the change that is occurring in the PhD students' and supervisors' profiles.

#### References

- Demystifying Learning Frameworks: The P21 Framework | Remake Learning, Retrieved on 1 Mar 2023, from <https://remakelearning.org>.
- Gaspar, D., Mabic., M. (2015). Creativity in Higher Education. *Universal Journal of Educational Research*, 3(9), 598-605.
- Kelley, T., Knowles, J., Han, J., & Sung, E. (2019), Creating a 21<sup>st</sup> Century skills survey instrument for high school students. *American Journal of educational research*, 7(8), 583-590.
- Kivunja, C. (2015) Exploring the Pedagogical Meaning and Implications of the 4Cs “Super Skills” for the 21st Century through Bruner’s 5E Lenses of Knowledge Construction to Improve Pedagogies of the New Learning Paradigm. *Creative Education*, 6, 224-239.
- Matraeva, A., Rybakova, M., Vinichenko, M., Oseev, A., Ljapunova, N. (2020). Development of creativity of students in Higher Education Institutions: Assessment of students and experts. *Universal Journal of Educational Research*, 8(1), 8-16.
- Partnership for 21 set century skills [P21] (2009). P21 framework definition. Retrieved from: <https://www.battelleforkids.org/networks/p21> on 4 January 2023.
- P21 Framework Definitions. Retrieved from <https://files.eric.ed.gov/fulltext/ED519462.pdf> on 4 January 2023.
- Ribau, I. (2019). Listening and feeling doctoral students’ perceptions of their doctoral supervision. The PhD students’ point of view. *Advances in Social Sciences Research Journal*, 6(12), 206-223.
- Ribau, I. (2020a). Doctoral Supervisors and PhD Students’ Perceptions about the Supervision Process in a Young European University. *Universal Journal of Educational Research*, Vol 8(1), 36-46.
- Ribau, I. (2020b). The drop effect at the doctoral supervision sea surface. Observing the waves with the supervisors’ lens. *Universal Journal of Educational Research*, Vol 8(4) 1579-1595.
- Ribau, I. (2020c). A (de)formed a perception of the pathway to be taken during the PhD. The influence of time in the student’s eyes perception in becoming a researcher. *Advances in Social Sciences Research Journal*. 7(11) 272-308.
- Ribau, I. (2021a). When you look at the supervisor’s image in the mirror, what do you see? The supervisors’ Mirror image regarding doctoral supervision. *Advances in Social Sciences Research Journal*, Vol 8(2) 398-410.
- Weiping Hu & Philip Adey (2002) A scientific creativity test for secondary school students. *International Journal of Science Education*, 24(4), 389-403.
- Wiyanto, Saptono. S. & Hidayah (2019). Scientific creativity: a literature review. *Journal of Physics: Conference Series*, (1567 (2020)022044. 6th International Conference on Mathematics, Science, and Education (ICMSE 2019) 9-10 October 2019, Semarang, Indonesia.

# GAUGING ANXIETY AND RESILIENCE IN THE MATHEMATICS CLASSROOM: VOICES OF GRADE 7 TEACHERS AND LEARNERS FROM SOUTH AFRICA

Jo Badenhorst<sup>1</sup>, & Dimakatso Rammile<sup>2</sup>

<sup>1</sup>Department of Postgraduate Education, Central University of Technology (South Africa)

<sup>2</sup>Departmental Head, Free State Department of Education (South Africa)

## Abstract

It is widely recognised that mathematics achievement is one of the foundations of success in any society. For job creation and employment in the labour market, sufficient levels of mathematical and technological expertise are required to sustain economic expansion. This also applies to the South African economy, which is hampered by serious skills shortages in science, technology, engineering, and mathematics. South Africa's education system is struggling to produce school leavers of the calibre required in industry, most notably when it comes to mathematics achievement. Therefore, mathematics and science should be the subjects of choice for most learners; however, mathematics is, for various reasons, widely perceived to be a difficult subject by learners and teachers. Learners require resilience and encouragement to overcome the difficulties they experience in learning mathematics. To this end, the aim of this study was to explore the causes of mathematical anxiety and how mathematical resilience in Grade 7 learners can be fostered. A qualitative inquiry, rooted in the interpretivist paradigm, was conducted to generate data from participants. The findings provided a multi-perspective on the complexity of mathematical resilience, the factors that inhibit mathematical resilience among learners and strategies to overcome the challenges posed by mathematics. Recommendations are made for consideration by the Department of Basic Education to improve classroom practice, to implement district-based interventions and to amend relevant policy.

**Keywords:** *Grade 7 learners, mathematics anxiety, mathematical resilience, mathematics achievement.*

---

## 1. Introduction

It is widely recognized that mathematics is one of the foundations of enhancement and success in any society. Betiku (1999, p. 49) claims "Mathematics is the bedrock of science, while science is the necessity for technological and industrial development." Similarly, Makgato (2007) points out that, for job creation or employment in the labour market, a sufficient level of scientific and technological literacy is required to sustain the expansion of an economy. This is true for most countries, but with a third world economy facing extreme economic challenges, South Africa, in particular, is socially and economically very vulnerable. Jojo (2019) correctly points out that, at the heart of a country's prosperity, is the quality of its education system and its ability to contribute to sustainable development. In a report on what is referred to as South Africa's 'education crisis', Spaul (2013) cautions that South Africa's education system faces many challenges and is struggling to produce school leavers of the calibre required in industry, most notably when it comes to the subject of mathematics. He notes the acute shortage of skilled people in occupations in arts or crafts as well as artisans, engineers, architects, and doctors where various kinds of applications of mathematics are required. He (2013, p. 17) emphasizes that "the teaching and learning of mathematics stratify society...mathematics education becomes responsible for the country's economic growth." Similarly, Jojo (2019) describes the dire need for mathematical knowledge and skills to survive and thrive in the so-called Fourth Industrial Revolution (4IR). According to him, learner performance in mathematics at school determines to a large extent access to jobs as well as further and higher education studies in a range of areas, including natural and physical sciences, economics, and technology. In this sense mathematics can be regarded as a gateway subject for admission to study for a large number of high-status, scarce professions that are critical for a flourishing economy (Spaul, 2013).

The reasons for poor performance in mathematics are wide-ranging and varied. While cognitive factors (intelligence) are essential in learning mathematics, Justicia-Galiano, Martín-Puga, Linares and Pelegrina (2017) argue that, on average, more than half of the academic achievement variance in

mathematics can be explained by affective variables. Many learners show little interest in mathematics, have lower perceptions of their mathematics skills, and consider mathematics a difficult subject that generates anxiety (Organization for Economic Cooperation and Development [OECD], 2013). Learners with 'mathematics anxiety' tend to avoid math tasks, show less persistence when it comes to math-related tasks and continue to have lower expectations about their own math performance (Justicia-Galiano et al., 2017).

Several researchers (Hafiz & Dahlan, 2017; Johnston-Wilder & Lee, 2011; Pieronkiewicz & Szczygiel, 2020) are of the opinion that fostering mathematical resilience in learners will contribute significantly to counteract anxiety, feelings of failure and lack of motivation. Johnston-Wilde, Lee, Garton, Goodlad and Brindley (2014) define resilience as learners' ability to deal with various difficult situations they find themselves in during their schooling career, which normally affect them very negatively - especially in their academic performance. By implication, learners developing mathematical resilience will have a better chance to succeed than their counterparts who lack this ability. Although a body of research on resilience in learners is available, we could not find studies that focuses on mathematical resilience which accounted for the views and challenges of learners themselves. In light of the above discussion, the main research question that guided the study has been formulated as follows:

*Which factors cause mathematical anxiety in Grade 7 learners and how, in their view, can mathematical resilience be fostered?*

## 2. The research design and methodology

A qualitative and contextual approach was used, mainly inductive, and which provided a clear understanding of the participants' views and capturing their perceptions in their own words (cf. Babbie 2015). A phenomenological design was used as the strategy of inquiry. The design involved both an interpretive perspective, primarily concerned with meaning, and a constructivist perspective, focusing on the feelings and beliefs of the participants. Twenty-four Grade 7 learners from three purposefully selected primary schools in an Education District in South Africa volunteered to participate in the study. These included African learners from a township school (a township is a poverty-stricken geographical area for black South Africans which was established during the *apartheid* years pre-1994); learners from a rural school, whose parents were farm workers in the area, and learners from a formerly all-white school, consisting of mixed races, situated in an upper-middle class community in an urban area.

Three focus group discussions were held, (one focus group per school) lasting approximately one hour each. Ethical guidelines included obtaining consent from the local Department of Education, the principals of the school, and parental consent from the participants' parents. This was done after all have been informed of the purpose of the study, the procedures to be followed, the risks, benefits, alternative procedures, and the measures implemented to ensure confidentiality (cf. Creswell & Creswell, 2015; Johnson & Christensen, 2011). During data analysis, the process of *in vivo* coding was followed, in which the same codes were reapplied to similar segments of the data. The data were then structured by categorising the codes and identifying the main themes to which the data were interpreted.

## 3. Findings and discussion

The learners surprised us with their unfeigned observations, candid descriptions and unapologetic views about what they believed their teachers' missteps. They generally accepted that resilience is within reach of every individual and agreed that people are not born with resilience, but rather, that resilience *develops with time and effort*.

*It means you conquer your fears, overcome things, self-independent.*" (BL2-F)

*"Because if you are being negative the whole time, you are giving your mind a mental block to say that you are not capable to do something."* (BL1-F)

*"If one can tell him/herself that no one can perform better than him/her, then no one will. You are going to be encouraged all the time by saying, 'I know now that there is no one who can outperform me'. When the teacher asks questions, you are the one to answer always."* (CL4-M)

A few learners relayed their personal experiences with adversity and how they took a conscious decision to overcome their obstacles.

*"I was shy. Always cried. You know? And then when I arrived at primary I was bullied. And then, after that, you know, I decided to stand up for myself because it does not help being the girl behind doors, being shy and everything. I taught myself. I saw other people stand up for themselves, so I also decided to do the same for myself."* (BL2-F)

Consistent with literature, participants generally – to a varied extent - found mathematics problematic and difficult to master. From the focus group discussions *teacher factors* emerged as the most important influence on learners' morale and their attitude towards mathematics. It is thus not surprising that Maluleke (2019) maintains that mathematics is one of the most poorly taught, disliked and misunderstood subjects in South Africa. As a result, the persistent low learner performance has piqued interest in determining how teacher traits and pedagogical techniques impact attitudes toward mathematics. Four broad areas related to teacher factors came to the fore, namely teachers' antagonistic attitude towards struggling learners; making derogatory and humiliating remarks; the importance of a relaxed and learner friendly classroom environment; and teachers' tendency to give stronger learners preferential treatment.

The wide-ranging accounts of participant learners who experienced explicit *antagonism* from their teachers were a concern. This antagonism manifested in the form of unfavourable and critical remarks which influenced learner morale and which had a distinctly negative effect on fostering resilient behaviour.

*"Sometime the teacher discourages learners when they are trying in the classroom. They tell us mean words or discouraging words. You struggle to have that confidence even when you wanted to ask something or give an answer, he/she will make a joke out of you."* (BL1-F)

This resulted in some learners withdrawing as they were too afraid to ask questions for fear of reproach or embarrassment. Poor-performing learners are admittedly those who are disobedient and tend to behave badly - something that can be very discouraging and difficult for teachers to handle, especially when faced with overcrowded classes. However, teachers may never fall victim to their own frustrations and challenges to the extent that learners are forced into submission or humiliated.

*The teacher chooses only those learners that are clever so that they can give the correct answers. When one of [the] other learners raises a hand to answer, they always say, 'Oh no! You know that you are going to give an incorrect answer' and then they will not choose him, they will rather choose someone else."* (CL1-M)

Participants were vocal about what they referred to as "a free environment" to be able to enjoy mathematics. Learners valued a *positive and learner-friendly classroom* environment that is conducive to learning. They were adamant that it was not possible to enjoy mathematics in a restricted and undesirable learning environment. They wanted to learn in a setting where the teacher makes jokes and allow for meaningful and congenial interaction – this is where a teacher's pedagogical knowledge is important.

*"You get teachers who teach and make jokes and make you laugh and enjoy the lesson. And I would say the...the marks are kind of your environment. So, if you are in an environment that is closed [restrictive] and you cannot do anything, then your marks are even lower. Some teachers do not want learners to have fun or enjoy their classroom session... instead learners are being intimidated and get punished."* (BL1-M)

A strong pedagogical foundation is needed to create an inviting and friendly learning environment. Learners were further critical of some teachers' lack of effective and fair learner behaviour management methods and teachers' tendency to punish the entire class when individual learners overstepped. Another major complaint was the *preferential treatment of performing learners*, which created divisions along performance lines and signalled that the non-performing learners were inferior and not valued.

*The teacher chooses only those learners that are clever so that they can give the correct answers. When one of [the] other learners raises a hand to answer, they always say, 'Oh no! You know that you are going to give an incorrect answer' and then they will not choose him, they will rather choose someone else."* (CL1-M)

A serious complaint was teachers' disinclination to *explain content* sufficiently. Some teachers were accused of impatience and being inapproachable and, as a result, learners refrained from asking clarity-seeking questions.

*"Teachers are the ones that sometimes make learner to believe that they are stupid, or they don't know anything....when they think that you're stupid and you know nothing, even when you know an answer, they will not choose you to answer because they believe that you are going to say incorrect answer."* (CL1-M)

A related complaint was that *instructional methods* were predictable and 'boring' and that learners' differing needs were not catered for. The learners were in favour of a variety of instructional methods and strategies. An important complaint was teachers' inability, or disinclination, to explain new content sufficiently.

*“Sometimes the teachers are failing learners because they don’t make any extra efforts to lay a good foundation on explaining some content and they become very offended when learners try to ask some clarity questions and learners end up being afraid to ask questions even if they don’t understand the context.” (BL1-F)*

Several studies found that mathematics teachers' 'Content Knowledge (CK) was lacking, as was their inability to *explain* content adequately (Pedagogical Content Knowledge - PCK). As can be expected, a teacher with insufficient CK will not be able to explain new content satisfactorily, however, many teachers with sufficient CK do not necessarily know how to skillfully *explain* such content (PCK).

*“Every learner can learn but not in the same way, we have different learning styles and that is very important. We are not all the same. Don’t do it the same way...every day...every day..it is so boring! I don’t like it.” (BL2-M)*

*“Some other people, when they get something incorrect, [the teacher] might think that they do not know anything but if they [teachers] sit down with them [learners] and explain in detail, they normally understand it better.....even if they did not understand at the beginning.” (CL1-M)*

Importantly, Siachifuwe (2017) confirms that teachers are the facilitators of the learning process and as such, they have a unique role in that they are managers, architects and engineers of the pedagogy. This implies that a competent teacher who can teach mathematics in a resilient manner will realise that there is no one fixed way of teaching all content. This is where PK is crucial - understanding different methods and strategies of teaching that allows teachers to continually develop and refine their own practices. Likewise, PCK will enable teachers to implement a variety of creative and proven instructional methods, resources and strategies when teaching mathematics.

Meador (2020) argues that parents are the most influential people in every aspect of a child’s life, especially when it comes to their children’s education. If the parents value education, it enhances resilience and academic success in their children (ibid., 2020). Boonk, Ritzen, & Brand-Gruwel (2018, p. 10-12) found that home-based involvement positively correlated with academic achievement, especially in cases where parents communicate with their child on school issues and regularly have motivating talks with them on the benefits of mathematics.

Participants’ experiences of their *parents’ involvement* varied between positive encouragement, undue pressure and negative input. The following reactions showed evidence of valuing achievement, academic encouragement and reinforcing schoolwork at home:

*“My mother used to tell me that, she does not want me to be like her, but she wants me to be better than her. She encourages me to know better than her, especially mathematics.” (CL4-M)*

There was some negative reinforcement as well:

*“My parents also tell us and they also tell us sometimes like our older siblings, our older cousins, when we tell them about how hard Grade 7 is, they’ll be like, that is nothing, wait until you get to high school! They do not understand we are not in high school yet. We are NOT in high school yet!” (BL3-F)*

Learners reported challenges with *mathematics terminology* and struggled to master the mathematics register. This impeded content understanding and created confusion.

*There are some difficult words that need to be explained in Sesotho. Sometimes a person knows those words but sometimes when it is said in a different terminology, it becomes so difficult to understand. We will understand if the teachers teach in English and then explains in Sesotho.” (CL3-M)*

Sufficient language or vocabulary to build a solid mathematics foundation is crucial for understanding mathematics content. Some learners were in favour of a bilingual model of instruction, in which the mother tongue and the LoLT are used alongside each other to facilitate understanding. Most Sesotho learners preferred code-switching between English and Sesotho, however this would exclude learners from other language groups. Predictably, most learners from homes where both English and African languages were used, were in favour of English as the LoLT. All learners regarded English proficiency as important for their future studies and careers.

#### 4. Summary and conclusion

The overall aim of this study was to explore the phenomenon of mathematical resilience as seen from the perspectives of Grade 7 learners and their views on how mathematical resilience could be nurtured. From findings in this study several proposed measures or changes that could help to alleviate the problems presented by poor mathematics performance and negative mindsets were offered. We are fully aware that there is no ‘quick fix’ in dealing with any burning issue in mathematics education, but we believe that if policy makers and teachers take note of learners’ concerns and wishes, much strides could be made in nurturing resilience and fostering a positive mindset towards mathematics.



## References

- Babbie, E. R. (2020). *The practice of social research*. Cengage learning.
- Betiku, O. F. (1999). Resources for the effective implementation of the 2-and 3-dimensional mathematics topics at the junior and senior secondary school levels in the Federal Capital Territory, Abuja. *Nigerian Journal of Curriculum Studies*, 6(2), 49-52.
- Creswell, J. W., & Creswell, J. D. (2015). *Research design: Qualitative, quantitative, and mixed methods approach*. Sage publication.
- Hafiz, M., & Dahlan J.M. (2017). Comparison of mathematical resilience among students with problem based learning and guided discovery learning model. *Journal of Physics: Conference Series*, 895, International Conference on Mathematics and Science Education (ICMScE) 24 May 2017, Bandung, Indonesia.
- Johnson, B., & Christensen, L. (2012). *Educational research: Quantitative, qualitative, and mixed approaches*. (4<sup>th</sup> ed.). Thousand Oaks, CA: Sage Publications.
- Justicia-Galiano, M. J., Martín-Puga, M. E., Linares, R., & Pelegrina, S. (2017). Math anxiety and math performance in children: The mediating roles of working memory and math self-concept. *British Journal of Educational Psychology*, 87(4), 573-589.
- Makgato, M. (2007). Factors associated with poor performance of learners in mathematics and physical science in secondary schools in Soshanguve, South Africa. *Africa Education Review*, 4(1), 89-103.
- Organisation for Economic Co-operation and Development. (2013). *OECD skills outlook 2013: First results from the survey of adult skills*. Paris: OECD Publishing.
- Pieronkiewicz, B., & Szczygieł, M. (2020) How can parents and elementary school teachers promote resilience in young children through mathematical conversations? *Early Child Development and Care*, (10), 1604-1618, DOI: 10.1080/03004430.2019.1647189
- Spaull, N. (2013). South Africa's education crisis: The quality of education in South Africa 1994-2011. *Johannesburg: Centre for Development and Enterprise*, 21(1), 1-65.

# CODING FOR CHILDREN – A WAY TO FULFILL THE AIMS OF THE OECD LEARNING COMPASS 2030?

**Olaf Herden**

*Department of Computer Science, Baden-Wuerttemberg Cooperative State University (Germany)*

## Abstract

In recent years two kind of publications were observable: On the one hand, there were many contributions arguing why every child should learn to code. Beside fascinating and motivating children for STEM (Science Technology Engineering Mathematics) topics and giving a good career preparation, coding also can strengthen general skills like e.g. resilience, creativity and organization. On the other hand, there exist several publications by the OECD (Organization for Economic Co-operation and Development) describing future skills for children as well as issues of future education and work. Particularly the OECD has developed the “OECD Learning Compass 2030”. This work is divided into several concepts. Each concept describes different skills being relevant for the children future.

In this contribution, we want to compare, contrast and merge these two fields of publications. Therefore, we examine an extensive literature review and give an overview about skills that can be imparted by teaching children to code. Then we take a look at OECD’s compass and general skills. Therefore, we analyze the publications of OECD and apply text extraction to get relevant keywords of skills. Subsequently, we compare the coding skills with the OECD skills and look which aspects of the OECD compass can be fulfilled by teaching to code.

As a result, we can note that attaining many of the OECD future skills can be supported by teaching children to code. We also have identified which skills cannot covered by coding resp. which additional benefits knowledge in coding offers.

The paper concludes with a summary and an outlook. Future tasks are, e.g. examine at which age children should start learning to code, which are appropriate ways to teach and learn coding or concerning the question whether coding education should be realized as an one-size-fits-all approach or by applying internal differentiation.

**Keywords:** *Children, coding, future skills, OECD learning compass.*

---

## 1. Introduction

In recent years two kind of publications were observable: On the one hand, there were many contributions arguing why every child should learn to code. Beside fascinating and motivating children for STEM (Science Technology Engineering Mathematics) topics and giving a good career preparation, coding also can strengthen general skills like e.g. resilience, creativity and organization. On the other hand, there exist several publications by the OECD (Organization for Economic Co-operation and Development) describing future skills for children as well as issues of future education and work. Particularly the OECD has developed the “OECD Learning Compass 2030”.

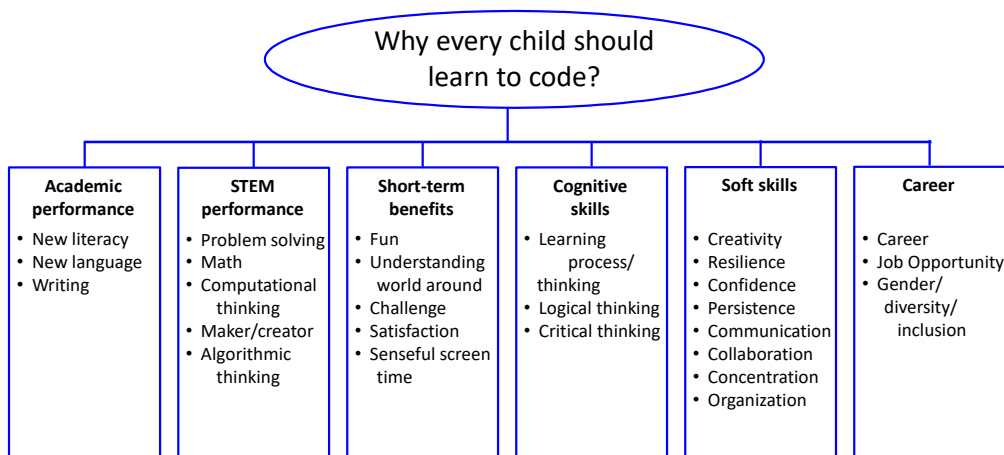
In this contribution, we want to compare, contrast and merge these two fields of publications. We want to show, which aspects of the OECD compass can be fulfilled by teaching to code and vice versa.

The reminder of the paper is organized as follows: section 2 describes the relevant literature and defines the objective. In section 3 we describe our process and the results. The paper concludes with a summary and an outlook in section 4.

## 2. Related work and objective

In recent years there were many publications about coding for children, as well in the scientific community (e.g. Mannova, 2022; Damla Kalyenci et al., 2022) as in internet blogs, newspapers and magazines. In Herden, 2022, we have read and analyzed many of these sources and summarized the reasons why children should learn to code. The result is depicted in figure 1.

Figure 1. Reasons why children should learn to code.



We have found 27 reasons and clustered them into the six groups academic performance, STEM performance, short-term benefits, cognitive skills, soft skills and career. Each reason and its relevance for learning to code is defined and described in Herden, 2022.

The OECD (OECD, 2019a) published its learning compass 2030. The learning compass is a framework for future education systems. The OECD chooses the metaphor compass for the framework helping students to orient themselves and navigate through uncertainty towards well-being for themselves, their community and the society. An important design principle of the compass is to describe skills, values and competencies on an abstract level, the concrete implementation and interpretation should be realized in certain countries. So, the learning compass neither is a curriculum, moreover the usage is that countries take the compass as guideline for future curricula or check their current curricula against the aims of the learning compass.

The learning compass is divided into several concepts. Each concept describes different aspects and skills being relevant for the children future:

- The "Learning Compass 2030" (OECD, 2019b) gives a general overview of the documents.
- The concept of student agency (OECD, 2019c) is the core idea of the framework. It is rooted in the principle that students have the ability and the will to positively influence their own lives and the world around them. Student agency is thus defined as the capacity to set a goal, reflect and act responsibly to effect change.
- The three "Transformative Competencies" (OECD, 2019d) that students need for acting and designing the future are creating new value, reconciling tensions and dilemmas and taking responsibility.
- The "Core Foundations" (OECD, 2019e) are the fundamental conditions and core skills, knowledge, attitudes and values that are prerequisites for further learning across the entire curriculum.
- "Knowledge for 2030" (OECD, 2019f) are theoretical concepts and ideas as well as practical understanding and application. This knowledge is split into the four types disciplinary, interdisciplinary, epistemic and procedural knowledge.
- "Skills for 2030" (OECD, 2019g) describes some operative issues to translate ideas and knowledge into practice.
- For getting competencies besides knowledge and skills "Attitudes and Values" (OECD, 2019h) are also important.
- The "Anticipation-Action-Reflection" (AAR) (OECD, 2019i) cycle is an iterative learning process linked with the idea of continuous improvement of thinking and acting.

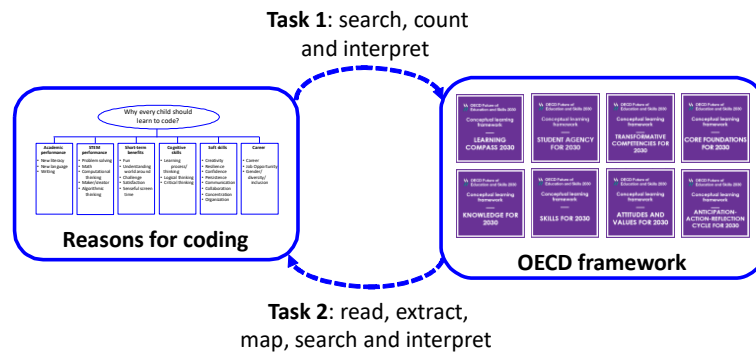
The objective of this contribution is to compare, contrast and merge these two publications.

### 3. Comparing coding skills and the OECD compass

In this section we want to compare the reasons for coding with the OECD documents. This comparison is executed by the following tasks:

- Task 1: Every reason from Herden, 2022, is taken for a full text search in the OECD publications, we document the number of occurrence, distributed to each document. Finally, we give an interpretation of matching and missing entries.
  - Task 2: By reading and analyzing the OECD documents we extract skills from them. We now look into the other direction by checking whether a detected skill is in Herden, 2022, or not. Here, we search for the extracted terms directly as well as mapped items to handle synonyms etc.
- The tasks are summarized in figure 2.

Figure 2. Analyzed documents and tasks.



### 3.1. Task 1: Checking OECD publications for reasons

In this step, we take a look which of the reasons for children coding occur in the OECD framework. Therefore, for every reason we apply a full text search in each OECD document. The hits were postprocessed and some of them removed because they were duplicates or the same term occurred many times in the same context. We counted the reminding occurrences; the result is depicted in figure 3.

We can see that all groups of coding reasons are in the OECD documents, too. More in detail, 17 of 27 reasons were (directly or after mapping) found in the OECD documents, which is a fulfillment rate of 63%. Most hits got the reason groups STEM performance, cognitive skills and soft skills. The distribution over the parts of the OECD documents is not equally, most reasons were found in the four documents “Transformative Competencies”, “Core Foundations”, “Skills” and “Attitudes and Values”.

The explanation for reasons not found in the OECD documents are manifold. For example, the rare occurrence of short-term benefits and the reasons career and job opportunity can be explained by the fact that these are operative items while the OECD compass focus on more general, strategic aims. On the other hand, computational thinking, algorithmic thinking and maker/creator are specific to coding at first glance but they important general future skills indeed (Wing, 2006). It seems that these aspects are underestimated in the OECD framework.

As a conclusion, we can record that coding reasons are important future skills.

Figure 3. Reasons for coding: occurrence in OECD framework.

	Learning Compass	Student Agency	Transformative Competencies	Core Foundations	Knowledge	Skills	Attitudes & Values	AAR	Total
Academic performance	0	0	1	6	1	2	2	0	12
STEM performance	0	2	4	6	7	5	2	0	26
Short-term Benefits	2	1	2	2	1	0	1	1	10
Cognitive skills	1	3	3	1	1	7	3	6	25
Soft skills	2	5	9	8	3	8	5	1	41
Career	2	0	2	0	2	0	7	0	13
<b>Total</b>	<b>7</b>	<b>11</b>	<b>21</b>	<b>23</b>	<b>15</b>	<b>22</b>	<b>20</b>	<b>8</b>	<b>127</b>

### 3.2. Task 2: Extracting skills from OECD publications

In this step, we want to examine which skills and competencies in the OECD documents can be reached by coding. Therefore, the OECD documents were read carefully and 136 skills were extracted. After reading we applied a postprocessing by mapping some terms to handle e.g. synonyms. 26 items had the same text and 68 after a textual mapping, the reminding 42 entries were not applicable.

The distribution of the found skills in the OECD documents and the distribution of their mapping to the coding skills is shown in figure 4.

Figure 4. Sills in OECD documents: occurrence in coding reasons.

	Total	Academic Performance	STEM performance	Short-term benefits	Cognitive skills	Soft skills	Career	Not
Learning Compass	0	0	0	0	0	0	0	0
Student Agency	6	0	0	0	0	2	0	4
Transformative Competencies	33	0	1	0	9	17	0	6
Core Foundations	20	4	1	1	4	3	0	7
Knowledge for 2030	18	1	3	0	3	3	0	8
Skills for 2030	33	1	3	0	7	8	1	13
Attitudes and Values for 2030	26	0	3	0	1	16	2	4
AAR Cycle	0	0	0	0	0	0	0	0
<b>Total</b>	<b>136</b>	<b>6</b>	<b>11</b>	<b>1</b>	<b>24</b>	<b>49</b>	<b>3</b>	<b>42</b>

As a result, the majority of extracted entries (69%) can be fulfilled by coding. The highest degrees of fulfillment are in the documents “Transformative Competencies” (82%) and “Attitudes and Values for 2030” (85%). The extracted entries are unequally distributed over the reason groups, most of them were found in the group soft skills. Some extracted skills do not occur in the coding skills, especially social emotional skills like empathy or sense of belonging.

As a result, we can say that many general skills from OECD documents can be supported by learning to code.

## 4. Summary and outlook

In this contribution we have compared publications about reasons why children should learn to code with the OECD learning compass. We applied this comparison by looking in both directions. As a result, we can record that there is a large overlapping in both directions. On the one hand, many of the reasons for coding can be detected in the OECD compass. On the other hand, many of the skills and competencies in the OECD compass can be fostered or fulfilled by coding skills. During the second task, we have found many general future skills that can be fostered by coding. In both tasks there remained reasons/skills that were not found. This is due to different reasons which we have mentioned above.

As future work different questions have to be tackled, e.g. examining which is the best age to start with coding or the question which tools are best depending on the child’s age.

## References

- Damla Kalyenci, D., Metin, S., & Basaran, M. (2022). Test for assessing coding skills in early childhood. *Education and Information Technologies* (2022) 27, 4685-4708 doi: 10.1007/s10639-021-10803-w
- Herden, O. (2022). Why every child should learn to code. *Proceedings of the 14th International Conference on Education and New Learning Technologies (EDULEARN22)*, Palma (Spain), IATED, 9782-9789. doi:10.21125/edulearn.2022.2354
- Mannova, B. (2022). Teaching Coding in Schools. *Proceedings of the 14th International Conference on Education and New Learning Technologies (EDULEARN22)*, Palma (Spain), IATED, 5961-5967. doi:10.21125/edulearn.2022.1399
- OECD. (2019a). OECD Future of Education and Skills 2030. Retrieved from <https://www.oecd.org/education/2030-project/teaching-and-learning/learning/>
- OECD. (2019b). Conceptual learning framework - LEARNING COMPASS 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/OECD\\_Learning\\_Compass\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/OECD_Learning_Compass_2030_concept_note.pdf)
- OECD. (2019c). Conceptual learning framework - STUDENT AGENCY FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/student-agency/Student\\_Agency\\_for\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/student-agency/Student_Agency_for_2030_concept_note.pdf)
- OECD. (2019d). Conceptual learning framework - TRANSFORMATIVE COMPETENCIES FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/transformative-competencies/Transformative\\_Competencies\\_for\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/transformative-competencies/Transformative_Competencies_for_2030_concept_note.pdf)
- OECD. (2019e). Conceptual learning framework - CORE FOUNDATIONS FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/core-foundations/Core\\_Foundations\\_for\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/core-foundations/Core_Foundations_for_2030_concept_note.pdf)
- OECD. (2019f). Conceptual learning framework - KNOWLEDGE FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/knowledge/Knowledge\\_for\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/knowledge/Knowledge_for_2030_concept_note.pdf)
- OECD. (2019g). Conceptual learning framework - SKILLS FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/skills/Skills\\_for\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/skills/Skills_for_2030_concept_note.pdf)
- OECD. (2019h). Conceptual learning framework - ATTITUDES AND VALUES FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/attitudes-and-values/Attitudes\\_and\\_Values\\_for\\_2030\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/attitudes-and-values/Attitudes_and_Values_for_2030_concept_note.pdf)
- OECD. (2019i). Conceptual learning framework - ANTICIPATION-ACTION-REFLECTION CYCLE FOR 2030. Retrieved from [https://www.oecd.org/education/2030-project/teaching-and-learning/learning/aar-cycle/AAR\\_Cycle\\_concept\\_note.pdf](https://www.oecd.org/education/2030-project/teaching-and-learning/learning/aar-cycle/AAR_Cycle_concept_note.pdf)
- Wing, J. M. (2006). Computational thinking. *Communications of the ACM* (2006) 49(3):33–25. doi: 10.1145/1118178.1118215

## MONITORING ORAL READING FLUENCY IN ELEMENTARY SCHOOL I

**Maíra Anelli Martins<sup>1</sup>, Noemi Del Bianco<sup>2</sup>, Ilària D'Angelo<sup>2</sup>, Catia Giaconi<sup>2</sup>,  
& Simone Aparecida Capellini<sup>1</sup>**

<sup>1</sup>*Investigation Learning Disabilities Laboratory (LIDA), Department of Speech and Hearing Sciences,  
São Paulo State University "Júlio de Mesquita Filho" (UNESP) (Brazil)*

<sup>2</sup>*Dipartimento di Scienze della Formazione, dei Beni Culturali e del Turismo,  
Università degli Studi di Macerata (UNIMC) (Italia)*

### Abstract

*Introduction:* Assessment measures of oral reading fluency can be applied by teachers or education professionals and help to provide an overview of the academic development in reading of each student; and when these simple measures are systematically applied over time, they can be used to track a student's possible difficulties. *Aim:* This study aimed to monitor the development of oral reading fluency in students from the 2nd to the 5th grade of Elementary School I during the school year. *Method:* This study was approved by the research ethics committee (09575419.0.0000.5406) of the home institution. The study included 400 students from the 2nd to the 5th grade of Elementary School I from a municipal public school in the interior of the State of São Paulo, aged from 7 years to 10 years and 11 months. The Performance Assessment in Reading Fluency was applied. Reading fluency measures were performed by collecting oral reading of three texts of the same textual complexity in the months of March, July and November. For the analysis of each text, the analysis parameters of the types of errors made during reading were used, referring to words read correctly and incorrectly per minute. *Results:* The results were statistically analyzed using the Statistical Package for Social Sciences, version 22.0, with a significance level of 5% (0.050). With the application of the Wilcoxon Signed Rank Test, it was possible to verify that there was a statistically significant difference in the groups of this study both for the total number of words read correctly in one minute and the total number of words read incorrectly between the third moment of the fluency measure in comparison with the first moment. With the application of the Mann-Whitney Test, it was possible to verify that there was a statistically significant difference, indicating that the groups had a lower number of words read correctly per minute in the first reading measure compared to the second and third measures. This same finding was found in the reading of misspelled words per minute. *Conclusion:* The results of this study allowed monitoring and accompanying in a simple, reliable and valid way, the progressive development of oral reading fluency, evidenced by the increase in the number of words read correctly and the decrease in the number of errors from the 2nd to the 5th grade of Elementary School I.

**Keywords:** *Oral reading fluency, measurement, screening, progress monitoring, assessment.*

---

### 1. Introduction

Oral reading fluency is a multidimensional construct with a three-factor structure (automaticity, accuracy and prosody) (Kim, Quinn, & Petscher, 2021). When the student acquires or improves his skills with the automatic decoding of words, becoming a fluent reader, he simultaneously releases attention and memory resources to use higher-order reading functions (Rasinski et al., 2017). For this reason, both assessment and intervention with reading fluency have been continuously studied by researchers (Bigozzi, Tarchi, Vagnoli, Valente, & Pinto, 2017; Kostewicz, Kubina, Selfridge, & Gallagher, 2016; Makebo Bachore, & Ayele, 2022).

Through oral reading fluency assessment measures, according to the literature (Hasbrouck & Tindal, 2006; 2017), this assessment can be used in different ways; the first (complicated by the small number of studies with Brazilian students who bring regulations to the population of other regions of the country; in addition to the lack of appropriate material), it would be based on the performance levels of the students, that is, based on short evaluations, comparing them with each other, thus obtaining a screening measure, an assessment focused on predicting the development and growth of reading skills (Alves et al., 2021; Pereira et al., 2021), which could determine whether a student would need support in reading (extra help or alternative forms of instruction), which would contribute to the early identification of students at risk of reading difficulties (Arnesen et al., 2017).

The second way to carry out the work with the students would be to observe the development of reading fluency with themselves over time and compare it to the class group. This second way of using oral reading fluency has been called a performance monitoring measure (Furey & Loftus-Rattan, 2022). Monitoring measures can be collected three times in the school year; they are short, individually administered assessments (typically 1 to 3 minutes in duration) that provide information on students' ongoing performance in reading fluency.

Thus, studies that assess reading fluency at the beginning of the school year and its growth throughout this year are critical. As few studies on oral reading fluency have been adapted as a screening and monitoring method in Brazil, this research is highly urgent. Furthermore, the need for psychometric validation of the screening measures concerns other researchers who are experts in reading fluency. While examining student progress over time is crucial, progress monitoring needs to be integrated into national reading assessments or broader reading tests.

## 2. Aim

This study aimed to monitor the development of oral reading fluency in students from the 2nd to the 5th grade of Elementary School I during the school year.

## 3. Methods

### 3.1. Participants

This study was approved by the home institution's research ethics committee (09575419.0.0000.5406). The study included 400 students from the 2nd to the 5th grade of Elementary School I from a municipal public school (in a medium- and a small-sized Brazilian city, Southeast Region of Brazil) in the interior of the State of São Paulo, aged from 7 years to 10 years and 11 months. The schools were selected through convenience sampling (simple convenience sample). The students participating in the studies did not have a history of repeating grades; they were monolinguals and native speakers of Brazilian Portuguese.

The inclusion criteria for the sample selection were as follows: informed consent form signed by the parents or guardians for the students; students with no history of neurological or psychiatric illnesses, uncorrected auditory and visual impairments, and cognitive performance within normal, according to the description at the school records and teachers' reports. The exclusion criteria for the sample selection were the presence of genetic or neurological syndromes in the students and students who did not present a satisfactory reading domain level for observing the variable proposed in the study.

### 3.2. Materials and procedures

The Performance Assessment in Reading Fluency was applied (Martins & Capellini, 2018). This procedure assessed reading fluency based on the number of words read correctly per minute. The instrument presents 70 passages (narrative and expository), with the word count, presented progressively per line to facilitate the evaluation, with passages that contain 64 to 194 words.

Initially, the passages were designed for students from the 1st to the 4th grade. However, a readjustment was necessary since most Brazilian students are not readers in the 1st year. The collection was restructured to be used as an assessment from the 2nd to the 5th grade when the first cycle of education in Brazil ends.

A study of the complexity of the passages was conducted and based on the fluency of oral reading; they were sequenced from the easiest to the more difficult passages since there is a range of criticisms for research that only uses readability formulas for selecting equivalent level probes (Ardoin, Suldo, Witt, Aldrich, & McDonald, 2005; Begeny & Greene, 2014). After this classification, a statistical analysis was conducted to categorise the passages by quartile to group the most similar texts. The averages of the passages were analyzed by quartile distribution and categorized into: low (< first quartile - Q1), regular (between the first and third - Q1 and third quartile - Q3), and high (> than the third quartile Q3). The normal distribution was verified using the Shapiro-Wilk test with Lillifor correction. Comparison between performance categories was performed using ANOVA for repeated measures and post hoc comparisons using the Bonferroni test. The significance level adopted was 5%. Data were analyzed using SPSS software, version 19.0 for Windows. Thus, sets of three passages were selected for each time of the year (beginning, middle and end) for each grade.

Reading fluency measures were performed by collecting oral readings of three passages with the closest possible textual complexity in March, July and November. For the analysis of each passage, the analysis parameters of the errors made during reading were used, referring to words read correctly and incorrectly per minute.

In this approach, the types of errors that are marked as WIPM are mispronounced words, words substituted with others, words omitted, words read out of order, addition or omission of word endings,



and hesitation (words on which the student paused more than 3 seconds, after which they are told the word, and it is marked as incorrect. If necessary, the student is said to continue with the following word (Martins & Capellini, 2018). The following items indicate all situations that are marked as WCPM: words pronounced correctly, self-corrections, words decoded slowly but ultimately read correctly, repeated words, words mispronounced due to dialect or regional differences, and words inserted. To quantify errors, scoring rules are also proposed for certain situations: lines or multiple words omitted; when one or more lines are not read (four or more omitted words in sequence), they are not considered errors, although those words are excluded from the WCPM (such that this rule is applied whenever a student skips four or more words within a sentence). If the student skips one, two, or three consecutive words, each word should be counted as an error (WIPM) (Martins & Capellini, 2018).

The Mann-Whitney Test was applied to verify possible differences between the three times of the year – March (beginning), July (middle) and November (end) for the WCPM and WIPM variables in each grade. After applying the Mann-Whitney Test, as statistical differences were found, the Wilcoxon Signed Rank Test was applied to identify which time of year variables (beginning, middle and end) differ when comparing two to two. The results were statistically analyzed using the Statistical Package for Social Sciences, version 22.0, with a significance level of 5% (0.050).

#### 4. Results

With the application of the Mann-Whitney Test, it was possible to verify that there was a statistically significant difference, indicating that the groups had a lower number of words read correctly per minute (WCPM) in the first reading measure compared to the second and third measures (see Table 1). This finding was also found in words read incorrectly per minute (WIPM), indicating that the number of errors decreased throughout the school year (see Table 2).

Table 1. Comparison of WCPM measures in 3 moments of the school year.

	WCPM	n	Average	SD	Min	Max	Percentile 25	Percentile 50	Percentile 75	Sig. (p)
2 <sup>nd</sup> grade	beginning of the year	100	16.89	4.13	7.00	30.00	14.00	17.00	20.00	< 0.001*
	middle of the year		23.38	4.94	9.00	32.00	21.00	24.00	27.00	
	end of year		27.14	5.91	10.00	37.00	24.00	28.00	31.00	
3 <sup>rd</sup> grade	beginning of the year	100	44.01	7.45	34.00	68.00	39.00	42.00	48.00	< 0.001*
	middle of the year		49.75	7.39	36.00	73.00	44.25	49.00	55.00	
	end of year		54.29	6.80	36.00	69.00	49.25	55.00	59.00	
4 <sup>th</sup> grade	beginning of the year	100	58.04	3.04	50.00	68.00	56.00	58.50	60.00	< 0.001*
	middle of the year		62.57	3.89	53.00	70.00	60.00	62.50	65.00	
	end of year		66.04	3.97	53.00	72.00	62.25	67.50	69.00	
5 <sup>th</sup> grade	beginning of the year	100	62.34	4.74	54.00	71.00	58.25	62.00	67.00	< 0.001*
	middle of the year		64.30	4.60	56.00	72.00	60.00	64.00	68.75	
	end of year		71.02	5.08	58.00	79.00	68.00	71.00	75.00	

\* Statistically significant difference

Table 2. Text Comparison of WIPM measures in 3 moments of the school year.

	WIPM	n	Average	SD	Min	Max	Percentile 25	Percentile 50	Percentile 75	Sig. (p)
2 <sup>nd</sup> grade	beginning of the year	100	5.57	2.20	2.00	10.00	4.00	5.00	7.00	< 0.001*
	middle of the year		3.45	2.07	0.00	9.00	2.00	3.00	4.75	
	end of year		2.64	2.04	0.00	10.00	1.00	2.00	4.00	
3 <sup>rd</sup> grade	beginning of the year	100	1.07	1.51	0.00	7.00	0.00	1.00	1.75	0.005*
	middle of the year		0.84	1.26	0.00	8.00	0.00	0.50	1.00	
	end of year		0.62	0.91	0.00	5.00	0.00	0.00	1.00	
4 <sup>th</sup> grade	beginning of the year	100	0.71	1.31	0.00	5.00	0.00	0.00	1.00	< 0.001*
	middle of the year		0.29	0.62	0.00	3.00	0.00	0.00	0.00	
	end of year		0.07	0.26	0.00	1.00	0.00	0.00	0.00	
5 <sup>th</sup> grade	beginning of the year	100	0.21	0.48	0.00	2.00	0.00	0.00	0.00	< 0.001*
	middle of the year		0.08	0.27	0.00	1.00	0.00	0.00	0.00	
	end of year		0.00	0.00	0.00	0.00	0.00	0.00	0.00	

\* Statistically significant difference

With the application of the Wilcoxon Signed Rank Test, it was possible to verify that there was a statistically significant difference in the groups of this study both for the total number of words read correctly in one minute and the total number of words read incorrectly between the third moment of the fluency measure in comparison with the first moment when compared to peers, as can be seen in Table 3.

Table 3. Comparison between pairs of reading measures at three times of the school year.

		2nd grade	3rd grade	4th grade	5th grade
WCPM and WIPM	Time of year	Sig. (p)	Sig. (p)	Sig. (p)	Sig. (p)
WCPM	middle X beginning	< 0.001*	< 0.001*	< 0.001*	< 0.001*
	end X beginning	< 0.001*	< 0.001*	< 0.001*	< 0.001*
	end X middle	< 0.001*	< 0.001*	< 0.001*	< 0.001*
WIPM	middle X beginning	< 0.001*	0.033	< 0.001*	0.009*
	end X beginning	< 0.001*	0.001	< 0.001*	< 0.001*
	end X middle	< 0.001*	0.009	0.001*	0.005*

\* Statistically significant difference

## 5. Discussion

Data collection in three periods of the year, with a median of three passages with elementary school students, is an unprecedented form of monitoring in Brazil since we have yet to find scientific articles that used the WCPM measurement in this monitoring format. Moreover, this is just the first step to start disseminating this type of assessment among teachers, and discussions about how to use these measures need to be the second step. This is because it is necessary that students are identified for their reading difficulties and also as at risk for future problems. When WCPM measures are collected systematically throughout the school year, they can be monitored to ensure that interventions are offered as identified (Deno, 1985; Nese, 2022; Stecker, Fuchs, & Fuchs, 2008).

Progress monitoring data has been much discussed in the literature in the context of producing estimates of growth that are sufficiently reliable for educators to make meaningful inferences about a student's response to the intervention. WCPM data can be graphed over time and compared to a trend line of student performance against an established goal. For this action to occur, studies like this must make data-based decisions. Many advantages can be observed for using oral reading fluency monitoring; the assessments are quick and easy to administer, being performed the same way every time (Fuchs, Fuchs, Hosp, & Jenkins, 2001).

### 5.1. Implications and limitations

Many limitations can be observed in this current research; therefore, the results must be interpreted cautiously. First, the study includes students from only one region of the country. Since Brazil is a country of continental dimensions, with significant cultural differences and even speech rates, research must expand to other areas and increase the sample size, schools, years and grades to assess the external validity of these findings.

However, this small study is also an impetus for discussions about methods, procedures and instrumentation to continue to be evaluated and developed, which may reach the context of supporting RTI models in Brazilian schools.

## 6. Conclusions

Monitoring carried out throughout the school year with students from 2nd to 5th grade revealed differences that are early evidence that measures of oral reading fluency can be used to monitor student progress over an entire year, and that brings several advantages discussed for educators, mainly making it possible to identify students at risk, monitor student learning outcomes, assess intervention effectiveness, and develop benchmarks for Brazilian students.

## References

- Alves, L. M., Santos, L. F., Miranda, I. C. C., Carvalho, I. M., Ribeiro, G. de L., Freire, L. de S. C., Martins-Reis, V. de O., & Celeste, L. C.. (2021). Evolução da velocidade de leitura no Ensino Fundamental I e II. *Codas*, 33(5), e20200168. <https://doi.org/10.1590/2317-1782/20202020168>
- Ardoin, S. P., Suldo, S. M., Witt, J. C., Aldrich, S., & McDonald, E. (2005). Accuracy of readability estimates' predictions of CBM performance. *School Psychology Quarterly*, 20(1), 1–22.
- Arnesen, A., Braeken, J., Baker, S., Meek-Hansen, W., Ogden, T., & Melby-Lervåg, M. (2017). Growth in oral reading fluency in a semitransparent orthography: Concurrent and predictive relations with reading proficiency in Norwegian, grades 2–5. *Reading Research Quarterly*, 52(2), 177–201. <https://doi.org/10.1002/rrq.159>
- Begeny, J. C., & Greene, D. J. (2014). Can readability formulas be used to successfully gauge difficulty of reading materials. *Psychology in the Schools*, 51, 198–215. <https://doi.org/10.2196/jmir.6962>
- Bigozzi, L., Tarchi, C., Vagnoli, L., Valente, E., & Pinto, G. (2017). Reading Fluency As a Predictor of School Outcomes across Grades 4-9. *Frontiers in Psychology*, 8, 200. <https://doi.org/10.3389/fpsyg.2017.00200>
- Deno, S. L. (1985). Curriculum-based measurement: The emerging alternative. *Exceptional Children*, 52(3), 219–232. <https://doi.org/10.1177/001440298505200303>
- Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: a theoretical, empirical, and historical analysis. *Scientific Studies of Reading*, 5(3), 239–256, doi: 10.1207/S1532799XSSR0503\_3
- Furey, J., & Loftus-Rattan, S. M. (2022). Actively involving students with learning disabilities in progress monitoring practices. *Intervention in School and Clinic*, 57(5), 329–337. <https://doi.org/10.1177/10534512211032618>
- Hasbrouck, J., & Tindal, G. A. (2006). Oral reading fluency norms: A valuable assessment tool for reading teachers. *The Reading Teacher*, 59, 636–644.
- Hasbrouck, J. & Tindal, G. (2017). *An update to compiled ORF norms* (Technical Report No. 1702). Eugene, OR, Behavioral Research and Teaching, University of Oregon.
- Kim, Y. G., Quinn, J. M., & Petscher, Y. (2021). What is text reading fluency and is it a predictor or an outcome of reading comprehension? A longitudinal investigation. *Developmental psychology*, 57(5), 718–732. doi: 10.1037/dev0001167.
- Kostewicz, D. E., Kubina, R. M., Selfridge, K. A., & Gallagher, D. L. (2016). A review of fixed fluency criteria in repeated reading studies. *Reading Improvement*, 53(1), 23–41.
- Makebo, T. H., Bachore, M. M., & Ayele, Z. A. (2022). Investigating the correlation between students' reading fluency and comprehension. *Journal of Language Teaching and Research*, 13(2), 229–242. <https://jltr.academypublication.com/index.php/jltr/article/view/2367/1935>
- Martins, M. A., & Capellini, S. A. (2018). *Avaliação do Desempenho em Fluência de Leitura: ADFLU*. Ribeirão Preto: Book Toy Livraria e Editora Ltda.
- Nese, J. F. T. (2022). Comparing the growth and predictive performance of a traditional oral reading fluency measure with an experimental novel measure. *AERA Open*, 8(1), 1–19. <https://doi.org/10.1177/23328584211071112>
- Pereira, E. S., Alves, L. M., Martins-Reis, V.O., & Celeste, L. C. (2021). Coeficiente de progressão da fluência de leitura no acompanhamento de escolares do Ensino Fundamental I. *Revista Brasileira de Educação Especial*, 27, e0093. <https://doi.org/10.1590/1980-54702021v27e0093>
- Rasinski, T. V., Paige, D. D., Rains, C. L., Stewart, F., Julovich, B., Prekert, D., Rupley, W. H., & Nichols, W. D. (2017). Effects of intensive fluency instruction on the reading proficiency of third-grade struggling readers. *Reading & Writing Quarterly*, 33, 519–532.
- Stecker, P. M., Fuchs D., & Fuchs, L. S. (2008). Progress monitoring as essential practice within response to intervention. *Rural Special Education Quarterly*, 27(4), 10–17. <https://doi.org/10.1177/875687050802700403>

# MAXIMIZING THE EFFICIENCY OF PRESENCE-DISTANCE EDUCATION MICROCOMPUTERS SYSTEMS

**Robert Plšičík, Peter Klčo, & Michal Praženica**

*Department of mechatronic and electrotechnology, University of Zilina (Slovak Republic)*

## Abstract

Embedded systems have been one of the most widely used areas of electrotechnology in recent decades. The common question is how to maximize the teaching efficiency of the technology area, where the IT technology and Electrotechnology areas are intersected. The departments of universities and future employer of absolvents are focused on different platforms of microcontrollers. That fact leads to finding an optimal teaching system. This article examines and proposes solutions for improving the teaching efficiency of the presence and distance education methods. The main challenge is to motivate students and increase their understanding of the microcomputer system. The article's secondary challenge is to offer a solution to the distance learning method, which has had a negative impact on students' knowledge levels. The article describes how to increase the effectiveness of distance learning using current software tools. The distance education methods are divided into two categories with a different way of education reaching.

**Keywords:** *Distance teaching, Proteus, versioning software, embedded systems.*

## 1. Introduction

The education of microcomputer systems is hard to generalize because there are so many ways to classify them. However, the order in which topics are taught and the level of computer programming must be followed in the process of education. Students' education on microcomputers sometimes does not have enough low-level programming, which means lack of basic knowledge about these issues. The classical teaching methods of programming microcontrollers and IoT applications are abstract (Li et al., 2008). The minimalization of abstraction is eliminated by using a development board and physical action members such as motors, buttons, voltage dividers and LED arrays. These action members for the maximization of student motivation can be extended to complex systems such as hydraulic pistons, fluid valves, etc. From a point of view, the goal of teaching programming microcontrollers makes these complex peripheries look like futility. However, the students' motivation and increasing their imagination of practical applications of separated teaching areas is the main goal of teaching. This task is feasible by choosing a development board that contains a complex system of peripherals or using a basic development board in the specialized laboratory with the mentioned complex action members.

Nowadays, the COVID-19 restriction makes a school subject with practical realizations a challenging task for teachers. Distance learning is not considered a unique issue. For this reason, it is highly recommended to start research about the effective usage of software as aid tools. During the distance learning, students do not have opportunities to work with the development boards, advanced peripheries, and to test their code. Furthermore, consultation about their codes, algorithms, etc. is arduous.

## 2. Common approach to the education of microcomputers systems

The classic approach to learning microcontrollers, used at many universities cannot be marked as wrong. However, this method does not produce the expected results if it is realized in the distance form of education. Furthermore, the absence of practical realization exercise tasks by students has critical consequences for the overall understanding of microcomputers systems.

### 2.1. Plan of topics for introduction to the microcontrollers

Looking for study plans at several universities showed a teaching procedure that can be generalized to a universal schedule, as will be discussed in the following part. This is the same approach our department uses to teach microcontroller systems. Furthermore, it is needed to keep in mind that this is the first contact of students with the topic of microcomputers, and they miss introduction information about categorized microcomputers and working with them at the assembler level. A lot of courses offer tutorials and

information about programming microcomputers with operating systems or usage of external libraries (Subbian & Purdy, 2013). These courses and non-compliance with teaching procedures cause the students to misunderstand of the covered topic.

The introduction to the subject includes:

- Recapitulation of acquired knowledge
- Getting acquainted with the development board
- Categorization of microcontrollers
- Pointing out to relationship between microcomputers, DSP, FPGA and embedded systems

For other topics of the plans such as GPIO, Timer, and ADC peripherals it is necessary to make code during the analysis of documentation. The pointing on the continuity block diagram of the periphery with the description of the registry. After intensifying this skill, based on working with students, a faster and deeper understanding of the topics of education is demonstrated. In the final weeks of the semester, students are gaining theoretical experience with communication buses. For the practical part of the subject, the UART bus was chosen. The bus is chosen for the reasons of frequent usage for communication with the master system.

Table 1. Comparison of Arduino development board.

Dev. board	Model of uP	Digital I/O; PWM	Analog I/O	Comm. buses	Dev. board	Model of uP	Digital I/O; PWM	Analog I/O	Comm. buses
Arduino MEGA2560	ATmega 2560	54; 15	16	4xUART/I2C/SPI	Arduino Nano 33BLE	nRF52840	14; 0	8	UART/I2C/SPI
Arduino Uno R3	ATmega 328P	14; 6	6	UART/I2C/SPI	Arduino ZERO	ATSAMD21 G18	20 ;10	7	2xUART
Arduino Nano	ATmega 328	14; 6	8	UART/I2C/SPI	Uno Wifi REV2	ATmega4809	14; 5	6	UART/I2C/SPI
Arduino Micro	ATmega 32u4	20; 7	12	UART/I2C/SPI	Arduino DUE	AT91SAM3 X8E	54; 12	14	4xUART/I2C/SPI

## 2.2. Educational development boards

There is a market with a lot of development boards that can be used for educational purposes. The main role in selection plays the level of the student's knowledge of the issue of the microcontrollers. As we can see in the attached reference, there are many approaches in the chosen development board for education (Beltran, 2013; Liu & Wang, 2012; Yablochnikova et al., 2022). When choosing the educational development board, the decisive factors are the experiences of the teacher with a chip of microcontroller, the amount of documentation, the license of IDE, and the price of the development board. It is also important to think about the goals of the subject. In many cases, the mentioned educational procedure is skipped over during the introduction to microcomputers, including low-level programming, and students are directly exposed to programming advanced microcomputers with operational systems. The comparison of microcontrollers, which provides a suitable introduction to microcontrollers, is described in (Rankovska, 2021). From the practice interactions with students, it is obvious that the students have marginal experience with hobby development boards such as Arduino, Raspberries and ESP32. Many web tutorials for working with this development use external libraries or programming operational systems, which might cause a misconception about developing codes for microcontrollers.

In our department, the first meeting for students with the topic of programming microcontrollers uses the TI-MSP430F5529. These microcontrollers are programmable at a low level without using additional external libraries and have integrated action members on the board. Even though the ATmega8-16 has been proven satisfactory for the first contact with microcontrollers, it had to be replaced by the MSP430F5529, due to the requirements of companies.

Table 2 represents the Arduino development board with an Atmel integrated chip for microcomputers. These chips are common for web courses, and students have experience with them. However, the courses use an external library and offer superficial solutions to problems without a deeper understanding. For education, it is important to adhere to the scheduled topics of the subject and solve issues at the registry level.

## 3. Advanced educational development boards

Regardless, many convenient advanced development boards are not modified for educational purposes, but they are commonly used in training programs. From those development boards that are intended for teaching and are available on the market, the TI Robotics System Learning Kit is currently in

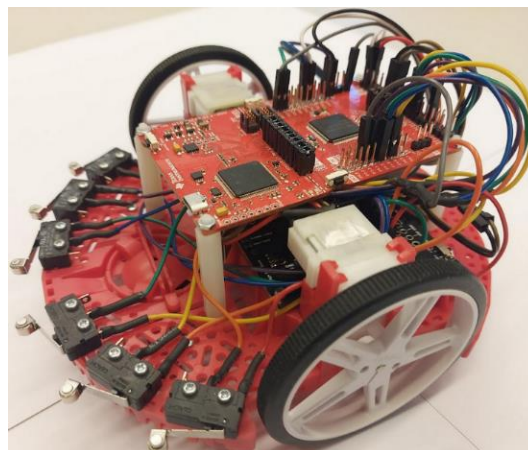
the process of implementation in our department. It is clear from the students' feedback that this choice led to an increase in their motivation.

### 3.1. TI Robotics System Learning Kit (TI-RSLK)

The TI-RSLK is a low-cost platform that was developed in partnership with the University of Austin and the company Texas Instruments. There exist two generations of the educational board - the TI-RSLK and TI-RSLK MAX. The difference between these versions is described in the attached document (Texas Instruments, 2020c). The TI-RSLK MAX is the next generation of the education board. Nowadays, the designer does not provide the full support of the older version TI-RSLK. Nevertheless, in our department, this older generation of the platform is used for implementation in education, since several pieces had been bought before the newest generation was released. The platform is aimed at the education of embedded systems in practical applications. The limitation on expansion options is only imposed by the core chip. The main advantages of the TI-RSLK in comparison with other basic development boards are the complexity of the embedded system and its applicability for many subjects, which are aimed at students with different degrees. The assembled TI-RSLK educational development board is figured at Figure 1.

The manufacturer has created a free training program that includes a plenty of documentation and video tutorials (Texas Instruments, 2016b). It is also necessary to note that the recommended schedule for the introductory subject for microcomputer systems is adhered to. However, the main pitfall of the manufacturer's training is the complicated external library "drivelib.h". The usage of this library causes the skip of the main pillar of the introduction subject, which is low-level registry programming. Integration into education demands the implementation of basic documentation. The documentation is for the low-level programming is difficult to reach, as the core unit, MSP432P401R, is not under the support of the TI anymore. For this reason, it is important to follow the attached documents: Technical reference manual (Texas Instruments, 2019), User's Guide (Texas Instruments, 2015b), Datasheet (Texas Instruments, 2015a). The TI-RSLK package includes these components: the Core Board MSP432P401R, the Motherboard, 2x DC motors, 6x bumper switches, and 8x IR line sensors. The line sensors are situated under the chassis to track the line. The bumper switches are connected to the port, which allows external interrupts. For that reason, it is highly recommended to modify the manufacturer's connection and plug the IR line sensors into the port, allowing external interrupts. The purpose of the motherboard is to provide power management for the entire system from the external replaceable batteries. The whole educational board is assembled by following the attached construction guide. (Texas Instruments, 2016a). That board is well applicable for introduction subjects. Furthermore, it is possible to add another peripheral like Wi-Fi, Bluetooth, or other advanced modules. These modifications allow the use of the same development board even for next-level education. The usage of the same platform in subsequent courses allows students to track their progress, which is currently reflected in the increase in interest in working in the embedded industry.

*Figure 1. Assembled TI-RSLK educational development board.*



## 4. Methods of distance learning

The distance method of learning provides a lower quality of education in comparison with the classical presence method. The distance method has to use many additional methods and tools to provide adequate education to students. It is not possible to consider distance education as an unrepeatable event. For this reason, there are tools and methods described that have proven to be effective. There are two main

methods. The first is in the use of versioning software for fast control of code, which is included in the separated branches. The second method is using software for microcontroller emulation. This method is based on the assumption of missing development boards for students.

#### 4.1. Versioning software

The key role of the versioning software is in managing the development and actualizing source code for a larger team. The secondary role is to manage backups of code and its development sequence. Moreover, for the distance method of learning it is possible to modify the approach and use it for education (Zakiah & Fauzan, 2016). If we consider that every student has a development board, versioning software is a great way to learn from afar. Many students are excited about microcomputers and embedded systems, and they have extra parts like sensors, communication peripherals, or actuators. These students call for extended knowledge and consultations. During distance learning, covering this type of student is complicated. However, using versioning software, it is possible to provide online consultation and solve shared source code in real time. This teaching system offers many benefits, such as very fast code comparison and implementation on a sample board. There is a wide range of versioning software available for this purpose. During distance learning, GitHub was used in our department. On the other hand, cases may occur when small groups of students are taught who don't have access to development boards. In this case, the use of emulation software proved to be an effective solution. That will be described in the next section. There are two approaches used of versioning software. The first approach is by the git bash, which is not suitable for students with no experience working with the command line. For this reason, it is recommended to use the desktop application of GitHub, which contains a user-friendly GUI. However, with less functionality. The newbies in the versioning software needed a few decades of minutes for understanding work with desktop GitHub.

The implementation of versioning software to the education allows to fast reach different students' codes. It is possible to consider that every lesson has created different projects, which are pushed on GitHub. After pushing those codes to the main branch, the students make their branches. The teacher can fast move between students' codes and compare those codes by method, which solves conflict. The next advantage of these methods is the history of committing codes. This advantage allows to leave valuable comments in the student's code. From the experiences, that approach is faster than walking between students and has a prerequisite for use in presence teaching and gives students valuable experience used later in their employment.

#### 4.2. Microcomputer emulation software

As the title suggests, this method uses specialized software for the virtualization of microcomputers or development boards. This software provides an environment for the creation of the whole embedded system by the virtualized parts. This method does not require students to be equipped with development boards and other tools included in the classrooms. For this reason, emulation programs have a high potential for application in distance learning.

Table 2 shows a comparison of the known emulation software. The Proteus PCB design is the top software listed. That software provides emulation of many microcontrollers for all competitor's companies. That software is universal and except for emulation, provides the design of PCB and simulation of the electrical circuits. However, the price of the software is high for educational use and the trial version does not provide the necessary conveniences and does not provide storage for students' projects. However, the departments which are able to buy, have very good tools for full-fledged distance education. In comparison with other similar software, Proteus own IDE with the function of stepping code or an alternative method for using a different IDE. The alternative method is to write compiled code in the .hex format to the emulated microcomputer. The technique of the hybrid-virtualization of embedded systems which is used by Proteus software is described in the (Baldin & Kerstan, 2009).

Table 2. Comparison of the software.

Name of software	Price	Emulated platforms	IDE
Proteus PCB design	Paid	most uP	Own + compatible with other IDE
Fritzing	Free	Arduino	Own
TinkerCAD Arduino	Free	Arduino	Own
Autodesk Circuits	Free	Arduino	Own

## 5. Conclusion

The analysis of the frequent approaches to education pointed to frequent errors in education. It should be remembered that the issue should be looked at through the eyes of the pupil. Without a solid foundation, students cannot be expected to develop a deeper understanding of the advanced implementation of microcomputers. The article offered a comparison of development boards that are used for educational purposes. However, in order to maximize the effectiveness of education, it is recommended to introduce a development board specializing in education. Another important pillar of the article on distance education methods was described in detail. The offered methods can be implemented for a wide range of subjects without reducing the quality of education.

### Acknowledgment

This work was supported by project KEGA 018ŽU-4/2021 "Modern education methods in analysis, modeling and control of Power Semiconductor Systems."

### References

- Baldin, D. & Kerstan, T. (2009). Proteus, a hybrid virtualization platform for embedded systems. *IFIP Advances in Information and Communication Technology*, 310, 185–194. [https://doi.org/10.1007/978-3-642-04284-3\\_17](https://doi.org/10.1007/978-3-642-04284-3_17)
- Beltran, A. E. (2013). Low-cost acquisition and development board. An open source hardware proposal. *Symposium of Signals, Images and Artificial Vision - 2013, STSIVA 2013*. <https://doi.org/10.1109/STSIVA.2013.6644920>
- Li, X., Guan, Y. & Yuan, H. (2008). Curriculum development and progressive engineering practice design in embed system education. *2008 IEEE/ASME International Conference on Mechatronics and Embedded Systems and Applications, MESA 2008*, 228–232. <https://doi.org/10.1109/MESA.2008.4735752>
- Liu, J. & Wang, Y. (2012). Development and use of an MCU experimental development board. *2012 2nd International Conference on Consumer Electronics, Communications and Networks, CECNet 2012 - Proceedings*, 2541–2543. <https://doi.org/10.1109/CECNET.2012.6202251>
- Rankovska, V. v. (2021). Review of Open-source Microcontroller and Programmable Logic Development Boards. *2021 30th International Scientific Conference Electronics, ET 2021 - Proceedings*. <https://doi.org/10.1109/ET52713.2021.9580150>
- Subbian, V. & Purdy, C. (2013). Redesigning an advanced embedded systems course: A step towards interdisciplinary engineering education. *ISEC 2013 - 3rd IEEE Integrated STEM Education Conference*. <https://doi.org/10.1109/ISECON.2013.6525231>
- Texas Instruments. (2016a). *Basic Kit Construction Guide TI Robotics System Learning Kit (TI-RSLK): The Maze Edition*. <https://www.ti.com/lit/ml/swrp249/swrp249.pdf>
- Texas Instruments. (2016b). *TI Robotics System Learning Kit (TI-RSLK) | TI.com Training Series*. <https://training.ti.com/ti-robotics-system-learning-kit>
- Texas Instruments. (2020c). *TI-RSLK to TI-RSLK MAX change document 2 TI RSLK to TI-RSLK MAX change document SEKP163 Introduction: TI-RSLK to TI-RSLK MAX change document*. <https://www.ti.com/lit/ml/sekp163/sekp163.pdf?ts=1649756392224>
- Texas Instruments. (2015a). *Datasheet MSP432P4xx microcontrollers*. <https://www.ti.com/lit/ds/slas826e/slas826e.pdf>
- Texas Instruments. (2015b). *User's Guide MSP-EXP432P401R LaunchPad™ Evaluation Kit*. <https://datasheet.octopart.com/MSP-EXP432P401R-Texas-Instruments-datasheet-39145419.pdf>
- Texas Instruments. (2019). *Technical Reference Manual - MSP432P4xx Microcontrollers - SLAU356I*. <https://web.archive.org/web/20200402132841/http://www.ti.com/lit/ug/slau356i/slau356i.pdf>
- Yablochnikova, I. O., Yablochnikov, S. L., Olisaeva, A. v., Makhiboroda, M. N. & Dadova, M. K. (2022). Some Features of the Implementation of Educational Processes in the Context of the Industrial Revolution 4.0. *2022 Systems of Signals Generating and Processing in the Field of on Board Communications*, 1–6. <https://doi.org/10.1109/IEEECONF53456.2022.9744388>
- Zakiah, A. & Fauzan, M. N. (2016). Collaborative Learning Model of Software Engineering using Github for informatics student. *Proceedings of 2016 4th International Conference on Cyber and IT Service Management, CITSM 2016*. <https://doi.org/10.1109/CITSM.2016.7577521>



# PRACTICING SOCIAL-EMOTIONAL AND COGNITIVE TEACHING STRATEGIES AND STEAM ACTIVITIES IN EARLY CHILDHOOD EDUCATION

**Ona Monkevičienė, Birutė Vitytė, & Birutė Autukevičienė**  
*Vytautas Magnus University/Education Academy (Lithuania)*

## Abstract

STEAM education is recognized as an efficient practice of holistic education, which is already relevant at the stage of early childhood education. STEAM research focuses on the search for models of interdisciplinary integration and the justification of innovative educational approaches. The aim of this paper is to reveal the relationship between practicing social-emotional and cognitive teaching strategies and STEAM activities in early childhood education. The conducted quantitative study reveals that the population of early childhood teachers is heterogeneous in terms of practicing teaching strategies and STEAM activities. Early childhood teachers, who use social-emotional and cognitive teaching strategies with equal frequency, also often use integrated STEAM activities in young children education. Other teachers prioritise social-emotional teaching strategies and pay less attention to cognitive teaching strategies, although the latter have a slightly stronger link to the development of STEAM practices. Teachers who are less likely to use cognitive strategies to teach young children tend to use STEAM activities less frequently.

**Keywords:** *Early childhood, STEAM, social-emotional teaching strategies, cognitive strategies.*

---

## 1. Introduction

STEAM (Science, Technology, Engineering, Arts, Maths) is defined as an integrated approach to education in these fields, as a model of inquiry-based, creative, interdisciplinary education, and as education based on solving real-life problems (English, 2016; Yata et al., 2020). STEAM education in many countries is related to the pursuit of technological breakthroughs, which need to stimulate learners' interest in science, mathematics, technology and engineering (DeJarnette, 2018). Research is actively carried out to find the best model for the integration of STEAM education domains, and the following models are distinguished: a model for exploring phenomena (water, energy, etc.) from a cross-disciplinary perspective (Aydin, 2020), engineering or technology education as a cross-disciplinary integrative field, and others (English, 2016; Bati et al., 2018; Yata et al., 2020; Aydin, 2020; Kastriti et al., 2022).

STEAM activities in early childhood education take the form of playful, spontaneous, and teacher-initiated interest in the world around children, exploring natural objects and phenomena (water, wind, diversity of life, the Earth, etc.) by asking questions, observing, experimenting, and drawing conclusions (science education); exploring the purpose, function, and operation of tools, instruments, technological processes, and mechanisms (measuring instruments, digital microscopes, pulleys, wheels, etc.), creating models, and testing them (technology education); designing, building, constructing different structures (houses, bridges, roads, robots, etc.), exploring the properties of materials (bricks, Lego, robotics kits, natural materials), and understanding the phenomena of stability, balance, etc. (engineering); activities involving calculation, measurement (maths), design (arts). (Campbell et al., 2018; Aldemir & Kermani, 2016; Ata Aktürk et al., 2017; Knaus & Roberts, 2017).

A wide range of research studies reveal how methods applied by teachers support and extend children's interest in STEAM activities and promote the development of their knowledge and skills. The emphasis is placed on methods that promote cognitive processes: raising hypotheses, observing, clarifying, questioning, exploring, experimenting, modelling, designing and redesigning, predicting, and developing higher order thinking skills of children (Yata et al., 2020; Aydin, 2020). According to Kastriti et al. (2022), these are scientific tools that should be used in a creative way. This is what children learn when the arts are integrated into the concept of STEM.

In their systematic review of research on teaching methods in STEAM education, Kastriti et al. (2022) highlight the most effective approaches to STEAM education - Project Method, Problem-Based

Learning, Inquiry-Based Learning, and Discovery Method. These approaches are also more associated with cognitive teaching strategies, although there is also an emphasis on the social aspect, promoting children's motivation and cooperation. Social-emotional approaches to teaching are less often emphasised in STEAM education. However, in early childhood education, the social-emotional dimension is relevant to the whole educational process, including STEAM education (Laureta, 2018).

In the present study, we analyse the social-emotional teaching strategies used by early childhood teachers in STEAM education, which include the Pedagogy of Listening to the Child, the Personalised Dialogue-Based Educational Interaction with the Child, Emotionally Engaged Learning, and Self-Regulated Learning. Attention was also allocated to cognitive teaching strategies, which include Experiential Development of Higher Order Thinking Skills (discriminate, compare, group, model, predict, reason), Promoting Deep Learning, and Reflective Learning. Attempts were made to reveal how social-emotional and cognitive teaching strategies practiced by early childhood teachers relate to the practice of STEAM activities. Recognising that the teacher population will not be homogeneous, we have analysed the grouping of teachers according to the characteristics of these practices.

## 2. Objectives

The objectives of the research were: a) to reveal the clusters of teachers according to social-emotional and cognitive teaching strategies and STEAM activities they practise in early childhood education; b) to establish the relationship between the frequency of using social-emotional and cognitive teaching strategies and the frequency of practising STEAM activities.

## 3. Methods

*The research instrument.* A quantitative research approach (Cohen, Manion, & Morrison, 2018) and survey design (Creswell, 2014) were used to conduct the study. The self-reported online questionnaire was designed following a theoretical construct. The questionnaire consists of seven subscales (46 items): two subscales focus on application of social-emotional and cognitive teaching strategies for organizing STEAM activities; five subscales are designed to reveal the integral practices used by educators in science, technology, engineering, art and mathematics education. The teachers rated each statement on a Likert scale from 1 to 5, with 1 being not applicable in their practice, 2 being rarely applicable, 3 being moderately frequently applicable, 4 being frequently applicable and 5 being very frequently applicable. It was recommended that the participants use "rarely" if they employ the relevant strategies or STEAM activities in their practice with children once a month or less; "moderately frequently" should be marked if they use them several times a month, "frequently" - if they apply strategies or STEAM activities once or twice a week, and "very frequently" should be chosen if the teachers apply them daily. The internal consistency of the questionnaire statements is high as the Cronbach Alpha equals 0.952. The internal consistency of the separate parts of the questionnaire is greater than 0.8.

*Sample.* The research participants included early childhood teachers working with 3- to 6-year-old children. The teachers were sampled using the random probability sample strategy. Raosoft software suggested that the minimum sample size needed in this study is 982, with a 3% margin of error and a confidence level of 95%. The internet questionnaire was filled in by 1231 teachers (2.65% margin of error, 97% confidence level).

*Methods of data analysis.* Statistical data processing methods were applied for the analysis of quantitative research results. The obtained research data were processed using IBM SPSS Statistics 23.0 and MS Excel programs adapted for Windows. Methods of descriptive statistics were applied. The normality of the variables was checked with skewness (<-1 or >1) and kurtosis (<-1 or >1) of the distribution. The analysis of the research data indicated that all variables were normally distributed (see Table 1). Cluster analysis and the K-Means method were used to group teachers into groups according to social-emotional and cognitive teaching strategies they apply and the STEAM activities they practice. Pearson correlation was used to identify correlations between the teachers' application of different teaching strategies and the practice of STEAM activities.

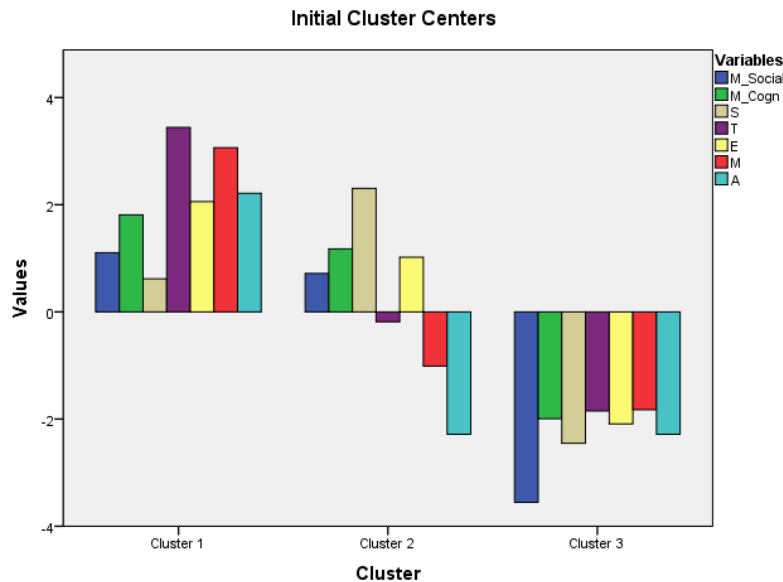
*Procedure and ethics.* All teachers participated in the questionnaire survey on a voluntary basis. The questionnaire was anonymous and full confidentiality was ensured.

## 4. Research results

In the present study, our aim was to reveal whether early childhood teachers are a homogeneous group in terms of which teaching strategies, social-emotional and/or cognitive they use more often to organise STEAM activities, as well as in terms of the frequency with which they implement integrated

STEAM activities (science, technology, engineering, art, maths). To achieve this, the cluster analysis of the data was carried out, the results of which are shown in Figure 1. The abbreviations used in this figure are as follows: M\_Social - social-emotional teaching strategies; M\_Cogn - cognitive teaching strategies; S - Science; T - Technology; E - Engineering; M - Maths; A - Arts. The data show that three clusters of early childhood teachers clearly stand out in terms of the teaching strategies used and the frequency with which they practise STEAM activities. Cluster 1 includes 27.86 % of early childhood teachers, Cluster 2 encompasses 46.95 % of teachers, and 25.18 % of the participants are assigned to Cluster 3.

Figure 1. Teacher clusters according to the frequency of practicing social-emotional and cognitive teaching strategies and STEAM activities (standardised values).



In addition, we analysed how often early childhood teachers from different clusters use social-emotional and cognitive teaching strategies and how often they practise STEAM activities. The mean scores for the different teaching strategies and STEAM activities practised in the education of the children in their group are shown in Table 1.

Table 1. Mean scores of frequencies of applying different teaching strategies and practicing STEAM activities.

Cluster	Social-emotional teaching strategies Mean	Cognitive teaching strategies Mean	Science Mean	Technology Mean	Engineering Mean	Arts Mean	Math Mean
1	4.66	4.13	3.78	3.12	4.05	3.98	3.36
2	4.20	3.13	2.97	2.27	2.97	3.03	2.39
3	3.13	1.95	2.23	1.71	2.00	2.03	1.76

The data show that Cluster 1 includes early childhood teachers who frequently and very frequently use both social-emotional and cognitive teaching strategies when implementing STEAM activities in early childhood education. The average score for the use of teaching strategies is between 4 (used frequently) and 5 (used very frequently). These educators practise social-emotional teaching methods such as listening to children, dialogue-based interaction with children, developing emotionally engaged learning, promoting emotional self-regulation, etc. They also use cognitive teaching methods: they practise child-friendly experiential techniques that encourage the development of higher-order thinking skills of young children (discriminate, compare, group, model, predict, reflect, argue), and they use techniques that stimulate children's deep learning, reflecting on their own cognitive experiences and others. Teachers assigned to Cluster 1 practise STEAM activities with early age children moderately frequently and frequently. The average score for practicing STEAM activities is between 3 (used moderately frequently) and 4 (used frequently).

Cluster 2 includes early childhood teachers who use social-emotional teaching strategies frequently and very frequently (mean score - 4.2), but only moderately frequently apply cognitive teaching strategies (mean score - 3.13). These teachers favour social-emotional teaching methods as they develop

personalised educational interactions with children, and their emotional response to children's interest is sensitive and frequent. They pay much less attention to cognitive methods. This is probably the reason why teachers in Cluster 2 practise science, engineering and art activities with early age children moderately often (mean scores - 2.97 and 3.03), and technological and mathematical activities rarely (mean scores - only 2.27 and 2.39).

Early childhood teachers in Cluster 3 also prioritise social-emotional teaching strategies but use them less frequently in STEAM activities than teachers assigned to Cluster 2, that is, only moderately often (mean score - 3.13). However, these teachers rarely use cognitive strategies to teach pre-school children. This clearly has an impact on the practice of STEAM activities in early childhood education, as these teachers rarely offer STEAM activities to children in their groups.

It can be assumed that the frequent and very frequent application of both teaching strategies (social-emotional and cognitive) is related to the frequent and very frequent practice of STEAM activities. In addition, teachers who are less likely to use cognitive teaching strategies are also more unlikely to practice STEAM activities.

To test this hypothesis, we found correlations between the social-emotional and cognitive teaching strategies used by early childhood teachers and the frequency of practicing STEAM activities. Pearson correlation was applied considering the normal distribution of the test data. The classical Pearson correlation coefficient was used: a coefficient value of up to 0.2 indicates a very weak correlation, 0.20 to 0.39 shows a weak correlation, 0.40 to 0.69 refers to a moderate correlation, 0.70 to 0.89 indicates a strong correlation, 0.90 to 0.99 demonstrates a very strong correlation, and when the coefficient value is 1, the relationship is linear.

*Table 2. Correlation between practicing of social-emotional and cognitive teaching strategies and STEAM activities (Pearson correlation coefficient values and p-values).*

Teaching strategies	Science	Technology	Engineering	Arts	Maths
Social-emotional teaching strategies	0.458	0.407	0.517	0.447	0.586
	p<0.0001	p<0.0001	p<0.0001	p<0.0001	p<0.0001
Cognitive teaching strategies	0.552	0.510	0.583	0.554	0.659
	p<0.0001	p<0.0001	p<0.0001	p<0.0001	p<0.0001

The data show that the relationship between the frequency of practicing social-emotional and cognitive teaching strategies and STEAM activities is moderate with all estimates of Pearson correlation coefficient ranging between 0.407 and 0.659, and the relationship is statistically significant ( $p<0.0001$ ). Pearson correlation revealed a slightly stronger correlation between the frequency of using cognitive education methods and practicing STEAM activities (0.510-0.659,  $p<0.0001$ ) than between the frequency of using emotional-social education methods and practicing STEAM activities (0.407-0.517,  $p<0.0001$ ).

## 5. Discussion and conclusions

Our study highlights a number of important aspects. Although most researchers (Yata et al., 2020; Aydin, 2020; Kastriti et al., 2022) point to the relevance of cognitive learning approaches in STEAM education, the results of our study show that it is not only cognitive, but also social-emotional teaching strategies that are relevant in the educational process. Our study reveals that teachers who are most likely to develop integrated STEAM activities in early childhood education are equally likely to use both cognitive and social-emotional teaching strategies. Teachers use listening pedagogy particularly frequently as hearing children's voices allows them to support the development of STEAM activities that are relevant to children and promote their motivation. To achieve dialogue-based interactions, teachers use collaborative participation and joint thinking methods, working together with the children, participating in STEAM activities they initiate or propose. Teachers use provocations, contexts that promote emotional engagement and timely responses to the child's emotional experience.

Some researchers justify the prioritisation of "soft skills" in early childhood education (Laureta, 2018). Our study reveals that about two-thirds of early childhood teachers also prioritise social-emotional teaching strategies for teaching children and less frequently use cognitive strategies. Such teachers employ STEAM activities less frequently. Possible assumptions of this fact are revealed by research carried out by other authors, which shows that early childhood teachers lack not so much motivation, but rather subject-specific STEAM knowledge, understanding of technological and engineering processes, and familiarity with methods that stimulate children's technological, engineering, and mathematical thinking (Bers et al., 2013; John et al., 2018; Yata et al., 2020). This fosters a fear of using practices based on exploration, modelling, designing, and testing to promote the development of children's higher order thinking skills and deep learning.

Our study reveals a statistically significant relationship between the frequency of social-emotional and cognitive teaching strategies and the frequency of practicing STEAM activities, although the relationship between the frequency of cognitive teaching strategies and the development of STEAM practices is slightly stronger. This is in line with the rationale for the effectiveness of cognitive approaches to STEAM education presented in Kastriti et al. (2022). The mastery and increased practice of cognitive teaching strategies could lead to the development of STEAM activities in early childhood education.

### References

- Aldemir, J., & Kermani, H. (2016). Integrated STEM curriculum: Improving educational outcomes for Head Start children. *Early Child Development and Care*, 187(11), 1694-1706.
- Ata Aktürk, A., Demircan, H. Ö., Senyurt, E., & Cetin, M. (2017). Turkish early childhood education curriculum from the perspective of STEM education: A document analysis. *Journal of Turkish Science Education*, 14(4), 16-34.
- Aydin, G. (2020). Prerequisites for Elementary School Teachers before Practicing STEM Education with Students: A Case Study. *Eurasian Journal of Educational Research*, 88, 1-39.
- Bati, K., Yetisir, M. I., Caliskan, I., Gunes, G., & Sacan, E. G. (2018). Teaching the concept of time: A steam-based program on computational thinking in science education. *Cogent Education*, 5(1), 1-16.
- Bers, M. U., Seddighin, S., & Sullivan, A. (2013). Ready for robotics: Bringing together the T and E of STEM in early childhood teacher education. *Journal of Technology and Teacher Education*, 21(3), 355-377.
- Campbell, C., Speldewinde, C., Howitt, C., & MacDonald, A. (2018). STEM practice in the early years. *Creative Education*, 9(1), 11-25.
- Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education*, 8th ed. London, UK: Routledge.
- Creswell, J. W. (2014). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, 4th ed. New York, USA: Pearson.
- DeJarnette, N. K. (2018). Implementing STEAM in the early childhood classroom. *European Journal of STEM Education*, 3(3), 1-18.
- English, L. D. (2016). STEM education K-12: Perspectives on integration. *International Journal of STEM Education*, 3(1), 1-8.
- John, M., Sibuma, B., Wunnava, S., & Anggoro, F. (2018). An iterative participatory approach to developing an early childhood problem-based STEM curriculum. *European Journal of STEM Education*, 3(3), 07, 1-12.
- Kastriti, E., & Kalogiannakis, M., Psycharis, S., & Vavougiou, D. (2022). The teaching of Natural Sciences in kindergarten based on the principles of STEM and STEAM approach. *Advances in Mobile Learning Educational Research*, 2(1), 268-277.
- Knaus, M., & Roberts, P. (2017). *STEM in early childhood education*. A Research in Practice Series. Early Childhood Australia Inc.
- Laureta, B. (2018). Soft skills and early childhood education: Strange bedfellows or an ideal match? *He Kupu*, 5(3), 28-34.
- Yata, C., Ohtani, T., & Isobe, M. (2020). Conceptual framework of STEM based on Japanese subject principles. *International Journal of STEM Education*, 7(12), 1-10.

# PLAYWORLDS: IMAGINATIVE ADULT-CHILD JOINT PLAY IN EARLY LEARNING CLASSROOMS

**Anna Pauliina Rainio**

*Faculty of Education, University of Helsinki (Finland)*

## Abstract

Play is considered as one of the most effective and meaningful ways of learning for children until the age of eight years (Skene et al., 2022). Play is also a prerequisite for human development and creativity (Rieber & Carton, 1987). However, many early learning classrooms struggle to find time or ways to include playful learning in their curriculums.

In this presentation I introduce an educational innovation that helps bring play in early learning classrooms. Playworlds are forms of adult-child joint play often centered around a piece of literature or story. The story is turned alive by acting, playing and creation of plot, characters and props (Lindqvist, 1995). Implementing playworlds often requires time and dedication so many teachers find it hard to combine it with formal learning goals of the school.

I will introduce a Finnish first year school classroom in which a teacher developed a playworld activity around the story of Crocodile Gene (by Eduard Uspenski). The class was culturally diverse with children from around six different home languages. The data analyzed consists of teacher diaries and notes, informal email correspondence and interviews between the teacher and the researcher during the school year.

I focus on one of the characters in the story, Chebi (a hand puppet played by the teacher) visiting the classroom and becoming a member of the class. I discuss how children who were ambivalently engaged (see Ferholt & Rainio, 2016) towards school going found meaningful ways to participate in class activities with the help of Chebi. The imaginative character played by the teacher was helping children to engage and attach to the classroom activities. The paper concludes that the power of imagination, play and stories should not be undermined in developing easy access and meaningful ways of participation in early learning classrooms.

**Keywords:** *Play, imagination, narrative, Early Childhood Education and Care (ECEC), student engagement.*

## 1. Introduction

In this paper I introduce a unique form of adult-child joint play called Playworlds. The work presented in the paper is based on a long-term work of International Playworld Network (IPWN), an organized group of playworld scholars who have been collaborating through joint research projects since 2003 (see more Chapter 14: Adult/Child Joint Play; Adult-child joint imaginative playworlds). Our work leans on cultural-historical theories on the role of play in children's development particularly as they are developed in Lev Vygotsky's (see e.g., Rieber & Carton, 1987) seminal work on imagination and creativity. Playworlds are based on a *holistic cultural approach* to children's play originally developed by an educational scholar and drama pedagogue Gunilla Lindqvist (1995; 2003) in Swedish preschools in 1990's. Since then, the playworlds have been actively developed, applied and studied in the field of ECEC in several countries including Finland, Sweden, Japan, Serbia, United States, and Australia. Our studies have shown for example that playworlds develop children's agency development (Rainio, 2008; 2010) and cognitive development such as narrative competence in classrooms (see Ferholt & Lecusay, 2009). Recently our focus has moved to analyzing and developing playworlds as ways of being that support engagement and belonging to children who feel easily excluded from classroom practices (see e.g., Ferholt & Rainio, 2016; Lecusay et al., 2022).

This paper discusses how joint play between adults and children can create possibilities for belonging and engagement for small children in preschools and schools. The empirical examples are from a Finnish elementary school classroom (first year class with 7-year-old children) in which the teacher

developed a small playworld around the story of Crocodile Gene (by Eduard Uspenski). The playworld was implemented in the class in Spring 2020 but could not be realized in its planned form as the COVID-19 lockdown closed schools in Finland for several months that season. Therefore, the playworld activity that took place in the classroom was very small-scale and was centered around one character from the book, Cheburashka (“Chebi”, a puppet played by the teacher). When school continued after the COVID-19 break, Chebi became an important part of the class activities. In my analysis of the data that I will present in closer detail in my presentation, this imaginative character, a puppet, turned to be an important mediating figure to the teacher to engage with children, and to the children to engage with school going.

## 2. Playworlds approach

In playworlds adult-child joint play is often centered around a piece of literature or story. The story is turned alive by acting, playing and creation of plot, characters and props (Lindqvist, 1995). Teachers often act in roles from the story. A thematic playworld lasting often several months is constructed by adults and children together using stories, folk tales, music, lights, dramatizations, visual aesthetics, pretending, role figures and characters (often presented by adults), scenery settings etc. Themes are selected by picking up some central themes from folk tales or stories, which are important in children’s general psychological development (e.g. fears, friendship, lying etc.). The themes are dealt with while constructing the plot of a playworld by acting and playing together (see more for example Rainio, 2010).

Playworlds can be described as a space between fantasy and reality where children and adults are able to meet to create meaning and to learn together about the world. For Lindqvist (1995, p. 211), the adults acting in a character are often mediators between the shared fictitious world created and the day care center in the playworld context. Adults’ role actions can make it easier for children to step into a literary world of the story and also help to establish a dialogue between the children. Lindqvist (1995, p. 211) writes: *“The children are enticed into the dialogue by the characters the adults dramatize, and as a result, both children and adults share a common playworld. This world is gradually established as children and adults interpret their experiences and portray a mutual world of meaning.”*

Recently, our focus has moved to understanding better how puppets – imaginative characters in the story becoming real for the class by being played by the teachers or for example professional artists – can help to establish such shared worlds between children and adults and help to deal with difficult themes and issues in the classroom and in children’s lives (see Ferholt et al., in press).

## 3. Research design: Crocodile Gene playworld in Finland

In Fall 2019 we launched a playworld collaboration with a first year class teacher Julia in Spring Valley School in Finland (all the names of people and places have been changed to protect the anonymity of the participants). The school was culturally diverse and Julia’s class was rich in languages with six different mother tongues. Many families had arrived in the country within a year so there were several children who did not yet speak Finnish. The teacher Julia knew the playworlds methods beforehand and decided to collaborate with the University of Helsinki to create a playworld project around the idea of supporting inclusion and student engagement in the beginning of the school path.

The research project (2019-2020) followed the principles of participatory research design (Bang & Vossoughi, 2016) with the idea that the actors involved in the research are experts in their respective fields and that the collaboration is built around dialogue of this expertise (with children also as active collaborators, see Clark, 2005). The project was based on active listening and building on the initiatives of the students in the classroom. The study has research permissions from the city, the school, the teacher Julia and the involved students’ parents as well as the children themselves. The research follows ethical guidelines of TENK (The Finnish National Board on Research Integrity).

Our main task in the project was to try out how a playworld way of being could play a role in creating a sense of community and belonging in the class with diverse language barriers between children. Julia formulated her idea of what she needed with a class like this:

*“[T]oday I thought that the most important thing is to build a way of working in the classroom, to the most mundane moments. [...] From the teacher's perspective, keeping in mind ways to build relationships and interaction with students that would support engagement, especially for children at risk of being misunderstood, due to challenging behaviors (which should rather be seen as symptoms of ambivalence) or because of the lack of [common] language.”*

The teacher Julia decided to build the playworld around the story of Crocodile Gene, a Russian children's book written by Eduard Uspenski (1994). In the book Chebi (Muksis in Finnish), a creature "completely unknown to science" transports from a tropical forest by mistake in a box of oranges in which it has jumped accidentally. Chebi tries to make its way in a new town and makes friends with Gena, a crocodile who works in a zoo; and Gail, a child. Chebi, Gene and Gail form a 'House of Friendship' together to help all different kind of beings, from people to animals, to find new friends and fight loneliness in the city. The teacher read aloud the book in the class and they watched a film based on it. The children discussed the events in the book and drew the characters. The idea was to gradually build the world of the story to the classroom and play in it, together with the children, and the teacher in role.

However, COVID-19 hit Finland and closed schools for several months so that the plans had to be postponed. Therefore, our data is from late Spring when the schools opened for two weeks and from the following Fall when the children returned to second grade. The researchers could not be present at these times either because of the corona restrictions but the teacher collected photos, wrote notes, memos and diary to the researchers. This data has been used to create our understanding of the Crocodile Gene playworld events from spring and fall 2020. Below I will present some of our very initial remarks from the data.

#### **4. Initial findings: Shared imaginative play with Muksis**

##### **4.1. Chebi arrives in the class after the COVID-19 lockdown**

In mid-May 2020 in Finland the schools opened again for a two weeks time before the start of the summer holidays. The students returned to classrooms. Julia had continued reading the story to the children during the close downs via online. During these two weeks that the school was open again, Julia felt that with the story she could create the class as supportive as possible for the children who had been away for so long. She decided to launch the playworld in a form of Chebi, a character from the story. Julia wrote to me:

*“This creature appeared into our class today. Chebi is a puppet but everyone is taking fully seriously and talking to it. Just this little push is needed and the whole thing takes off ♥. The first encountering was difficult for some of the children but I was surprised how all the students were involved in this already in the afternoon. However, most of my own energy went to playing the double role in the classroom.”*

After the students had met Chebi they wanted to include it to all school going activities. For example, Chebi got its own line on the blackboard for “credits” that the children got from behaving well or remembering to do things. Julia wrote in her notes that the students really helped Chebi to collect the credits and learn these skills. During the two weeks that is left of school before summer holidays, Chebi is a part of class activities daily, the children woke it up from naps by singing to it, they wanted to build a home to it during “art Tuesdays” and with Julia’s lead, they decided to “secretly” make their own school certificate for Chebi too. It included the same things as what the children were evaluated at the end of the year but the children also invented new things to praise Chebi about, such as “sleeping” and “reading ABC book”. Julia’s idea was that through this the class can also deal with what the certificate is as the students received it at the first time and many are very nervous about it. According to Julia’s notes, the children wanted to bring Chebi to the 2nd grade. They intended to teach all the necessary knowledge and skills to it. Chebi also participated in several trips with the class. During these trips, the students take care of and advice Chebi. Julia’s sense was that the presence of Chebi in the class helped the teacher and students to reconnect and perhaps also embrace the certain ambivalence caused by the challenging situation of returning to school after a long break just to enter the summer holidays again.

##### **4.2. Chebi helps Alex to participate and stay included**

After the summer break in Fall the children turned to second grade and Chebi, too. Below I describe the relationship between Chebi and one child, whom we here call Alex. Alex had been having hard time since the quarantine. It was hard for her to sit still, follow any orders, doing school tasks. There were many special arrangements for Alex, for example shortened school days, even home days. At the start of the second year, Alex was seriously at the edge of disengagement and even exclusion. Alex had been fond of Chebi already when it arrived but in the Fall she first strongly suspected that “Chebi has left us for good”. However, Chebi returned to the class and Julia told me that Alex (the pupil) started to interact with Chebi by introducing him friends, other soft toys from her home. Alex’s parents had told that Alex was very fond of soft toys and had many of them at home but that the parents “had been afraid that if Alex brought soft toys to school, she would be bullied.” (Julia’s notes). Julia told the parents that



on the contrary: *“all students like soft toys, that's our shared thing here. The soft toys specifically help Alex connect with others. And since I play along with the whole group, it also tells everyone that this is ok, I encourage with my own example.”* (Julia's research diary). At September Julia described several examples in which Alex could participate and was calmer in the classroom when Chebi or some other soft toy (Chebi's friend) was with her:

*“It was an incredible day with Chebi & Alex! This photo tells it all! [in the photo Alex's soft toy called Wolf sits with Chebi]. The toy lesson started to be quite rowdy for many. Alex took on a completely different mood, a calm one, when I was close to her with Chebi. I told the special education teacher the outline of Alex's day, because it was breaking news for her too that this day went so well.”*

In a school trip some days later, Julia had wondered whether Alex could participate at all as she had refused all collaboration earlier. Julia described:

*“In the morning Alex was frolicking but was really restless. I was nervous about our lunch time, during which the downhill always starts at the latest (for Alex). But there Alex showed signs of calming down and participating. Then she asked if Chebi and Pierre (a dog friend given to Chebi by Alex) could come along. I said yes good idea. You can be the one in charge of Pierre, you will take care of him throughout the trip. As soon as Alex got Pierre (the soft toy that had become friends with Chebi) in her lap, everything went smoothly. Alex followed all instructions. Was friendly and talkative. Did the school tasks in the forest. There was a lot of going on, but Alex took all the guidance I gave her and it went well. Finally, there was time to play in the park and Alex climbed a tree with Pierre and rested there contentedly.”*

My initial interpretation of Alex's case with Chebi is that Julia (by reading the Crocodile Gene story to the class, then introducing a central figure from the story to the class by playing it at her hand), had created a shared world between children, teacher and fictional characters in the classroom where imagination and creativity were present and available for use. This helped Alex to use these tools of imagination to regulate herself and to concentrate, all this with the help of her teacher. As we conclude in other analyses of a related activity, co-regulation between children and adults with the help of play and fictional characters, is an important yet under-researched topic in student engagement and deserves closer attention (see Rainio et al., 2021; also Lecusay et al., 2022; Ferholt et al., in press).

## 5. Conclusions and discussion

There is strong evidence that early childhood play is indispensable to human development, health and wellbeing across the lifespan (Brooker & Woodhead, 2013; Whitebread, 2017). It is also an essential human right (UNESCO, 1989). In spite of this, it is hard to find time for imaginative play in schools.

In the case presented in this paper the original plans of a full-scale playworld activity in a school classroom went anew when the COVID-19 closed schools in Spring 2020. This made Julia the teacher to implement the planned playworld in a smallest possible way – and interestingly, it is just this fact that perhaps makes the applicability of the case easier for many classrooms. What was needed was a story that was interesting enough for the children and a character from the story that the children were attached to when the book was read aloud. This character then became a puppet played by the teacher (she had found a similar enough looking puppet from the school's storage room). The teacher played the puppet in her hand and for these children it was immediately Chebi from the story who was unfamiliar with the class practices and needed children's help in relating to school and becoming a member of the class. At the same time, Chebi was helping children to concentrate, participate and focus just by sitting close to them and talking to them and their soft toys.

In Julia's class Chebi helped Julia and the pupils to orient back to the classroom after a two-month break, to reflect (by teaching it to Chebi) what a classroom was, what was learned there, and why. Chebi also became an emotional friend, a so-called transitory object (Winnicott, 1990) for a child who had hard time participating in the classroom activities or concentrating. When Chebi was in Alex's lap, and interacted with her, Alex could concentrate better. The remarks made in this paper are still very initial and the systematic analysis is yet to be made of the data. One cannot generalize the findings on the basis of one-time unique case. However, combined into our long-term ethnographic and intervention research on playworlds and our earlier findings of the role of play in student engagement from other

playworld settings (e.g., Rainio, 2008; Ferholt & Rainio, 2016; Lecusay et al., 2022, Rainio et al., 2021), the case sheds light into an important topic. The paper also introduces a relatively easy way of using play-based methods in school settings. Implementing playworlds often requires time and dedication so many teachers find it hard to combine it with formal learning goals of the school. Using stories and puppets as low-threshold tools for classroom activities can be seen as an easy access to imagination and creativity as a part of the classroom teacher work.

## References

- Adult-child joint imaginative playworlds. In Cultural-historical approaches to children's learning and development, University of Helsinki, 25 May, 2023, <https://www.helsinki.fi/en/researchgroups/cultural-historical-approaches-childrens-learning-and-development/research/adult-child-joint-imaginative-playworlds>.
- Bang, M., & Vossoughi, S. (2016). Participatory design research and educational justice: Studying learning and relations within social change making. *Cognition and Instruction*, 34(3), 173-193.
- Brooker, L., & Woodhead, M. (Eds.). (2013). *The right to play. Early childhood in focus*, 9. Milton Keynes: The Open University with the support of Bernard van Leer Foundation.
- Chapter 14: Adult/Child Play: Emotion, Cognition, and Development in Playworlds. In THE STORY OF LCHC: A Polyphonic Autobiography, Laboratory for Comparative Human Cognition, University of California, San Diego, 25 May 2023, <http://lchcautobio.ucsd.edu/polyphonic-autobiography/section-5/chapter-14/>.
- Clark, A. (2005). Listening to and involving young children: a review of research and practice. *Early Childhood Development and Care*, 175(6), 489-505.
- Ferholt, B., & Lecusay, R. (2009). Adult and child development in the zone of proximal development: Socratic dialogue in a playworld. *Mind, Culture, and Activity*, 17, 59-83.
- Ferholt, B., & Rainio, A. P. (2016). Teacher support of student engagement in early childhood: Embracing ambivalence through playworlds. *Early Years – An International Research Journal*, 36(4), 413-425.
- Ferholt, B., Rainio, A. P., & Cohen, L. (in press). Thinking about and experiencing life, death, and grief with imaginary characters. In K. Tobin & K. Alexakos (Eds.), *Multilogical approaches to education and research on birth, sustainable living, dying and death*. Brill.
- Lecusay, R., Rainio, A. P., & Ferholt, B. (2022). Caring about and with imaginary characters: Early childhood playworlds as sites for social sustainability. *Sustainability*, 14(9), 5533.
- Lindqvist, G. (1995). *The aesthetics of play. A didactic study of play and culture in preschools: Acta Universitatis Upsaliensis*, Uppsala Studies in Education 62.
- Lindqvist, G. (2003). The dramatic and narrative patterns of play. *European Early Childhood Education Research Journal*, 11(1), 69-78.
- Rainio, A. P. (2008). From resistance to involvement: Examining agency and control in a playworld activity. *Mind, Culture, and Activity*, 15(2), 115-140.
- Rainio, A. P. (2010). *Lionhearts of the playworld. An ethnographic case study of the development of agency in play pedagogy*. Studies in Educational Sciences 233. [Doctoral dissertation, Institute of Behavioural Sciences, University of Helsinki].
- Rainio, A. P., Mälkki, K., Mäkinen, M. (2021). Embracing 'the stranger' in us: Heterogeneity and ambivalent ways of being in classrooms. In M. Talvio, & K. Lonka (Eds.), *International Approaches to Promoting Social and Emotional Learning in Schools: A Framework for Developing Teaching Strategy* (pp. 15-36). Oxfordshire, UK: Routledge,
- Rieber, R. W., Carton, A. S. (1987). Imagination and its development in childhood. In: Rieber, R.W., Carton, A.S. (eds) *The Collected Works of L. S. Vygotsky. Cognition and Language*. Springer, Boston, MA. [https://link.springer.com/chapter/10.1007/978-1-4613-1655-8\\_15](https://link.springer.com/chapter/10.1007/978-1-4613-1655-8_15)
- Skene, K., O'Farrelly, C. M., Byrne, E. M., Kirby, N., Stevens, E. C., & Ramchandani, P. G. (2022). Can guidance during play enhance children's learning and development in educational contexts? A systematic review and meta-analysis. *Child Development*, 93(4), 1162-1180.
- UNESCO - United Nations Educational, Scientific and Cultural Organisation (1989). *Convention on the Rights of the Child*. Paris: UNESCO.
- Uspenski, E. (1994). *Crocodile Gene and his friends*. Knopf Books for Young Readers. (English translation).
- Whitebread, D. (2017). Free play and children's mental health. *The Lancet Child & Adolescent Health*, 3(1), 167-169.

# USE OF TECHNOLOGY IN SUPPORTING ECD CENTRES' PEDAGOGY AND MANAGEMENT FUNCTIONS TO PROVIDE QUALITY EDUCATION

**Adebunmi Yetunde Aina**

*Department of Education Management and Policy Studies, University of Pretoria (South Africa)*

## Abstract

Numerous studies focus on the advantages and elements of high-quality early childhood education but few to none concentrate on how technology tools are used to support their pedagogy and administrative functions. This study explored the provision of quality education through the use of technological tools of the selected ECD centres. Activity theory is employed to understand the technology tools and how they support and offer quality education at the participating centres. This study adopted a qualitative research approach and collected data through face-to-face interviews with eight participants purposively selected from four ECD centres situated in Pretoria. The data were analysed thematically. The findings reveal that participants believe that the use of technology tools will help the centre principals and teachers in their administrative duties and the teaching-learning processes. Although many of the participants lack tools and skills in technology usage. For instance, some participants said they cannot use digital applications to engage learners, maintain accounting records, or connect with parents. The study contributes to awareness and adherence to quality early childhood education by suggesting that ECD centres, principals and teachers should engage in relevant and practical training on establishing systems on the use of technology to enhance the provision of quality education. The study recommends a further empirical study on the topic of the digitalisation of administrative and teaching duties of ECD centre principals and teachers.

**Keywords:** *Technology Tools, Management, Pedagogy, Quality Early Childhood Education.*

---

## 1. Introduction

### 1.1. Quality ECE

Quality early childhood education (ECE) is acknowledged as having a long-term positive impact on children's lives as well as on society at large. Quality early childhood education includes those elements of the process and structural quality that stimulate, encourage and increase child outcomes in one or more of the development domains (Litjens & Taguma, 2010). Furthermore, according to Excell (2016), there are five indicators of quality ECE namely practitioners, leadership and management, environment, support systems and pedagogy resources. The quality ECE indicators identified by Excell (2016) are viewed as essential input resources when available and can improve quality learning at the ECD centres when used properly. Similarly, in South Africa, quality in early childhood development centres is mainly determined by the presence of structural and process quality indicators such as physical infrastructure, the learning programme, developmentally-appropriate education equipment, materials and resources, governance and financial management (Atmore, 2019). Concerning the ECE quality indicators, this study is intended to understand how technological tools are used to support pedagogy and management functions at some selected ECD centres in Pretoria South Africa.

### 1.2. Technology tools in early childhood education

The potential of technology in the 21st century to contribute to a dynamic, accessible, and comprehensive teaching and learning environment has led to its widespread acceptance around the world, notably in the educational sector (Alrefaie et al., 2020). Recently, the argument over whether technology should be used in early childhood education has evolved to concerns about how technology should be used and whether it has an impact on children's learning and development (Ko & Chou, 2014; Parette et al., 2010). Several studies show that using technology in a developmentally appropriate way can improve young children's learning, especially in the areas of emergent literacy, communication, problem-solving, and social skills through cooperation, and aiding children with disabilities and special needs (Darling-Hammond, Flook, Cook-Harvey, Barron & Osher, 2020). This implies that the use of technology tools has become the order of the day and has in one way or another enhanced the quality of

teaching and learning in early childhood education (ECE) in recent times (Ng'ambi et al., 2016). As such, it is vital to understand how technological tools are used to enhance teaching and management roles which are part of quality indicators in early childhood education. Computers, interactive books, interactive whiteboards, mobile devices, motion sensors, multi-touch tables, e-books, and programmable tools are examples of technology tools that can be used to support ECD centre practices (Hernandez et al., 2015).

### 1.3. Use of technology to support pedagogy and management functions in ECE as a quality indicator

In the context of early childhood education, pedagogy includes all instructional methods that promote learning (Agbagbla, 2018). Through play and routine daily activities, children are eager to learn from one another (Gashaw, 2014). Play contributes to children's development and helps them to practice newly acquired skills and concepts (Wood, 2010; Piaget, 1952). This suggests that playing should be emphasized in the pedagogy and curriculum for teaching young children as a useful way to improve the quality of education. Hernandez et al., (2015) state that ECD practitioners commonly employ computers and conventional software to teach curricular content to children. They further indicate that ECD practitioners use technology tools for their formal and informal professional development and also to connect with other ECE professionals. Therefore, technology tools can benefit both children and the human and material resources that are already present in their learning environment.

Although management responsibilities are important for improving the quality of ECD programs, many ECE processes lack this quality indicator (Myers, 2010). In the South African context, according to Mbarathi et al., the management systems and monitoring and evaluation tools required to oversee the performance of ECD centres are insufficient. Atmore (2019) also claims that Inadequate management and administrative mechanisms are a common problem at community-based ECD centres. However, the use of technology might help to solve the challenges with the ECD centres' management responsibility.

This study aimed to explore how the selected township ECD centres in Pretoria, South Africa, offered quality education by strengthening their teaching and management duties with technological tools. The research question to address the aim of the study is, '*How are technology tools used in ECD centres to enhance the pedagogy and management functions in sustaining quality education?*' The findings of this study are intended to help fill in the gaps in the knowledge concerning building technology-inclined quality ECE. Hence, this study is positioned to make recommendations concerning achieving one of the United Nations Sustainable Development Goals – quality education as well as the provision of quality services for South African young children.

## 2. Theoretical framework

The Activity Theory of Engeström (1996) was used as a lens to understand the use of technology tools in supporting the pedagogy and management functions at the selected ECD centres. Activity Theory sees technology integration as a facilitator of social action (Hashim and Jones, 2014). As sure using tools and technology to help facilitate is not a static process; the tools will have an impact on how the subject and the object interact. Engeström (1996) states that the work activity system is comprised of *subjects, tools, motives, rules, community, and division of labour*. The Activity theory is important and relevant for this study because it helps to identify and understand what to look for concerning the *tools* (what technology tools are available at the ECD centres). And how these tools were used – understanding the *subjects* (ECD practitioners), *rules* (principles that guide them), *motives* (reasons for using the tools), and *division of labour* (system in place).

## 3. Methodology

A qualitative research approach was used to explore the topic of this study which allows the gathering of data directly from the source and also to understand the participants' points of view (McMillan, 2014). A multiple case study design was engaged since it provides a greater scope of analysis. The purposive sampling technique was used to select four ECD centres situated in the township area of Pretoria, South Africa. One centre principal and one practitioner were chosen from each centre, in total, eight participants were selected. Participants' profiles are shown in Table 1.

Table 1. Participants' Profile.

ECD centre	Participants' pseudonyms	Position at the centre	Highest qualification	Gender	Years of experience in ECE
1	PR1	Principal	Diploma in ECE	Female	16
	PA1	Practitioner	Certificate in ECE	Female	5
2	PR2	Principal	Certificate in ECE	Female	9
	PA2	Practitioner	Diploma in ECE	Female	4
3	PR3	Principal	Certificate in ECE	Female	10
	PA3	Practitioner	Certificate in ECE	Female	4
4	PR4	Principal	Diploma in ECE	Female	11
	PA4	Practitioner	Diploma in ECE	Female	6

Data was collected through face-to-face semi-structured interviews at the participants' centre. The interview sessions were audio-recorded and transcribed to provide material for reliability checks. Data analysis was done thematically through coding and categorizing the generated data into themes that emerged from the data. Theoretical framework and research questions also served as a guide for the methodical study of data and its categorization into themes. To observe ethical standards, permission to conduct research was obtained from the centre principals, the aim of my study was explained to all the participants and consent forms were signed before any data is collected.

#### 4. Findings and Discussion

Two themes that emerged from the data analysis are discussed in the sub-headings below.

##### 4.1. Limited use of technology tools

The findings revealed that the participants have positive beliefs and attitudes towards the use of technology in engaging young children and performing their administrative activities. However, the majority of the participants were unable to use technology tools to enhance the quality of services they provide at their centres. The reasons for their inability to use technological tools in supporting their practices are what Johnson et al., (2016) referred to as external challenges to technology integration in the learning environment. These reasons are grouped and discussed below under theme two. Below are a few direct statements from the opinions of the participants.

*Things are changing and I believe that using technology to teach our children will help us and also help the children. I can say that I use technology like my phone to use rhymes, letters and numbers (PA2).*

*Yes, I like the idea of using technology to teach young children, so in our school, I downloaded songs for children, stories and animal pictures. I borrow teachers my laptop to use if am not busy with them (PR 3).*

*I cannot say that we are using technology tools to teach the children but we are trying our best... (PA 1). In our centre, our parents prefer face-to-face communication to send emails, so using technology for administrative work is not regular but I know that it can help us to keep records and also reduce paperwork (PR 4).*

*I downloaded some Apps on my tablet and I use them to teach them animals, colours, numbers and letters. I believe when young children see pictures and hear sounds at the same time, they don't forget quickly, so that is also good about technology tools (PA 4).*

The limited use of technological tools hinders the participants from giving a thorough explanation of how they use these tools in enhancing the quality of education but they displayed some level of confidence and positive attitude towards the use of technology. The positive attitude displayed by the participants towards the use of technology contradicts the claim of Peterson et al., (2018) that many ECE teachers find it difficult to adjust to a technology-enhanced learning environment because of their ingrained attitudes and beliefs. However, the reality still stands that limited technology use may result in lower-quality instruction for young children.

#### 4.2. Lack of technological resources

The data reveal that the participating township ECD centres do not have sufficient technology-based pedagogical knowledge, although they displayed some level of confidence and positive attitude towards the use of technology. Data also reveal limited technology tools in the centres to enhance their practices. The participants provided the following snippets as descriptions of these.

*Our greatest challenge is the lack of technology gadgets to teach children. I know that we can play songs on a big screen where the children can learn and also move their bodies but we don't have such equipment in our centre (PA 1).*

*As the principal, I want to learn more about how I can manage the staff members and parents using technology. Most times, I want to do online meetings and send important messages to our parents but I struggle in getting this done (PR 2).*

*In our centre, we need support in buying the latest technology tools and also training on how to use them to teach our children (PA 3).*

*I need more knowledge on how to prepare the school accounts on the computer, this will reduce my workload and stress (PR 4).*

The data reveals a lack of technological tools and sufficient technology-based pedagogical knowledge as factors that hinder the effective use of technology in enhancing the quality of ECE. This finding is similar to Johnson et al., (2016) extrinsic challenges to technology integration such as access to resources, training, and support. The need for support to make effective use of technology devices is also mentioned by Ogegbo and Aina (2020). The finding backs up Engeström's (1996) Activity Theory, which contends that technology tools are crucial to achieving a goal. The finding suggests that inadequate or absent technological tools may compromise the quality of early childhood education.

#### 5. Conclusion and Recommendations

Many studies concentrate on the benefits and components of quality early childhood education (Moore, Qaissaanee, & Sherretz, 2019; Excell, 2016), but very few, if any, look into how technology tools are used to support their pedagogical and administrative processes. This study explored the use of technological tools in supporting the pedagogy and managerial functions of the selected ECD centres. The study reveals that the participants have a positive attitude and confidence in the use of technology tools. They also believe that the use of technology tools would improve the quality of their teaching and administrative duties. However, technology tools are rarely used due to external challenges like limited technology tools, and lack of technological pedagogical knowledge and support. The absence of these essential technological resources will negatively affect the quality of early childhood education. Therefore, this present study recommends that training support and pedagogical orientation on the use of technology should be provided for early childhood principals and practitioners. The ECD centres should also be supported with technological tools by the government and parents and business organizations. Further study is recommended on the digitalization of ECD centre administrative activities.

#### Acknowledgment

I would like to express my sincerest gratitude to Google General Research Support Grant that has made it possible for me to attend the conference and publish this paper.

#### References

- Agbagbla, F. (2018). *A professional development programme for Ghanaian kindergarten teachers to implement an indigenous play-based pedagogy* [Doctoral Dissertation, University of Pretoria]. UPSpace Institutional Repository.
- Alrefaie, Z., Hassanien, M., & Al-Hayani, A. (2020). Monitoring online learning during the COVID-19 pandemic; Suggested online learning portfolio (COVID-19 OLP) [version 1]. *MedEdPublish*, 9, 110.

- Atmore, E. (2019). *An Interpretive Analysis of the Early Childhood Development Policy Trajectory in Post-apartheid South Africa* [Doctoral Dissertation, Stellenbosch University]. SUNScholar Research Repository.
- Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for the educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97-140. Retrieved from <https://doi.org/10.1080/10888691.2018.1537791>
- Engeström, Y. (1996). Developmental work research as educational research: Looking ten years back and into the zone of proximal development. *Nordisk Pedagogik/Journal of Nordic Educational Research, 16*, 131-143.
- Excell, L. (2016). Interrogating quality in early childhood development: Working towards a South African perspective. *South African Journal of Childhood Education, 6*(1), 1-9.
- Gashaw, R. (2014). *Quality of Early Childhood Care and Education: The case of selected Government ECCE centers in Bole and Kirkos Sub-cities in Addis Ababa, Ethiopia* [Master's thesis, University of Addis Ababa]. AAU Institutional Repository.
- Hashim, N. H. & Jones, M. L. (2007). *Activity Theory: A framework for qualitative analysis*. <http://ro.uow.edu.au/commpapers/408>
- Hernandez, M. W., Estrera, E., Markovitz, C. E., Muyskens, P., Bartley, G., Bollman, K., Kelly, G. & Silberglitt, B. (2015). *Uses of technology to support early childhood practice*. OPRE Report. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.
- Johnson, A. M., Jacovina, M. E., Russell, D. G., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. In S. A. Crossley & D. S. McNamara (Eds.) *Adaptive educational technologies for literacy instruction* (pp. 13-29). New York: Taylor & Francis.
- Ko, C.H., & Chou, M.J. (2014). Aesthetics in early childhood education: The combination of technology instruments in children's music, visual arts and pretend play. *Journal of Social Sciences, 10*(1), 39-45. doi: 10.3844/jssp.2014.39.45
- Litjens, I., & Taguma, M. (2010). *Revised literature overview for the 7th meeting of the network on early childhood education and care*. Paris: OECD.
- McMillan, J. S., S. (2014). *Research in Education: Evidence-Based Inquiry*. (7th ed.). London: Pearson Education Limited.
- Moore, L., Quassaanee, H., & Sherretz, K. L. (2019). *Delaware's Early Childhood System & the Economy: Benefits & Barriers to High-Quality Early Childhood Education and Childcare*. Institute for Public Administration.
- Myers, R. G. (2010). *In search of educational quality: A Mexican experience* [Paper presentation] Conference on Beyond Child Indicators: A Framework to Assess and Evaluate the Quality of Early Childhood Services and Programs in Global Contexts. NYU Abu Dhabi Institute, Abu Dhabi, United Arab Emirates.
- Ng'ambi, D., Brown, C., Bozalek, V., Gachago, D., & Wood, D. (2016). Technology-enhanced teaching and learning in South African higher education—A rearview of a 20-year journey. *British Journal of Educational Technology, 47*(5), 843-858.
- Ogegbo, A. A., & Aina, A. (2020). Early childhood development teachers' perceptions on the use of technology in teaching young children. *South African Journal of Childhood Education, 10*(1), a880. <https://doi.org/10.4102/sajce.v10i1.880>
- Parette, H., Quensenberry, A., & Blum, C. (2010). Missing the boat with technology usage in early childhood settings: A 21st-century view of developmentally appropriate practice. *Early Childhood Education Journal, 37*(5), 335-343. doi: 10.1007/s10643-009-0352-x
- Peterson, A., Dumont, H., Lafuente, M. & Law, N., (2018). 'Understanding innovative pedagogies: Key themes to analyse new approaches to teaching and learning', *OECD Education Working Papers, vol. 172*, pp. 1-134.
- Piaget, J. (1952). *The origins of intelligence in children*. New York: International Universities press.
- Wood, D. (2010). *How Children Think and Learn*, eTextbook. London: John Wiley & Sons.

# INSPIRATION FOR PRESCHOOL TEACHERS: CONTENT ANALYSIS OF CZECH FACEBOOK GROUP

**Marie Dědičová**

*Department of Pre-primary and Primary education, Charles University (Czech Republic)*

## Abstract

According to Britannica Dictionary inspiration is: “something that makes someone want to do something or that gives someone an idea about what to do or create” (@2023). Inspiration is one of the most important things in the teaching profession, teachers are always looking for new inspiration and ideas, what to do in their classrooms. And when the teachers lack inspiration, they try to find it, not in the books anymore, but on the internet. In this study the content of the biggest Czech Facebook group for preschool teacher “Inspiration for preschool teachers” (nearly 40 000 members) was analyzed. Because according to the Czech Statistical Office (2022) there are only 33 156 preschool teachers in the Czech Republic, only the posts that were clearly from preschool teachers were included in this research.

The main goal was to identify what kind of inspiration the teachers are looking for on Facebook, and what kind of inspiration are the teachers sharing in this group. From 623 posts (month and a half of posts) the following themes and characteristics were identified: Planning (activities in general, songs, fairy tales & rhymes, art, movement games, group activities, literacy, dramatization, math and themes). Equipment (art supplies, IT supplies, decorations, furniture, specific pictures or books), External programmes; Education. With the most common theme being questions about planning, specifically activities in general, when the teachers have a given theme and are asking for any activity related to this theme.

From the second research question “what kind of inspiration are the teachers sharing” were following themes and categories identified: Activities (art, math, literacy, inquiry-based learning, movement activities, graphomotoric, dramatization, polytechnic, group activities, songs). Education; External programmes, Materials and Decorations.

**Keywords:** *Inspiration, Facebook, preschool teachers, Czech Republic.*

## 1. Introduction

Being a teacher means constantly looking for new inspiration, constantly looking for new ways how to engage students, looking for new methods, materials or activities. The role of the teacher is constantly expanding, as are the necessary competences that a teacher must master. Teachers have new and additional responsibilities that they did not have a few years ago, and new problems appear every day for which they were not prepared (e.g. the Covid-19 epidemic or the war in Ukraine).

According to the Decree no.317/2005 Coll: “Teachers in the Czech Republic are obliged to continue to educate, deepen, renew and supplement his/her qualifications during the period of his/her teaching activity, i.e. even after completing his/her studies to obtain a professional qualification.”

Just as new problems emerge, so do new possibilities and opportunities that teachers can use to confront these problems. For this research we use the factor of inspiration - as an important factor that helps in problem solving. This is because when one is inspired, one can come up with more positive solutions. (Buheji & Ahmed, 2017). Inspiration is defined as “something that makes someone want to do something or that gives someone an idea about what to do or create.” (Britannica Dictionary, @2023) Or as “a breathing in or infusion of some idea, purpose, etc. into the mind; the suggestion, awakening, or creation of some feeling or impulse, especially of an exalted kind” in the Oxford English Dictionary (Simpson & Weiner, 1989, p. 1036). For teachers, inspiration is important not only because they need inspiration for the new teaching methods and ideas how to motivate their students, but also inspiration matters “since it fulfills an important aspect of our life essentials, be it our personal needs and/or professional growth and development. Inspiration has also a positive impact on our psychological well-being and life satisfaction.” (Buheji, Saif & Jahrami, 2014, p.22)



Nowadays teachers tend to look for inspiration to online space. For example, in the study of Janicke-Bowles et al. (2019), 64% of U.S. participants reported that they have been inspired by media content at least a few times a week, and they were also motivated to seek out more inspiring content. Even though there are many different places where to look for inspiration, the teachers still frequently use Facebook.

The Facebook group “Inspiration for preschool teachers”, which was selected for this research, has more than 40 000 members, and is quite active with approximately 35 post per day. For comparison, there are only 33 156 preschool teachers in the Czech Republic, according to the Czech Statistical Office (2022). In Turkish research (Sumuer, Esferb & Yildirim, 2014) was found that 71.9% of preschool teachers have been actively using Facebook for more than 3 years. In the research on music teachers’ perception on professional Facebook groups for teachers (2017) 97.7% check their Facebook account at least once a day. Sumuer, Esferb & Yildirim (2014, p.548) also proved that “although the teachers did not tend to have a high intensity of Facebook use, they were more likely to integrate Facebook into their daily routine, use frequently in a day, spent a considerable amount of time on, had contact with a large number of friends through and had a regular access to via computers and mobile phones. Teachers mostly used Facebook primarily for social engagement, entertainment and information.” In a study of teachers' perceptions of a professional Facebook group (Rhodes, 2017, p. 91), they found that the most common activity in the group was usually "reading other people's posts" (89.8%). The next most common activity was "searching for and reading old posts (49.8%). Most participants rarely or never posted their own posts (77.7%) or commented on other people's posts (51%).

Although we do not have data on how often and in what way Czech kindergarten teachers use Facebook, we can say that according to foreign research, the number of Facebook group members (which is still increasing) and the frequency of posts in the studied group, Facebook is a popular medium for sharing and finding inspiration. Scientifically, the question of how many Czech teachers use Facebook and how often was only briefly mentioned in the bachelor thesis (Ottová, 2018), where it was found that 90% of preschool teachers use Facebook to find inspiration for art activities.

## 2. Methodology

The aim of this research was to find out what kind of inspiration teachers seek and share in the Facebook group: “Inspiration for preschool teachers.” We tried to find out what kind of things teachers are proud of - and not afraid to share. And what teachers struggle with the most - and therefore seek help (inspiration). A mixed (qualitative and quantitative) research method was used for this research.

At the first phase of the research, we looked at the Facebook group and we analyzed around 200 posts (and went through almost 500) to refine what we would be looking for and to prepare a first draft of categories. After we have refined the first draft of categories, we prepared an excel spreadsheet with metrics to count the posts that correspond to each category.

During the research, we analyzed 623 posts that were posted in the Facebook group over a month and a half period. We had to go through many more posts than we analyzed because 2/3 of the posts in the groups are posts from various vendors that are selling their materials or worksheets. We wanted to analyze more posts, but nowadays Facebook has a limit of how many posts can be viewed at one time, and we couldn't surpass the number. That's also why we only analyzed posts created within a month and a half period, because we couldn't view older posts without using the "search" feature. We also tried to use only posts created by preschool teachers. We looked to see if the person who posted the question/shared the image was a preschool teacher, if this information was clearly written in the question, if it was posted on their Facebook profile, or if the image was clearly taken from the kindergarten. Posts in which teachers did not share or seek inspiration were also not considered.

The posts were coded immediately upon reading and the codes were counted manually (using an excel spreadsheet and hand-made meters). The codes were condensed, reconstructed and grouped into themes. The themes were then summarized into categories. The categories were re-arranged multiple times, to find out the right meaning of each one and to be sure the category contains only the relevant themes.

The results are presented in a graphs and in percentages of how many times the code appeared. Post citations are added to better understand the meaning of each category.

Research questions:

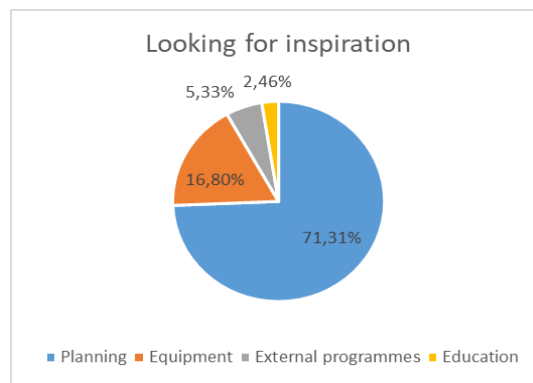
1. What kind of inspiration are teachers looking for on Facebook group?
2. What kind of inspiration are teachers sharing in Facebook group?

### 3. Results

First important finding from the research is that 60,08% of the post were sharing the inspiration and 39.2% were looking for inspiration. This may be due to the satisfaction that comes from sharing one's work with other teachers "because they would like to help others who have similar information needs, or they are interested in a selfless good deed" (Oh & Son, 2015, p. 2057).

#### 3.1. What kind of inspiration are teachers looking for on Facebook group?

Figure 1. Looking for inspiration 1.



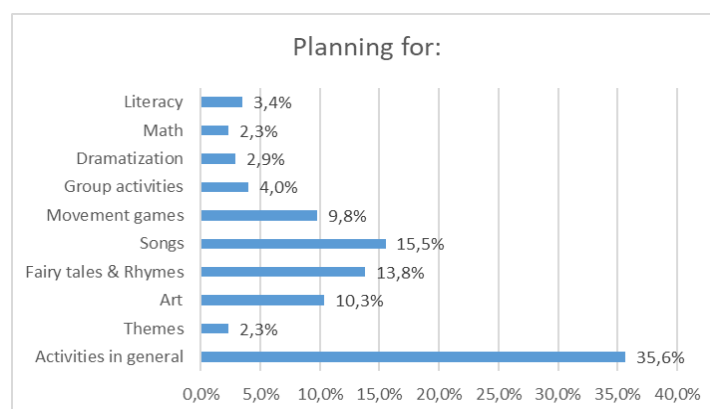
What kind of inspiration were the teachers looking for can be divided into four categories: Planning (71,3%), Equipment (16,8%), External programmes (5.33%) and Education (2.46%).

The category **Equipment** contained questions about art supplies, IT supplies, decorations, furniture, specific pictures or books: "Hello. I have a question about tablets in kindergarten. Does anyone have and if so where do you download the files.... Thank you very much"

In the category **External programmes** there were teachers looking for good external programmes that are pre-approved by the other teachers in the group. "Good afternoon, does anyone have a tip for an afternoon program for kindergarten children. Thinking of a pre-school graduation event. Some kind of animator with dancing, competitions or something like that? Zlín or Olomouc region. Thank you."

In the category "**Education**" the teachers were asking for tips for interesting online or offline seminars/courses about some theme. "Hello, can I ask you a question: do you have a tip for a course for teachers, longer, focused on PE, health exercises, etc. for preschoolers? Thank you."

Figure 2. Planning 1.



The category **Planning** - being the most featured (71,31%) can be divided into 10 more concrete categories: Activities in general (35,6%), Songs (15,5%), Fairy Tales & Rhymes (13,8%), Art (10,3%), Movement games (9,8%), Group activities (4%), Literacy (3,4%), Dramatization (2,9%), Math (2,3%), Themes (2,3%).

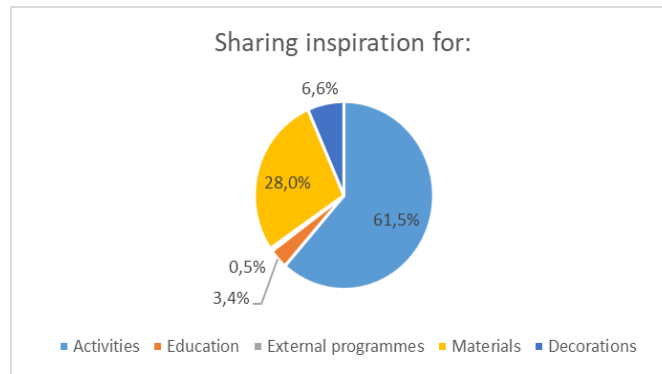
This category contains two types of situations when teachers are looking for inspiration. The first one is that the teachers are looking for tips for any activity in general. according to some theme, or according to children's age. "Hello, next week's topic is Space, Stars, Sun... I'd be happy for any ideas, be it art,

*movement, rational, poems, songs, anything you can think of. I can't think of much, I've never had this theme before, so I'd like to be inspired by more experienced ones. Thank you very much”*

The second situation is that the teachers are looking for inspiration for more specific and concrete types of activities (for art, movement game, song etc.) *“Please give me inspiration for movement games... or “monkey track” for children 2-4 years old? Thank you very much.” “Hello, I would like to ask for a recommendation of a song on the theme of meadow (in summer), wild flowers. Thank you very much.”*

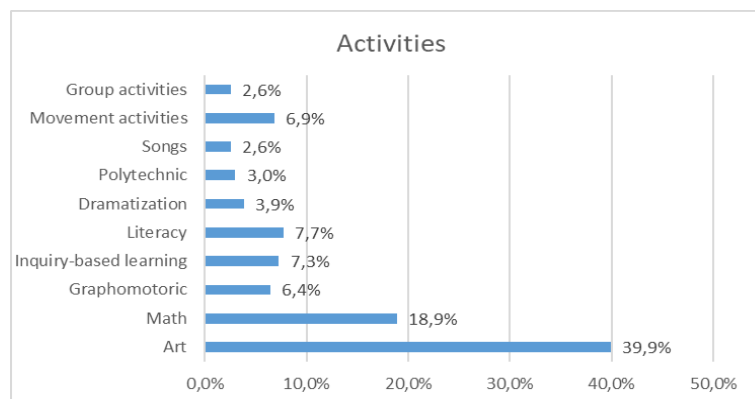
### 3.2. What kind of inspiration are teachers sharing in Facebook group?

Figure 3. Sharing inspiration.



From the graph we can see that most of the teachers are sharing inspiration for **Activities (61,5%)**. It is logical, that the teachers mostly share inspiration for the activities - it is something they have done in their own classroom. It's also what other teachers in the Facebook group most often search for.

Figure 4. Activities.



The activities which are the teachers mostly sharing the inspiration for are: Art (39.9%), Math (18.9%), Literacy (7.7%), Inquiry-based learning (7.3%), Movement activities (6.9%), Graphomotoric (6.4%), Dramatization (3.9%), Polytechnic (3%), Group activities (2,6%), Songs (2,6%). The most typical post in the group is a picture of some product that the kids made and teachers are sharing how they have done it. *“Our Easter baskets ... or how to use empty tissue boxes”*. *“Simple eggs that even 3-year-olds could handle. Marbling, balling, sponging.”*

Great number of teachers were also **sharing materials (28%)** - being their own collections of materials or worksheets they made. Category Materials also included tips for interesting pictures or books: *“I highly recommend the hatchery for kids, it's great fun and the result. The kids are thrilled, plus it's very educational.”*

In the category of **“External programmes” (3.4%)** they shared tips for good providers of external programmes: *“We had a wonderful trip to the Insect Kingdom today, big thanks to Mrs Eva, the children were enthusiastic, lovely interactive talk with music and movement. And we could all touch the insects. I recommend.”*

And in the category **“Education” (0.5%)** they shared tips for online or offline seminars in which they participated. *“I definitely recommend this course. I took it myself and it helped me a lot. The lecturer is very inspiring, has many years of experience, has published and works in inspection.”*

In the last category, “**Decorations**” (6.6%) the teachers are sharing what decorations they made for their classroom (teachers alone, without kids), or how their classroom is decorated.

#### 4. Conclusions

Answer to the first research question: "What kind of inspiration do teachers look for in a Facebook group?" is that most teachers a) look for inspiration for any activity that is related to a topic they have in mind, or b) look for inspiration for a specific activity (most often songs, art activities, stories and rhymes, and movement games), (71.31%). Teachers also look for inspiration for Equipment (16.8%), External Programs (5.33%) or Education (2.6%).

The answer for the second research question “What kind of inspiration are teachers sharing in Facebook group?” is that the teachers are mostly sharing inspiration for activities (61.5%), for materials (28%), for decorations (6.6%) for external programmes (3.4%) and education (0.5%).

We can say that, as in Lantz-Andresson, Peterson, Hillman, Lundin & Rensfeldt research (2017), the most prominent theme in the research was requesting and giving tips.

One of the important findings of the research is that in 60.08% of the posts people shared inspiration and in 39.2% they were looking for inspiration. This also corresponds with the Oh & Syn research (2015) that Facebook users are highly motivated to share their information because they would like to help others who have similar information needs or they care about selfless good deeds.

The results of this research can help us better prepare future teachers for their profession - by understanding what inspiration they are looking for, we can prepare them for better classrooms and give them what they will need in their teaching profession. We can also identify ways to create more effective professional development opportunities - as part of mandatory "continuing education for teaching staff."

Also, the data found here can be used to create new educational technologies or methods - depending on what teachers are struggling with most. If a mentoring teacher wants to improve and offer student teachers what they are looking for, they need to know, or at least suspect, what is happening in Facebook groups as well. As Lieberman & Pointer-Mace's (2010, p. 77) research states, professional development opportunities are: "fragmented, disjointed, and irrelevant to the real problem of their classroom practice."

#### References

- Buheji, M., & Ahmed, D. (2017). *Breaking the Shield: Introduction to Inspiration Engineering: Philosophy, Practices and Success Stories*. Archway Publishing.
- Buheji, M., Saif, Z., & Jahrami, H. (2014). Why inspiration matters. *Journal of inspiration economy*, 1(1), 15-24.
- Český statistický úřad. (2022). *Školy a školská zařízení za školní rok 2021/2022*. [Schools and school facilities for the school year 2021/2022]. Praha: Český statistický úřad.
- Decree No. 317/2005 Coll. *Decree on further education of teaching staff, accreditation commission and career system for teaching staff*.
- Janicke-Bowles, S. H., Raney, A. A., Oliver, M. B., Dale, K. R., Jones, R. P., & Cox, D. (2019). Exploring the spirit in U.S. Audiences: The role of the virtue of transcendence in inspiring media consumption. *Journalism & Mass Communication Quarterly*, 98(2), 428-450.
- Lantz-Andersson, A., Peterson, L., Hillman, T., Lundin, M., & Rensfeldt, A. B. (2017). Sharing repertoires in a teacher professional Facebook group. *Learning culture and social interaction*, 15(4), 44-55.
- Lieberman, A., & Pointer Mace, D. (2010). Making practice public: Teacher learning in the 21st century. *Journal of teacher education*, 61(1-2), 77-88.
- Oh, S., & Syn, S. Y. (2015). Motivations for sharing information and social support in social media: A comparative analysis of Facebook, Twitter, Delicious, YouTube, and Flickr. *Journal of the Association for Information Science and Technology*, 66(10), 2045-2060.
- Ottová, V. (2018). *Social networks as a means of communication for teachers of kindergartens with a focus on sharing ideas for work activities*. [Bachelor's thesis, Západočeská univerzita v Plzni]
- Rhodes, A. L. (2017). *Early-career music teachers' perceptions of the Facebook Band Directors Group as professional induction* [Doctoral dissertation, University of Illinois at Urbana-Champaign].
- Simpson, J. A., & Weiner, S. C. (Eds.). (1989). *Oxford English Dictionary* (2nd ed., Vol. 7). Oxford, England: Clarendon Press.
- Sumuer, E., Esfer, S., & Yildirim, S. (2014). Teachers' Facebook use: their use habits, intensity, self-disclosure, privacy settings, and activities on Facebook. *Educational Studies*, 40(5), 537-553.

# VIRTUAL REALITY IN PRE-SERVICE TEACHER EDUCATION: CHALLENGES OF REALIZATION IN MUSIC EDUCATION

**Ari Poutiainen, & Heidi Krzywacki**

*Faculty of Educational Sciences, University of Helsinki (Finland)*

## Abstract

Virtual reality (VR) is seen as a tool that can enrich and advance education but there are still pedagogical and practical challenges to overcome. In this article, we present some findings on the VR usage in teacher education and student teachers' experiences and perceptions of employing VR especially in music education. We apply a categorization by Bower et al. (2020) to our analysis in order to structure student teachers' reflections. It appears that the VR applications for music are yet rather limited, their quality varies, and their pedagogical applicability seems to be poor. We argue that it is necessary to develop and design VR technology for educational purposes in collaboration with different stakeholders including teachers, and thus, address the current technical and pedagogical challenges.

**Keywords:** *Pre-service teacher education, student teacher, virtual reality, music education.*

---

## 1. Introduction

Virtual reality (VR) technology has caught educators' interest. It is seen as a tool that can enrich and advance education, take it to a new level. In general, VR and related technological solutions are considered to have tremendous potential for enhancing and transforming education (Fowler, 2015; see also Pendergast et al., 2022). Still, it seems that the pedagogical and practical challenges in using VR in different educational contexts are hardly overcome. As Fowler (2015) has stated, there is a need for pedagogical models and better understanding of the perspective 'design for learning' when the use of VR technology in education is discussed.

One way to meet these challenges is to investigate the user experience and delve into users' perceptions of VR as a tool for teaching learning. In this article we focus on studying the use of VR in teacher education similar to some other scholars (e.g. Cooper et al., 2019; Pendergast et al., 2022). We authors work as associated professors of teacher education at the University Helsinki (Finland). As a part of our academic work, we frequently examine fresh pedagogical approaches aligned with equipment. We test their applicability in engaging student teachers in using digital technology. In this research we focused on music education.

Music is a challenging school subject. It calls for a wide selection of crafts and skills. Our study is based on activities employing VR technology as a pedagogical teacher training instrument. This article presents our findings of student teachers' experiences and perceptions of using VR in music education.

## 2. Theoretical framework

Several scholars have noticed the importance of applying VR in pre-service teacher education. VR can provide student teachers authentic experiences and strengthen their willingness to use this technology in their future work. (Bower et al., 2020; Cooper et al, 2019). Both researchers and practitioners understand that there are still several essential issues to overcome. Typically, teachers are expected to solve independently, as a part of their classroom work, the pedagogical problems that are related to VR usage.

Users' willingness and attitudes appear essential for transforming practices. Bower et al. (2020) have examined student teachers' motivational background of intention to use VR in future work by employing the UTAUT model (by Venkatesh et al., 2003; originally a model for acceptance of new technologies by Davis, 1989). They claim that it is difficult to establish a rooted habit of applying VR technology in teaching and learning. However, they show that student teachers do value hedonic motivation (i.e. enjoyment) most as a catalyst for a change in their habits. Bower et al. (2020) categorize constraints of using VR in teaching and learning to three areas, which we also apply in our study:

- *External barriers* such as technology and functionality, access, logistics and support. External barriers associate to the organization of work, time and VR in working environment.
- *Internal barriers* such as attitudes and appreciation of the potential VR provides for education. The internal barriers are also related to expectations of technology in general. Internal barriers grow from the lack of experience and negative perceptions of technology. At the same time, there is some evidence that enjoyment and positive experience in technological design that fits classrooms improve confidence and willingness to use such technology.
- *Design-related barriers* refer to users' abilities to act creatively when using VR applications. This relates to their personal technical skills and attitudes but also how well they notice pedagogically meaningful tasks and function.

One way to address the need for pedagogical design for using VR is to consider applications for a specific subject area. Serafin et al. (2017) state that technologies might offer an alternative approach to areas of music education such as training rhythmic skills, playing together with others regardless time and place (i.e. creating social presence), training stage fear, training composition and music production, training STEAMS skills and training acoustics. Still, the potential of using VR in music education is recognized only in few areas of music education at school.

In this study, we apply the categorization by Bower et al. (2020) to our analysis in order to structure student teachers' reflections on their experience in music education. However, we extend our analysis to investigate both supportive and hindering aspects, and thus rename the three categories as external, internal and design-related factors.

### 3. Research data and approach

We started our project on using VR in music education as early as spring 2019. The global pandemic, however, caused lockdown restrictions which made it impossible to carry out any activities with the VR equipment. Our research involved a VR laboratory which again entailed a large classroom that was equipped with a VR system by Vive. We refer to VR as 3D-simulated environments where one interacts by employing a headset and two controllers. The immersive experience involves body movements, images and sounds. VR environments can be simulations of reality or fictional. (Hemminki-Reijonen, 2021; Vasarainen et al., 2021).

In the fall 2022, we involved 17 volunteer student teachers in our VR study project and accomplished a research data collection. These students studied for example the fundamentals of music theory, rhythm and pulse, composing and producing by experimenting with representative VR applications.

Our research data comprises of student teachers' written reflections in which they share constructive and critical views on how to apply VR both in higher education and schools. In addition to this data, we made some notions during the experiment, and these were helpful in our data analysis and interpretation of the student teachers' experience. Our qualitative research draws from theory-driven content analysis.

### 4. Experiences and perceptions of using VR in music education

In general students had positive expectations of VR technology. Most of them had employed VR but only for a brief time. All of them started testing in uplifted spirits and announced their enjoyment of the immersive, playful and inspiring experience. Soon as they had become more familiar with the VR technology, they felt ready to comment and criticize constructively it and the applications they had used as well.

We present our findings on student teachers' perceptions and experience by structuring them according to external, internal and design-related factors (cf. Bower et al. 2020). We limit our analysis to mainly those aspects that focus on music education and only briefly introduce some of the interesting additional material. We have anonymized our student responses and refer to them with acronyms S1-S17.

#### 4.1. External factors

All students were fascinated by VR as a new tool. However, there were also several technological issues. In this regard, majority of the students mentioned the high cost of the equipment, considerable space requirements, VR applications' limited language selection (i.e. there were no tutorials available in students' mother tongue, Finnish), challenges related to sustainable development and equality, disability to work together in small groups, too complex or difficult applications and their badly designed tutorials. Obviously, this developing digital technology still has several general challenges to overcome before it can reach a wide popularity.

Learning to use VR system was seen somewhat time-consuming. VR also raised a concern of privacy and sensibility: Our VR laboratory was not completely private, and two students (S3, S14) reported that they felt vulnerable to outside impulses and disturbances (happening in reality) when they were deeply immersed in VR. Some students (S1, S6, S10, S15) brought up motion sickness and dizziness as a challenge when using VR (cf. Howard and Van Zandt, 2021). VR technology also has some other physical issues: A few students reported, for example, that the VR headset was relatively heavy to wear and could not be used for longer time periods (S1, S2, S8, S11).

#### 4.2. Internal factors

It was somewhat surprising that student teachers hardly reflected on their personal stances towards using technology and especially VR in education. As some scholars have noticed (e.g. Bower et al., 2020; see also Cooper et al., 2019), teachers' perceptions and attitudes relate to their willingness to apply technological solutions in their work. For example, the lack of self-efficacy and not being convinced of the benefits of using VR do decrease teachers' motivation.

Due to students' strong pedagogical motivation and call, however, they did wish to reflect VR in more general educational levels. They acknowledged that VR does have plenty of various pedagogical potential. It offers, for example, a chance to visit far-away places, areas of music history, musical genres, concerts and environments that could otherwise be out of reach or beyond restricted access (S2, S3, S8, S10, S11, S12, S16). VR also grants an exceptional chance to design and paint 3D fine art objects (S2). In addition, students suggested that younger pupils could face frightening places or environments (e.g. heights and dark rooms), take part in physical education and learn about travelling in an airplane first and safely in VR (S11, S12, S14). In addition, a chance to learn biology and geography in VR was highlighted in several responses.

#### 4.3. Design-related factors

Design-related factors refer to the users' abilities to act creatively with the VR. This relates to how well one can notice pedagogically meaningful tasks and function (see Bower et al., 2020). Apparently, the musical VR applications were not originally designed according to any pedagogical aims but simply for having fun with music and playing in VR. Our test group, however, had a severe interest in education and related matters. Therefore, the group members were imminently toned to observe these applications pedagogically.

Among the most popular musical VR applications the students explored were "Beat Saber", "Drops: Rhythm Garden", "EXA" and "LyraVR". Most of them saw the quality of the applications problematic. They were poorly designed for learning and teaching any fundamentals of music. Two students reported that they experienced EXA's dark and murky working environment distressing, heavy and unpleasant if compared to other applications' environments (S13, S15). Another two students (S1, S11) pointed out that actually those instrumental musical skills that one could learn in VR can hardly be removed to reality: playing of a virtual instrument does not directly benefit the playing of a real instrument. One student criticized the VR instruments' sounds being dissatisfactory and lacking timbral quality (S4).

Although safety is not a significant factor within music education, some students (S1, S8, S13) mentioned that this aspect could be taught in VR, just like precautions of dangerous tools in crafts (e.g. in welding). VR has been successfully applied in this fashion, for example, in surgical training (see Pulijala et al., 2018). Some students (S4, S7, S13) highlighted that through musical VR applications pupils could examine and try more special and traditional instruments, instruments they normally could not have access to since they are too expensive or rare, for example. Also, the immersiveness of VR may create a kind of embodiment or at least strengthen the internalization of musical information if compared to mere listening and following of music (S9). Testing musical VR instruments could as well work as a source of motivation to learn real instruments and related skills (S15).

One student (S4) pointed out that one could learn how to play in a small band in VR, reach sentiments of rehearsing with an ensemble instead of practicing alone. Another (S11) suggested that in order to overcome stage fright one could keep dress rehearsals of a musical performance in VR. A third (S16) saw aspects related to classroom pedagogy (e.g. observation of classes, recording and studying personal pedagogical performance) fascinating. Two students (S7, S9) forecasted that in the future people can connect to the same VR space from separate locations and that this will grant an exciting possibility regarding ensemble playing.

The application "Drops: Rhythm Garden" was among students' most favorite since it is based on a relatively simple but playful idea of constructing rhythms and soundscapes by adding obstacles to a brook of dropping, sounding marbles. Its tutorial also appeared to be approachable. One student (S5) envisioned that the "rhythmical sceneries" created in the application could be applied as a background for improvisations and physical musical activities (e.g. dance). According to another (S6), this application

could be applied in teaching directions, distances and other physical attributes of objects, musical tempo, measuring of 3D objects – and verbalizing and discussing these concepts. A third student (S9) suggested that pupils could be assigned to accomplish a shared construction by taking turns and adding obstacles one by one. This way they could learn the fundamentals of improvisation. One wished to celebrate the liberating and creative feeling that this application's playful concept did spark (S10).

EXA and LyraVR applications offer a chance to study and learn music production in an environment that reminds of a recording studio. This aspect was especially embraced by one (S2) student. Many others who learned and tested these applications unfortunately reported issues regarding the complexity of the workstations and their tutorials. Within these applications the musical information is visualized (but not notated) for the user. One student (S6) saw this inspiring and claimed that 3D notation in VR seems considerably easier to comprehend if compared to the traditional 2D musical notation.

Some students also discussed their VR testing experiences in relation to more general aspects and elements of educational sciences. Some (S4, S9, S15) agreed that VR embraces constructive learning models and phenomenon-based teaching. On the other hand, one wished to warn about VR technology taking to learning that is teacher-led (S4). It was also found out that VR indeed offered exciting potential within classroom pedagogy, training and practice (S9, S14). One noted that musical VR applications could be applied in developing kinesthetic memory that is a significant part of musical instrumental skills in reality (S10). Another initiated a project where a musical instrument was to be designed in VR and then 3D printed or crafted by hand (S17).

## 5. Towards VR that is designed for education

Our study focused on encouraging and hindering aspects that influence student teachers' willingness to develop their skills in using VR and their motivation to apply this technology in their pedagogical work. We analyzed student teachers' (N=17) reflections in terms of external, internal and design-related factors. Our categorization applied a model of three barriers that was originated by Bower et al. (2020). We wished to learn about student teachers' views and attitudes without announcing any specific goals for their VR adaptations. At the end we could report more on external and design-related factors and less on internal factors.

It was clear that the three factors can overlap and influence each other. Our results, however, are in line with notations by Cooper et al. (2019). They reported that despite student teachers' favorable dispositions towards VR technology and positive expectations (internal factor), one of the challenges is nonexistent platforms and pedagogical designs that are in an agreement with teaching syllabus (design-related factor). This implies that it is worth studying profoundly (student) teachers' perceptions and use of VR technology and attempt to develop a model for mapping out the influential factors.

Even if several scholars widely recognize the potential of VR technology and its usage and set high expectations for it, it seems that we still lack pedagogical models and approaches that could support us in employing VR for teaching and learning. Evidently this technology should overcome some practical issues of accessibility and functionality first: establishing a VR laboratory essentially leads to designing and re-organizing of a learning environment. VR sets are still relatively expensive as well. In regard to music education especially, it appears that the musical VR applications are rather limited, their quality varies, and their pedagogical applicability appears to be poor. We argue that teacher educators and teachers should be actively involved in application design processes, in order to make the applications successful both technically and pedagogically. Only then could we provide meaningful VR experiences for our student teachers and secure in them a willingness to use VR in their future work.

## References

- Bower, M., DeWitt, D. & Lai, J. W. M. (2020). Reasons associated with preservice teachers' intention to use immersive virtual reality in education. *British Journal of Educational Technology*, 51(6), 2214-2232. Retrieved April 16, 2023 from <https://doi.org/10.1111/bjet.13009>
- Cooper, G., Park, H., Nasr, Z., Thong, L. P. & Johnson, R. (2019). Using virtual reality in the classroom: Preservice teachers' perceptions of Its use as a teaching and learning tool. *Educational Media International*, 56(1), 1-13. Retrieved April 16, 2023 from <https://doi.org/10.1080/09523987.2019.1583461>
- Fowler, C. (2015). Virtual reality and learning: Where is the pedagogy? *British Journal of Educational Technology* 46(2), 412-422. Retrieved April 16, 2023 from <https://doi:10.1111/bjet.12135>



- Hemminki-Reijonen, U. (2021). *Virtuaaliodellisuus oppimisessa: Opas opettajalle* [Virtual reality in learning: A teacher's guide]. Helsinki: Opetushallitus. Retrieved April 16, 2023 from <https://www.oph.fi/fi/tilastot-ja-julkaisut/julkaisut/virtuaaliodellisuus-oppimisessa>
- Howard, M. C., & Van Zandt, E. C. (2021). A meta-analysis of the virtual reality problem: Unequal effects of virtual reality sickness across Individual differences. *Virtual Reality*, 25, 1221-1246. Retrieved April 16, 2023 from <https://doi.org/10.1007/s10055-021-00524-3>
- Pendergast, D., O'Brien, M., Prestridge, S., & Exley, B. (2022). Self-efficacy in a 3-dimensional virtual reality classroom: Initial teacher education students' experiences. *Education Sciences*, 12(6), 368. Retrieved April 16, 2023 from <https://doi.org/10.3390/educsci12060368>
- Pulijala, Y., Ma, M., Pears, M., Peebles, D., & Ayoub, A. (2018). Effectiveness of immersive virtual reality in surgical training: A randomized control trial. *Journal of Oral and Maxillofacial Surgery*, 76(5), 1065–1072. Retrieved April 16, 2023 from <https://doi.org/10.1016/j.joms.2017.10.002>
- Serafin, S., Adjorlu, A., Nilsson, N., Thomsen, L. & Nordahl, R. (2017). Considerations on the use of virtual and augmented reality technologies in music education. *2017 IEEE Virtual Reality Workshop on K-12 Embodied Learning through Virtual & Augmented Reality (KELVAR)*, 1-4. Retrieved April 16, 2023 from <https://doi: 10.1109/KELVAR.2017.7961562>
- Vasarainen, M., Paavola, S., & Vetoshkina, L. (2021). A Systematic literature review on extended reality: Virtual, augmented and mixed reality in collaborative working life setting. *International Journal of Virtual Reality* 21(2), 1–28. Retrieved April 16, 2023 from <https://doi.org/10.20870/IJVR.2021.21.2.4620>

## EDUCATION MODEL FOR FUTURE

**Marcin Fojcik<sup>1</sup>, & Martyna K. Fojcik<sup>2</sup>**

<sup>1</sup>*Department of Computer Science, Electrical Engineering and Mathematical Sciences,  
Western Norway University of Applied Sciences (Norway)*

<sup>2</sup>*Department of Humanities and Education, Volda University College (Norway)*

### Abstract

The modern work environment requires many new abilities. Hence, there are often called 21st-century skills. It can be caused to the increasingly common use of digital tools or by more and more individualization (fitting) occurring in all aspects of life. These skills are not only subject-matter skills but auxiliary such as time planning, flexibility, ability to contact and discuss with others, social skills, etc. These skills are often called "hard" and "soft" skills. Many professions introduce these skills to help employees adjust to future changes.

All industries had to follow changing world, mainly from an economic point of view. Banking, manufacturing, tourism, hotel industry, and sometimes administration, medicine, and healthcare focus on customization. Doing work quicker and more flexibly in all these areas is essential. Unfortunately, education is one of the arenas more resistant to these changes. There are "traditional" exam forms, "traditional" lecture forms, etc. The pandemic has introduced changes, but now there is a great willingness (from teachers, administration, and some students) to return to the previous situation.

University is an old institution. There was a time when the university was used to individual development. There were units – students studied chosen subject in their own time and developed themselves in the desired direction (Humboldt University model). Most important was feeling like part of science society. After this, the following model – the French university, shows that students should learn to be a valuable element of the state. Students' feelings were not significant. Students can be treated as the "labor force". They learn to fulfill state expectations.

What university model is desired now? What university model is practical enough to give work knowledge and prepare for new challenges? Are some pedagogical theories better matched to unknown current and future abilities? What is essential for students, and what is vital to the state?

In this paper, we would like to discuss some of the possibilities of different university models and different pedagogical theories with a focus on flexibility and further self-development of students

**Keywords:** *21st-century skills, education model, pedagogical theories.*

---

### 1. Introduction

The development of Industry 4.0, the digitalization of everyday life, the post-pandemic effect on social issues, and the technological development of processes and practices in different fields are causing an increasing interest in Education 4.0 and skills for the 21st century (González-Pérez & Ramírez-Montoya, 2022; Syahril et al., 2022). "Technology is leading to massive changes in the economy, in the way we communicate and relate to each other, and increasingly in the way we learn. Yet our institutions were built largely for another age, based around an industrial rather than a digital era" (Bates, 2022, pp. 30).

Voogt et al. (2013) in their study argues that there is a consensus in public and private sector, to develop skills for present and future society, but the research show that these skills are poorly integrated and implemented in educational practice. "The sort of future-oriented change and development required by this shift [21st century] in institutional practices, programming, and structure will likely meet with significant resistance from comfortably entrenched (and often outdated) segments of traditional education and training establishment" (Thornhill-Miller et al., 2023, pp. 23-24). The idea of effective, flexible production and individualized service systems in the global economy that rapidly changes and greatly influences today's society challenges the educational learning model.

This paper aims to present different educational models that historically had been used and compare them to the 21st-century skills, learning theories and requirements of education for future work.

## 2. 21<sup>st</sup> century skills

"21<sup>st</sup>-century skills" can be described as an umbrella term with a broad spectrum of different skills (Chen, 2021). Those skills vary from one source to another, there is no consensus nor consistency in what skills to implement in such framework (Kocak et al, 2021; Mitsea et al, 2021) but the 21<sup>st</sup> century skills are often characterized as higher-order skills (Chen, 2021; Thornhill-Miller et al, 2023).

According to Raitskaya and Tikhonova (2019), at least nine frameworks for 21st-century skills have been developed. Yet, there are many combinations and approaches to the different frameworks. Kocak et al. (2021) researched seven skills as 21<sup>st</sup>-century skills: problem-solving, critical thinking, cooperativity, digital literacy, algorithmic thinking, creativity, and effective communication skills, and they proposed three models of the relationship between these skills. Raitskaya and Tikhonova (2019) propose "three major clusters of skills" (pp. 7), namely social and communicative skills, cognitive skills, and personal attributes and emotional intellect. World Economic Forum (2015) proposed 16 skills divided into three categories: Foundational Literacies (literacy, numeracy, scientific literacy, ICT literacy, financial literacy, cultural and civic literacy), Competencies (critical thinking/problem-solving, creativity, communication, collaboration) and Character Qualities (curiosity, initiative, persistence/grit, adaptability, leadership, social and cultural awareness). Battelle for Kids (2019) proposes a model visually represented as a rainbow with different components: Life and Career Skills, Learning & Innovation skills- 4Cs, Information, Media & Technology Skills, Key Subjects – 3Rs & 21<sup>st</sup> Century Themes. The 4C from Battelle for Kids stands for (1) creativity and innovation, (2) critical thinking and problem solving, (3) communication, and (4) collaboration (Syahril et al., 2022; Thornhill- Miller et al. 2023) and are quite like the "Competencies" from the report by World Economic Forum (2015).

In their study, van Laar et al. (2017) lists different skills associated with 21<sup>st</sup>-century skills while acknowledging that the emphasis is on the knowledge-based workforce with the essence to "put employees in charge of their own learning" (pp. 584). Due to the lack of a clear, universal definition of 21<sup>st</sup>-century skills, there is an expectancy of a natural or implicit understanding of what skills employees could need in their future work. But according to Suleman, there is an underlying assumption that "employers are undoubtedly aware of their needs. But is this a reliable assumption?" (2016, pp. 173). Suppose the context of the 21st-century skills is to get the students to be better equipped for work possibilities in the future. In that case, there is no chance of knowing exactly what skills would be needed since these possibilities do not exist yet (Bates, 2022). However, González-Pérez and Ramírez-Montoya argue further that: "It is necessary to analyze the curricula holistically to balance the various objectives of education with the soft and technical competencies" (2022, pp. 2). Every framework or strategy might shed some light on the topic, but predicting skills is a gamble with no clear solution. Even more, one could argue that if such a solution existed, it might differ from person to person, from situation to situation and from paradigm to paradigm.

## 3. Teachings paradigms

There are many paradigms of teaching. Some of the more famous are behaviorist, constructivist and cognitivist (Ertmer & Newby, 2013). These paradigms are described differently in different countries, depending on tradition, history, and the development of pedagogy and didactics in the area (Sajdak-Burska, 2013). In general, Behaviorism is based on the formation of expected student attitudes with the help of feedback. The goal is to form the desired knowledge (Skinner, 2011). The student is more passive, while the teacher is more active. Constructivism is based on the student's creative approach to learning (von Glasersfeld, 2000). Instead of passively receiving knowledge, the student is encouraged to be involved, act, develop, and solve problems. There doesn't have to be the only proper solution, but different solutions are possible depending on different expectations. Constructivism assumes students should learn by exploring the world, not just by listening to lectures and reading textbooks. As a result, students gain knowledge and practical skills to successfully deal with challenges at school and in life (Sajdak-Burska, 2013). Cognitivism assumes that the student is an active recipient of the information (Bruner, 1964). The learning process involves actively processing information and assimilating new knowledge. Cognitivism emphasizes the student being an active participant in the learning process, not just a passive recipient of information. The main goal of cognitivism is to develop students' cognitive skills, such as memory, attention, abstract thinking, analysis, knowledge synthesis, creativity, and problem-solving. Cognitivism also assumes students should learn based on understanding, not just memory.

The various paradigms appear to vary in degrees in different teaching models.

#### 4. University educational models

There are many approaches to educating students. The best-known are the Humboldt model and the French model (Sajdak-Burska, 2013). The Humboldt model is an approach to education developed by German student Alexander von Humboldt in the early 19th century. This model focuses on an interdisciplinary approach to learning and on developing students' intellectual, moral and emotional personalities.

Features of the Humboldt model (Tomicic, 2019) include:

- **Interdisciplinarity:** The Humboldt model assumes that science should be based on a combination of different disciplines, such as the natural sciences, humanities, and social sciences, to increase understanding of the world.
- **Individualization:** The Humboldt model focuses on an individualized approach to learning, meaning that teachers must adapt their teaching methods to each student's needs and abilities.
- **Personality development:** The Humboldt model focuses not only on shaping students' knowledge but also on their personality development, including developing their intellectual, moral, and emotional abilities.
- **Critical thinking:** The Humboldt model encourages students to think critically and analyze information rather than accepting it uncritically.

The model stipulated that learning should be combined with practice to shape practical knowledge and professional skills. In the Humboldt model, the teacher acts as a guide to help students discover and shape their interests and talents. Also crucial in the Humboldt model was academic freedom, the freedom to educate and research without interference from authorities and other institutions. This paradigm aimed to create a society where freedom of learning and research is the basis for social and economic development.

A French model is a traditional approach to education that has developed in the French school system over the centuries. Features of the French model (Rüegg, 2004) include:

- **Centralization:** The French model focuses on the centralization of power in the education system, meaning that decisions about curriculum and teaching methods are made by central government bodies.
- **Structure:** The French model emphasizes structure, meaning teaching is organized around curricula and rigid lesson plans.
- **Examinations:** The French model uses examinations as a tool to assess students' progress and as a condition for advancement to the next levels of education.

These features of the French model have influenced the concept of education in many countries around the world, especially in Europe. As a result, modern educational approaches are often based on a combination of different elements of educational models, including the French model.

The Humboldt and French educational models are very different and differ in many aspects (Macfarlane & Erikson, 2021). Here are some of the most important differences between these models:

- **The purpose of education:** The Humboldt model assumed that the purpose of education was to develop an individual's personality and enable him to reach his full potential. In the French model, conversely, education aimed to ensure the teaching of the ruling class, which was to be an elite educated in the humanities and mathematical and natural sciences.
- **Curriculum structure:** In the Humboldt model, curricula consisted of various subjects, and students were free to choose the subjects they wanted to study. In the French model, the curricula were more centralized and based on divisions into departments and majors, with little freedom of choice.
- **Teaching methods:** The Humboldt model emphasized practical classes and exercises, and teaching was more individualized. The French model was dominated by lectures and seminars, and teaching was more centralized and focused on learning by memory.
- **Status of university teachers:** In the Humboldt model, academics were considered academic authorities. Their role was to inspire and provoke students to think and explore. In the French model, the teacher's role was to impart knowledge to students.

Although the two models are fundamentally different, they influenced the development of education worldwide. They played a crucial role in shaping the concept of the university. These models do not exist in their pure form but are after many transformations and evolutions.

## 5. Discussion and conclusions

What university model is practical enough to give work knowledge and prepare for new challenges? Are some pedagogical theories better matched to unknown current and future abilities?

The Humboldt model is based mainly on individual learning, using various methods and speeds. The goal is to expand one's knowledge. Each student does this in their own way, learning and being in an academic environment - through conversations, discussions, polemics, research, lectures, etc. The student chooses the paradigm independently.

The French model's primary goal is to provide the expected (central) skills for a large segment of population. Individual objectives and values are less important. The paradigm of behaviorism is often used - reinforcement of desired (socially and politically) behavior.

21st-century skills mean not specific measurable skills but more qualities such as preparing to solve a problem, cooperating, talking, and planning time and resources. Therefore, behaviorism, which focuses on repeating specific behaviors, may not be considered an appropriate teaching model for 21st-century skill development. Instead, more relevant are constructivist or cognitivist paradigms. These paradigms, in turn, require different preparation, i.e., teaching and learning.

"Traditional educational approaches cannot meet the educational needs of our emergent societies if they do not teach, promote, and assess in line with the new learner characteristics and context of the 21<sup>st</sup> century" (Thornhill-Miller et al., 2023, pp. 23).

The Humboldt and French models exist as a virtual reference points. In today's world, there is no way to return to the times when a student used as much time as he wanted to assimilate knowledge. In turn, the model of educating everyone equally provides the knowledge needed in the near future. It is (and will be) necessary to change the way of teaching, focusing more on individuality, critical thinking, creativity, and problem-solving cooperation and less on hearing, memorized learning, and instruction-based work.

## References

- Bates, A. W. (2022). *Teaching in a digital age: Guidelines for designing teaching and learning* (3rd ed.). Tony Bates Associates Ltd. <https://pressbooks.bccampus.ca/teachinginadigitalagev3m/>
- Battelle for Kids (2019). *Framework for 21st Century Learning Definitions*. [https://static.battelleforkids.org/documents/p21/P21\\_Framework\\_DefinitionsBFK.pdf](https://static.battelleforkids.org/documents/p21/P21_Framework_DefinitionsBFK.pdf)
- Bruner, J. S. (1964). The course of cognitive growth. *American psychologist*, 19(1), 1-15. <https://psycnet.apa.org/doi/10.1037/h0044160>
- Chen, D. (2021). Toward an understanding of 21st-century skills: From a systematic review. *International Journal for Educational and Vocational Guidance*, 1–20. <https://doi.org/10.1007/s10775-021-09511-1>
- Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance improvement quarterly*, 26(2), 43-71. <https://doi.org/10.1002/piq.21143>
- González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: systematic review. *Sustainability*, 14(3), 1493. <https://doi.org/10.3390/su14031493>
- Kocak, O., Coban, M., Aydin, A., & Cakmak, N. (2021). The mediating role of critical thinking and cooperativity in the 21st century skills of higher education students. *Thinking Skills and Creativity*, 42, 100967. <https://doi.org/10.1016/j.tsc.2021.100967>
- Macfarlane, B., & Erikson, M. G. (2021). The right to teach at university: a Humboldtian perspective. *Educational Philosophy and Theory*, 53(11), 1136-1147. <https://doi.org/10.1080/00131857.2020.1783245>
- Mitsea, E., Drigas, A., & Mantas, P. (2021). Soft Skills & Metacognition as Inclusion Amplifiers in the 21st Century. *International Journal of Online & Biomedical Engineering*, 17(4), 121-132. <https://doi.org/10.3991/ijoe.v17i04.20567>
- Raitsjaya, L. & Tikhonova, E. (2019). Skills and competencies in higher education and beyond. *Journal of Language and Education*, 5(4), 4-8. <https://doi.org/10.17323/jle.2019.10186>
- Rüegg, W. (Ed.). (2004). *A history of the university in Europe: Volume 3, Universities in the nineteenth and early twentieth centuries (1800–1945)*. Cambridge University Press.

- Sajdak-Burska, A. (2013). *Paradygmaty kształcenia studentów i wspierania rozwoju nauczycieli akademickich: teoretyczne podstawy dydaktyki akademickiej. Teoretyczne podstawy dydaktyki akademickiej* [Paradigms of student education and of support for the development of academic teachers. Theoretical basis of academic didactics]. Oficyna Wydawnicza "Impuls".
- Skinner, B. F. (2011). *About behaviorism*. New York: Vintage Books.
- Suleman, F. (2016). Employability skills of higher education graduates: Little consensus on a much-discussed subject. *Procedia – Social and Behavioral Sciences*, 228, 169-174. <https://doi.org/10.1016/j.sbspro.2016.07.025>
- Syahril, Purwantono, Wulansari, R. E., Nabawi, R. A., Safitri, D., & Kiong, T. T. (2022). The Effectiveness of Project-Based Learning On 4Cs Skills of Vocational Students in Higher Education. *Journal of Technical Education and Training*, 14(3), 29-37. <https://doi.org/10.30880/jtet.2022.14.03.003>
- Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J. M., Morisseau, T., Bourgeois-Bougrine, S., Vinchon, F., El Hayek, S., Augerau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D. & Lubart, T. (2023). Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education. *Journal of Intelligence*, 11(3), 54. <https://doi.org/10.3390/jintelligence11030054>
- Tomicic, A. (2019). American dream, Humboldtian nightmare: Reflections on the remodelled values of a neoliberalized academia. *Policy Futures in Education*, 17(8), 1057-1077. <https://doi.org/10.1177/1478210319834825>
- van Laar, E., van Deursen, A. J., van Dijk, J.A., & De Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in human behavior*, 72, 577-588. <https://doi.org/10.1016/j.chb.2017.03.010>
- von Glasersfeld, E. (2000). Problems of constructivism. In L. P. Steffe & P. W. Thompson (Eds.). *Radical constructivism in action: Building on the pioneering work on Ernst von Glasersfeld* (pp. 3-10). Routledge.
- Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of computer assisted learning*, 29(5), 403-413. <https://doi.org/10.1111/jcal.12029>
- World Economic Forum (2015). *New Vision for Education: Unlocking the potential of technology*. BC: British Columbia Teachers' Federation. [https://www3.weforum.org/docs/WEFUSA\\_NewVisionforEducation\\_Report2015.pdf](https://www3.weforum.org/docs/WEFUSA_NewVisionforEducation_Report2015.pdf)

## TRENDS IN LEARNING GROUP PERFORMANCE IN PROBLEM-SOLVING SIMULATIONS

**Alexander Pojarliev**

*Department Administration and Management, New Bulgarian University (Bulgaria)*

### Abstract

The paper discusses the application of simulations for group problem solving in management training. The aim is to explore trends in group performance, which can then serve as a starting point for analysis and discussion of decision-making processes during training sessions. The results of the observation of the work process of 113 groups with a total number of participants of about 500 people were obtained from 5 different simulations based on a procedure developed by Human Synergetics. Average individual and group results, the gain/loss from the group discussion and the resulting synergy in the group were calculated as efficiency measures. The results of the Bulgarian groups are compared with those of known published studies and can serve as reference values. Expectations of similarity in the performance trends of individuals and groups are confirmed. The hypotheses regarding the increase in the quality of group decisions compared to the averaged individual results (in 82% of cases) and the relatively limited achievement of synergy (only in 30% of cases) are confirmed. Differences are also established between groups based on belonging to a private or state organization and open groups or members of a team/organization. The observations create a basis for more in-depth discussions during the training sessions on how the quality of decisions can be improved by increasing the quality of interactions between group participants.

**Keywords:** *Training groups, synergistic problem solving.*

---

### 1. Introduction

The decision-making process is of critical importance in all areas of human activity. Some early studies from the 1930s formed the view that groups perform better than individuals due to the effect of accumulating more knowledge and experience, which increases the probability of making a better decision (Shaw, 1932). However, it was later stated that the answer to the question is unclear and there is evidence both for and against this proposition (Maier, 1967). Groups can contribute to a better quality of the decisions made, but also impair the performance of the individuals of which they are composed. Branson et al. point to a number of studies supporting both the advantages of group work and its disadvantages related to inherent characteristics of the group process leading to a decrease in effectiveness (Branson et. al, 2010: 76). The present study takes as its main research question what are the trends in the performance of learning groups compared to individual performance in practical problem-solving learning situations?

### 2. Factors affecting the effectiveness of group decision making

Effective group decision-making depends on a number of factors. According to Maier, the forces that influence problem solving are group assets, constraints inherent in the group process, and factors dependent on the skills of the leader. The information and knowledge in the group always exceeds that of any individual and the number of approaches to the problem is greater. On the other hand, restraining forces can be group pressure for conformity, the "valence" of decisions (Hoffman & Maier, 1964), dominance of individuals and conflicting side goals (eg, power, winning the argument). However, a number of situational factors should also be taken into account. In addition to the skills of the leader, the essence of the problem and the goal to be achieved are also important. Another key factor that can significantly influence the increase in group performance is the style of interaction between its members (Group Styles Inventory etc., 1990). It is addressed in detail in the synergistic problem-solving model developed by the research organization Human Synergetics (Subarctic etc., 2007: 27-31), which pioneered the development of problem-solving simulations measuring and demonstrating the idea of

synergy. Their mechanism is based on making a judgment and prioritizing a list of items or actions according to their importance to achieve goals such as survival or higher efficiency. The model is built on the premise that when groups adopt a constructive interaction style and their members approach problems in a rational and supportive manner, the collaborative effort of people working together will have a greater impact than the sum of their independent efforts.

According to data in a study of 244 teams, 96% of them achieved a better group score than the average individual score. Respectively, only 4% of the groups failed to improve the average individual score (Subarctic etc., 2007: 55). Another study of 388 groups shows that the percentage of them that improve the average individual score varies between 85-100%, and of those that improve the best individual score and achieve synergy is in the range of 17-50% (Szumal, 2000).

The present study aims to investigate to what extent Bulgarian groups make decisions of a higher quality than individuals and achieve synergy. Based on the known data the following hypotheses were formulated: 1. The trends in the results of the same simulation for foreign and Bulgarian groups will be similar. 2. The quality of group decisions will in a comparably high percentage of cases be better than the quality of averaged individual decisions. 3. Synergistic groups will be a significantly lower percentage - less than half of all groups, confirming that groups do not achieve synergy easily.

It can be assumed also that the quality of interaction in groups is likely to depend on whether the people know each other and have experience working together. Thus, there is reason to expect that groups consisting of members from one organization or team will achieve better results than open groups composed of people who do not work collaboratively. Also, the dynamics of work in private business suggest greater pressure for efficiency and results, and a higher need to develop teamwork skills, group decision-making, and higher-quality interactions. Therefore, it is interesting to check if the groups composed by participants working in private organizations achieve better results than those working in public organizations.

### 3. Methods

This study includes the registration of the results of the group problem solving of 113 groups, most of which are 4-6 people, with the exception of several groups consisting of 3 or 7 participants. The total number of participants amounts to over 500. The study covers 5 different problem-solving simulations conducted as part of open or corporate management trainings. Participants in the study are both real teams working in private business organizations and in the public sphere, as well as open groups, including students and managers from the Master's and Professional Management Programs of New Bulgarian University, and participants in other management skills trainings.

Table 1. Types of group participants.

Types of groups	No
<b>Groups from one organization</b>	<b>42</b>
- Private Business (8 organizations)	37
- Public Organizations (2 organizations)	5
<b>Open Groups</b>	<b>71</b>
- Private Business (in a wide range of sectors)	36
- Public Sphere (Directors of VE schools)	35

Table 2. Distribution of groups in simulations.

Types of simulations	No groups
Envisioning a Culture for Quality	60
Subarctic Survival Situation	33
Organizational Change Challenge	10
The Stuck Truck	7
Managing Transitions	3
<b>Total groups:</b>	<b>113</b>

These simulations were held between 2009 and 2022. Three of the simulations were developed by Human Synergistics, the first being perhaps their most popular simulation - the Subarctic Survival Situation (Lafferty, 2007). The other two are: Organizational Change Challenge (Szumal, 1998) and Envisioning a Culture for Quality (Cooke, 2004). The fourth simulation is The Stuck Truck, developed by R. Baker and D. Kolb (Baker & Kolb, 1990), and the fifth is Managing Transitions based on a case published in the W. Bridges book of the same name (Bridges, 2003).

The procedure for conducting simulations follows the leader's guides of Human Synergistics (Subarctic etc., 2007; Envisioning etc. 1993; Szumal, 1998) and lasts an average of about 2 hours. In the procedure for calculating the results of simulations as the main indicators of efficiency are the obtained individual scores (IS), the group score (GS) the best individual score (BIS) in the group, the average individual score (AIS), gain/loss score (comparison between AIS and GS) and the resulting synergy (comparison between GS and BIS). IS and GS are calculated by summing the absolute differences between the participants' rates and the best solution (expert or obtained in research) of the arrangement of the items from the list. The lower the values, the smaller the deviations, i.e. the solution comes close to the best and therefore has a higher quality. AIS is calculated as the sum of the ISs of the group members is divided into their number and is a measure of the average level of knowledge and resources they bring



to the group. It can also be considered as an indicator of the expected level of decision quality if a member of the group is elected randomly to solve the problem. GS in turn, is a measure of the quality of the decision made by the participants working together as a group. Groups can improve the quality of the solution if they achieve a lesser deviation of the GS than AIS over the best solution. However, this does not yet mean achieving synergy. The calculation of synergy is done by GS being subtracted from the BIS. The positive value obtained indicates that the interaction of people in the group achieves a higher quality than each of the individual decisions, i.e., the synergistic solution is better than the mechanical sum of the individual solutions.

#### 4. Results

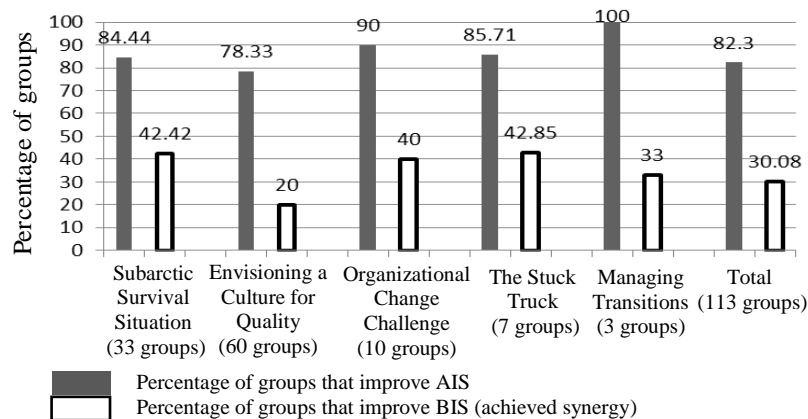
According to the study of a sample of 58 groups, the results of the Subarctic Survival Situation in 90% of cases are achieve a better group score than the average individual and in 50% of cases achieve a better score than the best individual score (Szumal, 2000). The results of the same simulation in the present study on 33 Bulgarian groups are slightly lower, but the tendency is similar: 84.44% of the groups achieve an improvement in AIS (28 of 33) and 42.42% achieve better results than BIS (14 of 33). This gives reason to confirm the first hypothesis of this study. Confirmation of the results can be considered as verification, both of the observations so far and the validity of the Bulgarian adaptation of the simulation.

Table 3. Comparison of the results of the Subarctic Survival Situation in the US and Bulgarian study.

N o.	Indicators	Scores of 244 groups (Subarctic etc., 2007: 55)		Scores of 33 BG groups
		Total	Poorly performing	
1.	Average individual score	47,3	50	60,5
2.	Average group score (GS)	29,8	40,9	49,1
3.	Average Gain/ Loss in group work	17,4	9	11,4
4.	Average best individual score (BIS)	32,5	36,4	46,2
5.	Average difference between the BIS and GS	2,7	-4,5	-2,9
6.	Groups that improve the average individual score	96%		84,4%
7.	Groups that do not improve the average individual score	4%		15,2%

The results show similar trends, as well as in the cited study by Human Synergistics of the same simulation, where 96% of the groups improve AIS. The comparison of the results in Table 3 also shows that the groups in it generally do better than the groups in the present study which are much closer to the results of the sample of poorly performing US groups including the value of gain which is insignificantly higher. The best individual results in the Bulgarian sample are also clearly weaker, i.e., the knowledge, skills and experience to solve the problem are lower. One possible reason for this could be related to cultural characteristics that determine the competence of the participants in both samples. However, the amount of gain/ loss in group work is also lower and the share of groups that do not improve is significantly higher (15.2% compared to 4%). This should no longer be relevant to the competence of the participants as to the quality of group interaction in the Bulgarian groups. It is necessary to interpret the data with a high degree of caution due to the small size of the Bulgarian sample and its disproportionateness relative to the control group, including their placement in distant periods of study. However, they can serve to compare the general trends of the performance of the groups.

Figure 1. Trends in the performance of groups in the five simulations.



The trends in the performance, observed in all 113 groups, participated in one of the five simulations are depicted in Fig 1. The share of groups that improve the average individual score varies between 78.33-100% (85-100% in Szumal), and those who improve the best individual score and achieve synergy is between 20-42.85% (17-50% in Szumal). In total, for all 113 groups, the results are 82.30% (93 groups), respectively, improved AIS and 30.08% (34 groups) that improved BIS.

The results regarding synergy show that in one of the simulations covering over half of the sample, the ratio is 1 in 5 groups. In three of the simulations, just under half of the groups achieved synergy, close to the results in the cited study of Szumal describing one of them. In general, synergy achieves an average of only 1 in 3 groups, which, despite the use of different simulations, is comparable to that of the Szumal study (Szumal, 2000) and gives grounds to confirm both the second and the third hypothesis of the present study.

To examine the alleged influence of the established group collaboration on the results, the sample was divided into two parts, based on whether the participants are from one organization, work in one team or at least joint (company groups, n=42), or are enrolled in an open training program, including strangers and colleagues from different organizations (open groups, n=71). The results of the comparison are presented in Fig 2, where the difference in AIS improvement is 9.22%, and in BIS 12.74% in favor of company groups. In general, the data testifies to support the grounds for confirming the expected results. However, care must be taken with the conclusions, as the two compared groups participated in different simulations and their results may have a cross-influence of factors related to their content. It is likely that differences are due, for example, to differences in the difficulty of simulations and the level of success in each of them.

Figure 2. Comparison between the performance of company and open groups.

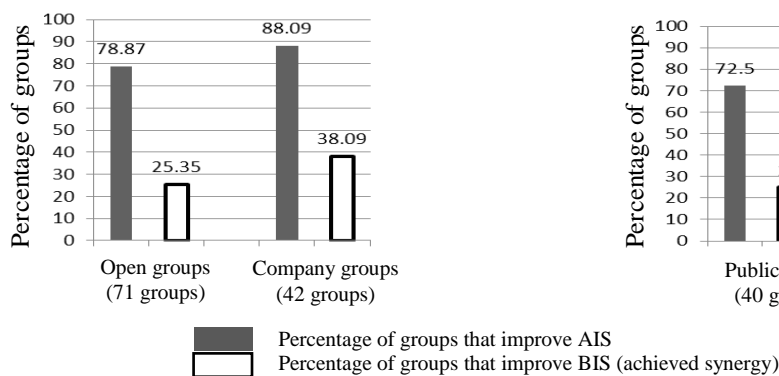
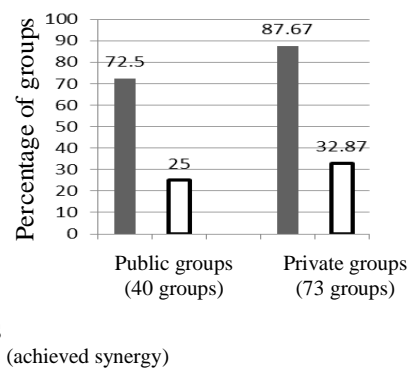


Figure 3. Comparison between the performance of groups in public and private areas.



To check the alleged influence of the different dynamics of work in the private and public area on group interaction skills and the results, the sample was divided into two parts, based on whether the participants are members of public (n=40) or private organizations (n=73). The results of the comparison are presented in Fig.3, where the difference in AIS improvement is 15.17% and in BIS is 7.87% in favor of private groups. The data testifies to support the conditional acceptance of this expectation too.

It should be noted that the comparisons made do not have the rigor and accuracy of a statistical analysis. They only show trends in the performance of the groups. However, the expressed trends in the results are indicative and set grounds for more precise future research.

## 5. Using results to improve the quality of group processes

According to the model of Human Synergistics, there are two groups of key factors that contribute to effective decisions. The first group includes the skills and knowledge of the group members and the resources they have in regard to the problem. The second group of factors refers to the quality of the skills for rational thinking and interpersonal interaction of participants, i.e., to the emerging group process in solving the problem. (Subarctic etc., 2007: 29).

The established tendencies in the performance of the groups can serve as a starting point for analysis and discussion of the quality of group decision-making and the search for answers on how decisions can be improved. Usually, participants are interested in how they did, for which they receive an immediate answer by comparing expert answers. However, the calculated difference has greater value if compared to the results of as many other groups as possible.

To this end, for the two simulations where there is an accumulation of data, the average values and standard deviations of the measured criteria were calculated (Table 4). They can be used as

benchmarks for comparison. The range of average scores is presented in the table. Values outside it can be considered respectively as significantly low and high results.

Table 4. Comparison criteria.

AIS	Group score (GS)	Gain/ Loss	BIS	Difference BIS & GS
Subarctic Survival Situation, N=33				
$\bar{X} = 60.5$ $\sigma = 6.2$ low < 53 – 66 < high	$\bar{X} = 49.1$ $\sigma = 12.8$ low < 36 – 62 < high	$\bar{X} = 11.4$ $\sigma = 10.9$ low < 0 – 22 < high	$\bar{X} = 46.2$ $\sigma = 9.1$ low < 37 – 55 < high	$\bar{X} = -2.9$ $\sigma = 13.2$ low < -16 – 10 < high
Envisioning a Culture for Quality, N=60				
$\bar{X} = 98.4$ $\sigma = 11.3$ low < 87–109 < high	$\bar{X} = 86.5$ $\sigma = 14.9$ low < 71–101 < high	$\bar{X} = 11.9$ $\sigma = 12.6$ low < -1 – 24 < high	$\bar{X} = 79.0$ $\sigma = 12.6$ low < 66 – 91 > high	$\bar{X} = -7.5$ $\sigma = 12.5$ low < -20 – 5 < high

Based on the comparison of their position against the criteria, participants can analyze the quality of their interactions and seek an explanation of the reasons for their results. This can be done using carefully designed questions that target the characteristics of the group process or through retrospection using coaching questions such as "What did we do well?", "What prevented us from achieving a better result?", "What would we change next time?" After identifying areas for improvement, group members can plan how to work on developing the necessary skills and reassess how they handle a later situation.

## 6. Conclusion

The results of the study unequivocally show that the quality of group decisions is in a very large number of cases better than that of a randomly taken individual in the group (measured by AIS). However, this is not the case when it comes to the quality of the group decisions compared to those of the best participants in the groups (BIS). Less than one-third of the groups manage to achieve a better solution, which means that in the other two-thirds of the cases, there is a better individual solution that has failed to manifest and accept. In other words, groups could improve the quality of their decisions if they identify their most competent members and listen to them. However, in order for this to happen, a high quality of interaction is required, related for example, to the rational structuring of the group process, specific leadership and achievement of the most constructive rather than defensive style of communication between participants. Obviously, such a quality is more difficult to achieve, which is why it is necessary for it to become the focus of working with the groups after the simulations.

## References

- Baker, R., & Kolb, D. (1990). *The stuck truck - An exercise in learning and problem solving*. Boston: TRG Hay/McBer.
- Branson, L., Steele, N., & Sung, C. (2010). When two heads are worse than one: Impact of group style and information type on performance evaluation. *Journal of Business and Behavioral Sciences*, 22(1), 75-84.
- Bridges, W. (2003). *Managing transitions: Making the most of change*. USA: Da Capo Press.
- Cooke, R. (2004). *Envisioning a culture for quality participant's booklet*. Plymouth: Human Synergistics International.
- Envisioning a culture for quality situation leader's guide* (1993). Human Synergistics International.
- Group styles inventory leader's guide* (1990). Plymouth: Human Synergistics International.
- Hoffman, R. & Maier, N. (1964). Valence in the adoption of solutions by problem-solving groups: Concept, method, and results. *The Journal of Abnormal and Social Psychology*, 69(3), 264-271.
- Lafferty, Cl. (2007). *Subarctic survival situation participant's booklet*. Plymouth: Human Synergistics International.
- Maier, N. (1967). *Assets and Liabilities in Group Problem Solving: The Need for an Integrative Function*. *Psychological Review*, Vol.74, No.4. 239-249.
- Shaw, M. E. (1932). Comparison of individuals and small groups in the rational solution of complex problems. *American Journal of Psychology*, 44(3), 491-504.
- Subarctic survival situation leader's guide* (2007). Plymouth: Human Synergistics International.
- Szumal, J. (1998). *Organizational change challenge exercise booklet*. USA: Center for Applied Research, Human Synergistics International.
- Szumal, J. (2000). How to use problem-solving simulations to improve knowledge, skills and teamwork. In Mel Silberman and Pat Philips (Eds.) *The 2000 Team and Organization Development Sourcebook*. NY: McGraw-Hill.

## DEVELOPING YOUNG CHILDREN'S TEXT PROCESSING SKILLS BY USING DETECTIVE BOARD GAMES AND RWCT TECHNIQUES

**Barbara Zsiray**

*ELTE Bolyai János Practice Primary and Secondary Grammar School (Hungary)*

### Abstract

Using board games in the classroom is an opportunity for experiential learning. A previous examination proves that the systematic use of Rory's Story Cubes in the methodology of native language teaching can be included as a playful method because they are useful in the development of oral and written communication. I have reflected on this with a new project focusing on reading skills. My goal is to examine how the card games, Black Stories Junior (Red Stories, Rainbow Stories) combined with RWCT techniques (Reading and Writing for Critical Thinking) can develop the interpretation of texts in 9 to 10-year-old students. The games contain riddles with exciting criminal cases for children. The players try to reconstruct the stories by asking, guessing, and fiddling. RWCT methods are the sum of cooperative, interactive and reflective techniques that make the learning process more successful and creative. In the first period, the experimental and the control group were formed. After that, the experimental group played the card game 30 times and got to know graphic organizers, drama pedagogical methods, and creative writing tasks related to the short stories. The activities were carried out under the supervision of the methodical leader of the experiment and recorded with a video camera. In the end, the students could use the learned methods independently and achieved more points on reading comprehension tests than the control group members. Thanks to the drama techniques the students were able to write in a more meaningful way from another person's perspective. The results show that the consistent use of the given board game is beneficial for reading and writing skills. The project's achievements may contribute to the widespread educational use of board games and RWCT techniques, thereby expanding the methodology of native language teaching.

**Keywords:** *Board game, primary education, cooperation, Black Stories Junior, RWCT techniques.*

### 1. Introduction

Good communication skills are essential for success in school, the labour market, and society. However, in Hungary, less than half of the students reach the minimum reading comprehension level defined by the OECD, even though this level would be crucial for successful entry into the labour market (Arató, 2006). I realized that many primary school students have difficulty in understanding and interpreting fiction and non-fiction texts. Lack of adequate reading comprehension skills makes it difficult for students to learn independently and access information in adulthood. Therefore, I believe that one of our most crucial tasks as educators is to introduce students the use of easy-to-operate toolkits that facilitate the absorption of paper and electronic texts. Students need abilities that help them process text (*for example, seeing cause-and-effect relationships, highlighting the point, recognizing and formulating sentences, visual knowledge of information, prediction based on keywords, and note-taking*). The use of diverse and creative text-processing procedures has a beneficial effect on students' reading comprehension levels. In addition, it is essential that students encounter different text genres and text types that help them in everyday life. The regular use of collaborative working methods is also key to the development of students (Tóth, 2006).

Board game pedagogy, one of the areas of experiential pedagogy, provides an excellent opportunity for students not only to learn in a frontal framework but also to acquire knowledge indirectly and experientially (Jesztl, & Lencse, 2018; Zsiray, 2021). Our previous experiment had proved that the oral and written communication of students between the ages of 9 and 10 can be improved by using Rory's Story Cubes regularly. Significant positive changes have appeared in the oral text creation of the participants both at the individual and group levels (Zsiray, & Koós, 2022).

Their written texts became more coherent and meaningful thanks to the complexity of the plot, the forward movement of the train of thought, and the nuanced use of language. The development can

also be seen in the increasing tendency of MLU numbers (Crystal, 1997) and KFM values (Lee, & Canter, 1971; Gerebenné, Gósy, & Laczkó, 1992). My current research focuses on the ability to text comprehension, as it is closely related to text processing skills.

## 2. Methods

The RWCT program (Reading and Writing for Critical Thinking) reached Hungary through the mediation of the Hungarian Reading Association. The IRA (International Reading Society) initiated its development, which was supported by the Soros Foundation in its dissemination. RWCT techniques are a collection of interactive and reflective learning methods that help the efficiency and creativity of the teaching and learning process with cooperative procedures (Nemoda, 2008). The program is based on the theory of metacognition and constructivism (Tóth 1999). RWCT techniques include graphic organizers, discussion techniques, creative writing tasks and methods for developing reading comprehension and speaking skills, in addition to elements of drama pedagogy (Pethóné, 2005).

My research focuses on the children's versions of the exciting Black Stories card game, which are called Red Stories and Rainbow Stories. Author Corinna Harder recommends these editions for children ages 8 and up, which are great fun for kids. Magical creatures and mysterious legends can be found in the cards of Rainbow Stories. Crime cases and everyday stories play the central role in Red Stories. Based on the title of the mystery, the 1-2 sentence hint, and the illustration of the card, the players have to ask questions to arrive at the complete solution, which only the game master knows. The only thing mysteries have in common is that nothing is what it seems at first glance. Detectives often face the challenge of deciphering misleading clues that may not be as straightforward as they initially appear. The journey of a joint investigation can be full of unexpected twists and turns, with detectives encountering both comical blunders and uplifting breakthroughs along the way. Laughter is never in short supply during such investigations. The cards in both packs are divided into three levels of difficulty, making the game more exciting and offering new challenges even for experienced detectives. After solving a mystery case in the card game, players have the opportunity to learn or practice an RWCT technique based on the text of the current mystery.

To commence the research, I assembled an experimental and a control group of fourth-grade students at the ELTE Bolyai János Practice Primary School. The age of 4th grade is a critical period in terms of students' mother tongue competencies. By this age, the students' reading technique has already developed to such a level that they can read in sentences. This provides an opportunity to move the development of communication skills in the direction of creative text interpretation and creation. The card game suggested for 2-20 players was chosen as the investigative tool. The experimental group comprised nine students (seven girls and two boys), and I deemed this number appropriate for active participation, allowing each child to have a role in the investigation and ask questions. The control group only participated in certain aspects of the research process. The sample selection criteria prioritised different reading comprehension levels among the children. Gender differences were not a focus of the research. The series of sessions comprised thirty occasions, held twice a week, each lasting approximately thirty minutes, audio and video recordings were captured to analyse the students' verbal and non-verbal responses.

During the planning of the session series, my goal was to create a gradual and spiralling structure. In the initial sessions, the children were introduced to the game and learned its basic rules and elements. They also solved a mystery from each of the decks while adhering to the standards of behaviour essential for a game that is enjoyable for all. One of these standards included paying attention to each other, as the cause-and-effect relationships in the mystery emerged from the players' guesses that ultimately led to the solution. To break away from the typical frontal teaching style, we arranged ourselves around two benches at the beginning of each session, enabling cooperative problem-solving as the participants could see each other. Additionally, instead of the usual hand-raising, we used laminated paper magnifiers that allowed players to ask questions by placing their magnifying glasses in front of them and being called on by the game master. This approach allowed the children to immerse themselves even more in the role of a detective. In the third session, the students were introduced to the RWCT technique alongside solving the mystery. I chose to use graphic organisers as one of the procedures, as they could be related to the card game. After encountering the technique, the students independently practised this procedure. Techniques that were already introduced were repeated at certain intervals to ensure a more permanent impression.

I structured the sessions based on the RJR model (*ráhangolódás – jelentésteremtés – reflektálás*), in which three phases are distinguished (Bárdossy et al., 2002). In the introduction phase, the children recalled the previous mystery. The recall was done using the worksheet containing the most recently learned RWCT technique. At this stage, the children can return to the detective role. In the

meaning-creation phase, namely the game phase, I offered the students several cards from which they could choose the mystery of the day. In the beginning, I played the role of the game master, but later in the session, I allowed the students to experience the game from a completely different perspective. After I disclosed the clues on the chosen card, the process of guessing commenced, which ultimately resulted in the solution to the mystery. During the reflection phase, I distributed an RWCT technique template to all participants, which we filled out together. In the case of uncomplicated techniques (*mind map*), the children themselves created the given graphic organizer on a blank piece of paper. If we practiced a learned procedure, everyone first solved the task independently, then we discussed the ideas, and those who could not write in all the places, could get ideas from the work of the others. Depending on the mystery's time and nature, we also used drama pedagogic procedures. During the latter half of the session, we focused more on dramatic plays. Among the organizers, the participating students learned the mind map, the five-line summary, the prediction table, the character map, the cluster diagram, the timeline, and the T-chart.

I introduced my group to the mind map, one of the elemental graphic organizers, during our first occasion. The members quickly grasped the concept and discovered numerous advantages to its application. In creating the diagram, they honed their skills in defining key terms and were able to quickly recall the previous crime next time. In contrast, the five-line summary I offered as the second technique diverges significantly from the former and requires greater attention and practice to master. While both methods share the task of identifying keywords, the five-line form demands strict adherence to the prescribed types of words and alignment with the verse structure.

Prediction is a technique that encourages students to make educated guesses about a text using limited information. After reading the text, they can compare their predictions with the actual outcomes, analyse the discrepancies, and consider which of their assumptions were correct, how, and why. During the game, the students made predictions on three occasions. They started by making predictions based on the title and clues presented in the figure and justified their inferences. For the second prediction, their guess was corrected based on the short text. The final prediction was made halfway through the game when the mystery had already been partially solved. I found that it was challenging to convince kids to record their predictions as it interrupted their gameplay experience. They were not enthusiastic about having to document their ideas first and then discuss them with each other. It was also difficult to support their assumptions with justifications.

A character map is an appropriate tool in games, where players are committed to make inferences, as it allows them to step into the shoes of the characters being investigated. For example, they may try to uncover the motives of a criminal by thinking like them. After much contemplation, by the end of the game, students gain a more intricate understanding of the characters and their personalities.

The cluster diagram is a more sophisticated version of the mind map that involves defining additional nodes, not just assigning information to a central idea. After the investigation, this technique proved helpful in enabling students to create a clear and comprehensive visualization of the network of characters, locations, and events in the plot.

Using a timeline, the students could visually represent the sequence of events in the mysteries. The T-chart provided an effective tool for discussing the topics that arose on the cards and summarizing the arguments and counterarguments in a clear and organized table.

At the beginning and end of each session, I gave students emoji cards to help them determine their current mood. With this, on the one hand, I investigated the effect of the experience of the playful session on them. On the other hand, I encouraged them to express their feelings as nuanced as possible. I also used emoticons before the drama pedagogic procedures and the diary technique. After solving the mysteries, the students used emojis to depict the emotional changes the characters might have gone through. After identifying and naming the emotions, it was no longer a problem to write a diary from the perspective of the characters or to present a scene authentically. After thirty sessions, I tested the effectiveness of the drama techniques and the emoji cards with a text creation task. I considered the complexity of the texts and the quantity and nature of the words referring to emotion found in them as an evaluation aspect.

### 3. Results

I conducted an assessment of the proficiency level of various RWCT techniques, as well as the impact of these sessions on reading comprehension, using worksheets. During the development of the worksheets, I kept the principle of gradualness in mind. The tasks followed each other in a gradually increasing order of difficulty. To ensure unequivocal correction, I considered the three general requirements of the methodology: objectivity, validity, and reliability (Csapó 1997). After thirteen sessions, both the experimental and control groups were tasked with independently processing a narrative

text. At the end of the series of sessions, after thirty occasions, the students had to independently process an informative text. In both cases, the students of the control group could start filling in the worksheet immediately, while members of the experimental group used different graphic organizers to arrange the acquired information before the test. It was important to me that the texts used for the tasks were appropriate for the age group and matched their interests and knowledge (Csapó 1997).

Firstly, I selected J.K. Rowling's "The Tale of the Three Brothers" from the "Beedle the Bard" volume. I chose this genre as the 4th-grade students had already extensively covered fairy tales. Before completing the worksheet associated with the text, members of the experimental group had to prepare a five-line summary and two-character maps based on the story content. Meanwhile, members of the control group were able to begin completing the test immediately after reading the story. Once the children in the sessions created their graphic organizers, they were given a set of tasks. Examining the prepared graphic organizers, it can be concluded that the students are at the expected mastery level, most of them were able to fill out the provided templates correctly without help. The content of the five-line summaries were almost flawless, in some cases, the wrong part of speech was listed (*use of a noun instead of a verb*). For the two-character maps, the students could choose the characters from the story they wanted to examine. By reading the characterizations and the arguments associated with the characteristics, I got a complex picture of the given character thanks to the children's extensive vocabulary. Of the available 32 points, the experimental group achieved an average of 25 points, while the control group achieved 20.2 points. In terms of average scores, the children participating in the sessions performed better in all tasks. The most significant point difference was perceived in the tasks requiring completion of the outline and those related to the character's traits. In the latter case, it is clear that the students had already spent time examining the personalities of the characters when creating the two-character maps. The completion of the outline was supported by the five-line summary, as the children had to condense the events in the text.

During the final measurement, the members of the experimental and control groups prepared an informative article that presented the work of Hungarian natural scientists and researchers. The students of the experimental group started their task by designing a cluster diagram and a timeline and filling in a T-chart. During this time, the others could already solve the worksheet associated with the text. In this study, the experimental group was able to effectively use the techniques taught, even without the assistance of the game. They could organize the necessary information before starting the task, as shown by the cluster diagrams they produced. Most students could summarize the text and highlight the essential parts visually. However, some had difficulty reducing selected sentences into word combinations or identifying the most crucial information from the context. Students who had good graphic organization skills also scored higher on the reading comprehension test. They were able to identify important events in the researcher's lives in their life summary timelines. Finally, the T-chart allowed the students to express their thoughts on the advantages and disadvantages of moving away from home. Based on the average scores from 32, the experimental group received 25.6 points, while the control group received 21.5 points. The most significant difference was observed in the tasks where the statements about the characters of the article had to be categorized, and when the starting sentences had to be finished based on the text. I believe that the reason for this is that the created graphic organizers helped them to separate the characters and to recognize cause-and-effect relationships.

In both cases, the members of the experimental group spent a relatively long time, on average 35-40 minutes, on reading and creating RWCT techniques out of the available 60 minutes, but they were able to complete the worksheet quickly afterward. Based on this, I concluded that the thoughtful preparation of graphic organizers provided immense help to the students in organizing their knowledge, making the task easier to solve.

At the end of the research, the students of both groups had to write diary entries independently from the perspective of another person. The posts deal with an everyday topic that is close to children. According to the given situation, a student diligently prepared for his mathematics assessment. While writing the test, his classmate copied her, but he did not report this to the teacher. When the paper was assigned, the main character was shocked because his classmate got a better mark than him. In the first diary entry, the students had to write a narrative about the day the assessment was written, and in the second, the day the test was assigned. It was an important aspect that, in addition to recording the events, the emotions associated with the situation should also play a role. The results show that the members of the experimental group mentioned more words or combinations of words in their sentences that express emotions. These emotions mostly appeared as adjectives (*nagyon dühös voltam; csalódott voltam*) or verbs (*reméltem, elszomorodtam*) in the diary entries. While eighteen different emotions appeared in the works of the test group, only thirteen appeared in the control group. In the experimental group, I also encountered a status-determining structure three times (*büszkén léptem be, kíváncsian várom*). In one case, there was personification in the text (*zakatolt a szívem az izgalomtól*), which further increases the

stylistic value of the wording. In terms of sentence types, in addition to declarative sentences, exclamations and questions appeared in higher numbers in the experimental group, which had an emotional charge and added colour to the text.

#### 4. Conclusion

The results of the research prove that using the Black Stories junior card games can be an effective tool for learning RWCT techniques. The products created during the independent tasks prove that the students can efficiently organize the acquired knowledge with the help of graphic organizers. Students also gradually developed their investigative skills and were able to solve increasingly challenging riddles as their keyword search strategies and understanding of cause-and-effect relationships improved. Based on the scores of the reading comprehension worksheets, the members of the experimental group performed an average of five points better than the control group. The students participating in the activity process have been able to enhance the emotional depth and personal tone of their texts through detective story-based drama games and emotion-focused tasks using emoji cards. The completed reflective questionnaires confirm that participating students would recommend these activities to their peers. According to their feedback, they have learned a lot, enjoyed playing, and gained valuable experiences during the sessions.

#### Acknowledgments

Supported by the ÚNKP-22-2 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund.

#### References

- Arató, L. (2006). Szövegértés, szövegalkotás a magyarórán. In L. Sipos (Ed.), *Irodalomtanítás a harmadik évezredben* (pp. 144-160). Székesfehérvár: Krónika Nova Kiadó.
- Bárdossy, I., Dudás, M., Pethőné, N. Cs., & Priskinné Rizner, E. (2002) *A kritikai gondolkodás fejlesztése: Az interaktív és reflektív tanulás lehetőségei. Tanulási segédlet pedagógusok és pedagógusjelöltek számára a saját élményű tanuláshoz*. Pécs: PTE Kiadó.
- Crystal, D. (1997). *The Cambridge Encyclopedia of Language*. Cambridge University Press.
- Csapó, B. (1997). A tanulói teljesítmények értékelésének méréses módszerei. In Pöcze Gábor (Ed.), *A közoktatási intézmények tevékenységének tervezése és ellenőrzése* (pp. 97-111). Budapest: OKI.
- Gerebenné Várbíró, K., Gósy, M., & Lackó, M. (1992). *Spontán beszéd megnyilvánulások szintaktikai elemzése DSS technika elemzésével*. Budapest: Manuscript.
- Jesztli, J., & Lencse, M. (2018) *Társasjáték-pedagógia*. Budapest: Demokratikus Ifjúságért Alapítvány.
- Lee, L. L., & Canter, S. M. (1971). *Developmental sentence scoring: a clinical procedure for estimating syntactic development in children's spontaneous speech*. *Journal of Speech and Hearing Disorder*, 36(3), 315-340.
- Nemoda, J. (2008). Kritikai gondolkodást fejlesztő magyarórák. *Anyanyelv-pedagógia*, 1(3-4). <https://www.anyanyelv-pedagogia.hu/cikkek.php?id=129>
- Pethőné, N. Cs. (2005). *Módszertani kézikönyv – Befogadás-központú és kompetenciafejlesztő irodalomtanítás*. Budapest: Korona Kiadó.
- Tóth, B. (1999). *Olvadás és írás a kritikai gondolkodásért (Egy pedagógus-továbbképző program körvonalai)*. Sáropatak: HUNRA és Városi Könyvtár.
- Tóth, B. (2006). A szövegértés fejlesztésének elmélete és gyakorlata. *Magyar Nyelvőr*, 457-469. <http://www.c3.hu/~nyelvor/period/1304/130406.pdf>
- Zsiray, B. (2021). *A társasjátékok alkalmazási lehetőségei kiemelten az anyanyelvi nevelés keretein belül*. OTDK dolgozat. Nyíregyháza: Manuscript.
- Zsiray, B., & Koós, I. (2022). How Rory's story cubes can improve the ability of storytelling in writing and speaking. In M. Carmo (Ed.), *Education and New Developments 2022*, Volume 1 (pp. 193-197). Lisboa: inScience Press.



# IMMERSIVE VIRTUAL REALITY AND ARTIFICIAL INTELLIGENCE FOR ENHANCING STUDENT PREPAREDNESS FOR CLINICAL EXAMS

Brendan Concannon<sup>1</sup>, & Shaniff Esmail<sup>2</sup>

<sup>1</sup>*Faculty of Rehabilitation Medicine, University of Alberta, Edmonton, AB (Canada)*

<sup>2</sup>*Department of Occupational Therapy, University of Alberta, Edmonton, AB (Canada)*

## Abstract

**Introduction:** Test anxiety is a common issue among post-secondary students, leading to negative consequences such as the increased risk of dropout, lower grades, and limited employment opportunities. Students unfamiliar with the test-taking environment are more likely to have test anxiety. This study aimed to explore virtual reality (VR) and artificial intelligence (AI) as potential solutions to reduce test anxiety in health science students preparing for clinical exams. By utilizing an AI-powered virtual testing environment with interactive virtual patients, students acted as medical professionals in a simulated clinical setting, allowing them to familiarize themselves with the environment and potentially reduce their anxiety levels. The study utilized AI in the form of a generative pre-trained transformer (GPT) to generate responses from virtual patients. System was evaluated on its ability to reduce test anxiety.

**Objective:** To assess the efficacy of a VR simulation of a clinical setting in reducing student anxiety for a clinical exam and gather student perspectives on their VR simulation and coursework experiences to better understand their learning environment.

**Methods:** First-year health science students were invited to participate in a VR session that took place three-days before their clinical exam. Students exposed to VR (YesVR) and those who opted out (NoVR) had their anxiety levels compared to one another using the State Trait Anxiety Inventory (STAI) and Test Anxiety Inventory (TAI). Immersive VR simulation included history-taking and cognitive assessment modules, allowing students to communicate with virtual patients in natural language in a virtual clinic. Virtual patient responses were generated by GPT, fine-tuned with transfer learning techniques based on real-world student and standardized patient video recordings. After completing their clinical exams, students were invited to participate in semi-structured interviews and focus groups.

**Results:** A total of 108 students participated in the quantitative aspects of the study (mean aged 24.53 years, *SD* 2.64): 61 for the NoVR group (mean aged 24.52 years, *SD* 2.42) and 47 for the YesVR group (mean aged 24.54 years, *SD* 2.93). There was a significant difference in state anxiety scores between groups, with NoVR showing greater anxiety scores (mean 51.69, *SD* 11.87) than YesVR (mean 39.79, *SD* 12.21) ( $t_{106}=5.10$ ,  $P<.001$ , Cohen  $d = 0.99$ ). The mean difference was 11.90 units (95% CI 7.28-16.53). A total of 25 students participated in the interviews and focus groups – 16 from interviews and 9 from focus groups. The major themes emerging from focus groups and interviews were overall student background, exam feedback, fear of the unknown, self-consciousness, and the exam environment.

**Conclusion:** This study highlights the potential of AI-enhanced VR as an effective tool for reducing test anxiety and increasing student familiarity with clinical exam environments. The results suggest that VR may reduce ambiguity and uncertainty, which are key contributors to test anxiety. The findings provide valuable insights into the potential of VR and AI in addressing test anxiety.

**Keywords:** *Virtual reality, artificial intelligence, student anxiety, examination preparation, learning tools.*

---

## 1. Introduction

### 1.1. Campus anxiety

Anxiety is a natural and innate reaction, readying the body for upcoming situations that are perceived to be risky or harmful (Perrotta, 2019). This implies a theoretical concept that has the potential to occur in either general or specific contexts, with *predisposition* (ie, trait anxiety) representing how often or strongly the response generally occurs and *transitory* (ie, state anxiety) representing a reactionary response, prompted by a present circumstance (Spielberger et al., 2015). Anxiety experienced in post-secondary education may cause numerous long-term implications, including higher risk of student

drop out, decreased academic performance, reduced employment opportunities, and financial losses in billions of government dollars per year (Pascoe et al., 2020). The Intolerance of Uncertainty model (IUM) theorizes that people may inherently have an intolerance of the unknown, resulting in ambiguous situations being perceived as threatening, resulting in increased worry and anxiety (Dugas et al., 1998). It is common for students to feel symptoms of test anxiety, when preparing for practical exams with uncertain elements.

### 1.2. Reducing anxiety

One method of conditioning individuals to cope with anxiety-inducing scenarios is through *in vivo* exposure, where individuals are gradually exposed to real-world situations until their stress levels are reduced (Freitas et al., 2021). Virtual Reality (VR) can also be used to create computer-generated environments that replicate real-world situations to help alleviate anxiety, which is known as VR exposure therapy (VRET). VRET is also referred to as *in virtuo* exposure. For more details about the immersive and interactive aspects of VR, refer to the studies conducted by Concannon and colleagues in 2019 and 2020. For cognitive adaptation (e.g., improvement of memory, information processing, problem solving and logical sequencing), VR training of procedural tasks has shown improvements in the brain's frontal lobe, which is responsible for cognitive functions such as the ability to recall prospective memory tasks and achieve precise objectives based on time and events (Yip & Man, 2013). VR may improve procedural memory by altering neural plasticity to improve working memory (Grealy et al., 1999). VR training of daily living activities may improve attention and cognitive function (De Luca et al., 2019). When researching how students respond to VR simulation, a mixed-method approach recommends combining quantitative evaluations with student feedback to better understand their motivations (Bennett et al., 2017).

### 1.3. Aim of this investigation

To assess the efficacy of a VR simulation of a clinical setting in reducing student anxiety for a clinical exam and gather student perspectives on the VR simulation and coursework to better understand their learning environment.

## 2. Methods

### 2.1. Experimental design, recruitment and ethics

This investigation was a mixed, cross-sectional, nonrandomized controlled trial, involving two groups of participants, each comprised of first year occupational therapy (OT) students from the same class. All 125 OT students were invited and eligible to participate. This investigation was approved by the Research Ethics Office of Research and Innovation, University of Alberta, Canada. After inspection, this investigation was deemed ineligible to record participant sex variables, due to required de-identification of students to ensure their privacy.

### 2.2. Experimental process

VR was open-access to all students and self serve. This investigation utilized class email announcements to offer scheduled VR session appointments. Those who accepted the offer were designated as YesVR participants, with scheduled VR sessions taking place three-days before the OSCE. After the VR sessions were complete, a class email announcement was sent out to invite all students to complete online surveys, measuring student state anxiety and trait test anxiety levels. Students who reported to have not used the VR simulation, yet chose to complete the surveys, were designated as the NoVR group. Semi-structured focus groups and interviews were scheduled after the students completed their OSCE, within a one-week timeframe.

### 2.3. The anxiety surveys

The State-Trait Anxiety Inventory (STAI) is divided into two forms: Y-1 (S-Anxiety) scale, which this investigation used to measure each participant's level of anxiety at a specific moment in time. The STAI also contains the Y-2 (T-Anxiety) scale, which is used to measure generally trait anxiety, yet this form was substituted for the Test Anxiety Inventory (TAI) as this instrument measures trait test anxiety levels in academic contexts. Each form is comprised of 20 items, with final scores ranging from 20 to 80, with higher scores representing greater levels of their respective anxiety types (Spielberger et al., 2015).

### 2.4. Interviews and focus groups

Questions focused on how student overall experiences, expectations, difficulties, stressors and VR influenced their performance in the OT program. Interviews took up to 45-minutes in duration while focus groups lasted 60-minutes. Interview and focus group data were summarized using an interpretative thematic

analysis, based on an approach developed by Burnard (1991), interview process guide by Kvale (1996) (Kvale, 2007) and general approach by Maykut and Morehouse (1994).

## 2.5. Simulation design

The VR simulation in this investigation included the following components:

1. Meta Quest 2 headsets that ran the VR software, uploaded using SideQuest. These headsets were portable and free of cables. The headset could detect a user's hand gestures, without the use of controllers. The headset was also equipped with a microphone to detect user speech for communicating with the virtual patients.

2. A virtual environment depicting a health sciences clinic, rendered with Unity game engine software (Unity Technologies). The environment allowed the student to select from one of two modules: History Taking or the St. Louis University Mental Status Exam (SLUMS) cognitive assessment (*SLU Mental Status Exam*). Once the student entered the virtual exam room, a buzzer sounded the start of the virtual OSCE and a miniature timer on a desk began counting down from either 8 minutes for the History Taking module or 15 minutes for the SLUMS module. Students could grasp and turn pages on a virtual clipboard to read notes. The History Taking clipboard contained preliminary notes about the virtual patient, similar to what the student would receive before interacting with their real-world OSCE standardized patient, while the SLUMS clipboard contained a scoring rubric and question sheet. Refer to Figure 1 for a screenshot of the History Taking module.

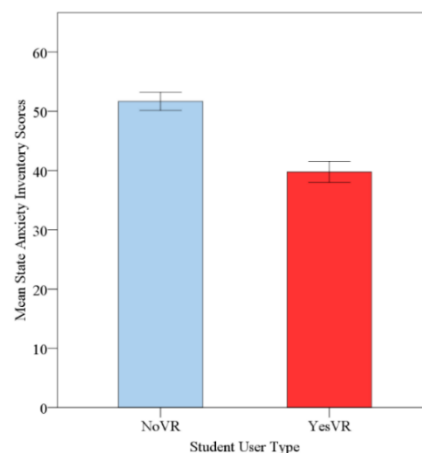
3. Three virtual avatars. The first appeared in the history taking module as a virtual standardized patient who would respond to a user's questions; the second appeared in the cognitive assessment module as a virtual standardized patient, who would respond to user questions from the SLUMS cognitive assessment; the third being a virtual exam evaluator (present in both modules) who observed the user and would write notes into their clipboard during each module.

4. Speech recognition and response software using Azure Cognitive Services. The student could ask the virtual patient questions in natural language, with the user's voice being detected by the headset's microphone to convert the question from speech to text. The process pipeline includes user speech-to-text, open artificial intelligence for language processing and generation of virtual avatar's text response, avatar's text converted from text-to-speech. The virtual standardized patients' text responses were generated using a generative pre-trained transformer (GPT-2), which was fine-tuned (ie, trained) on recorded interactions from real-world student and patient actor interactions during real-world lab exercises. This avatar training was performed using a transfer learning technique using real-world student and standardized patient text files that were collected from transcribed recordings. GPT-2 uses word vectors and input, producing estimates for the probability of the next word as outputs. It is auto-regressive in nature: each token in the sentence has the context of the previous words. Virtual avatar actions (behaviors) were generated in text form by GPT-2 then linked to appropriate animations (movements), allowing them to respond to user requests (eg, drawing pictures when asked to do so during the SLUMS module).

Figure 1. Screenshot of History Taking module.



Figure 2. Student state anxiety between groups; error bars represent standard error. NoVR: subjects not exposed to the virtual reality simulation; YesVR: subjects exposed to the virtual reality simulation.



## 2.6. Statistical analysis

Statistical significance was evaluated at  $\alpha=.05$ , and a two-sided P value of .05 or less was considered to be statistically significant. Comparisons between the NoVR and YesVR groups were performed using independent *t* tests, which compared STAI and TAI scores between the groups.

### 3. Results

A total of 108 students participated in the quantitative aspects of the study (mean aged 24.53 years, *SD* 2.64): 61 for the NoVR group (mean aged 24.52 years, *SD* 2.42) and 47 for the YesVR group (mean aged 24.54 years, *SD* 2.93). A total of 25 students participated in the interviews and focus groups – 16 from interviews and 9 from focus groups. The majority of YesVR participants utilized the VR simulation for both modules, which typically meant 8-minutes of the History Taking module and an additional 15-minutes with the SLUMS module, in addition to some participants retrying one or both of the modules. The mean VR simulation time spent by the YesVR group resulted in a mean VR simulation time of 24.11 minutes (*SD* 8.00) per participant.

#### 3.1. The anxiety scores

Figure 2 shows student state anxiety scores between the NoVR and YesVR groups. There was a significant difference in state anxiety scores between groups, with NoVR showing greater anxiety scores (mean 51.69, *SD* 11.87) than YesVR (mean 39.79, *SD* 12.21) ( $t_{106}=5.10$ ,  $P<.001$ , Cohen  $d = 0.99$ ). The mean difference was 11.90 units (95% CI 7.28-16.53). There was no significant difference in test anxiety scores between groups, with NoVR showing similar anxiety scores (mean 46.66, *SD* 11.15) to YesVR scores (mean 43.28, *SD* 11.58) ( $t_{106}=1.53$ ,  $P=.128$ , Cohen  $d = .29$ ). The mean difference was 3.38 units (95% CI -.985-7.74).

#### 3.2. Interview and focus group themes

VR was cited as being useful in helping with student orientation of the exam procedure, while allowing students to fail and work through difficulties in a low-stakes environment. The major themes emerging from focus groups and interviews were overall student background, exam feedback, fear of the unknown, self-consciousness, and the exam environment. Refer to Table 1 for the major themes derived from the interviews and focus groups.

Table 1. Major themes derived from student interviews and focus groups.

Theme	Sample student quotes	Interpretation
Exposure and Background	"The OSCE <sup>a</sup> is quite stressful is because many of us have not done a practical exam like this."	Students claimed those with related clinical exposure may have lesser exam stress.
Exam Feedback	"...to get feedback was not always easy because there is only one instructor to how many students?" "VR <sup>b</sup> made us be more aware to ask simpler questions in the OSCE <sup>a</sup> , because it would glitch if talked too much."	The majority of students recommended additional performance feedback be provided, especially for the VR <sup>b</sup> simulation.
Fear of Unknown	"I dreaded the [patient scenario] because you didn't know what you were going to get and the exam was new to me."	Students claimed they felt anxious of the OSCE <sup>a</sup> , because they did not know what to expect.
Self-consciousness	"No one wanted to be known as the person who failed the OSCE <sup>a</sup> ."	Students claimed they worried about being deemed incompetent by their peers.
Exam Environment	"I found [VR <sup>b</sup> ] helpful. [It was] my first VR <sup>b</sup> experience. I got to see what the layout of the room would be like."	Students recommended the VR <sup>b</sup> have exam rooms mimic the actual test environment.

<sup>a</sup>OSCE: Objective Structured Clinical Exam.

<sup>b</sup>VR: Virtual reality.

### 4. Discussion

This study shows evidence of immersive VR's potential as a tool for reducing state anxiety in health science students, who are preparing for clinical practical exams. The interviews revealed the importance of VR's role in improving student familiarity with the exam environment. Improved familiarity in this manner may have reduced student feelings of uncertainty, thus reducing student state anxiety levels. VR allows for students to make mistakes and learn in a private environment, away from peer observation and criticism. Students reported that their most preferred feature of future VR designs is to receive exam feedback, during their clinical skill practice. The feedback may inform students of their degree of completeness of questioning procedures or wording of questions to improve attentional efficiency. Additionally, the students requesting the implementation of features, such as the ability to perform physical check procedures on virtual patients, was recommended in future VR design.

## 5. Conclusion

Intolerance for uncertainty may cause students to interpret ambiguous exam situations as precarious events, manifesting symptoms of worry, self-doubt and anxiety. VR simulation has the potential to improve exposure to the exam environment, reducing feelings of uncertainty, while improving their exam familiarization. One of the major themes found in this investigation is the need for increased student practice opportunities for new components of clinical practical exams, along with receiving unbiased feedback. The use of VR simulation can provide students with opportunities to practice and receive feedback in a safe environment, potentially leading to improved performance in real-world clinical settings.

## References

- Burnard, P. (1991). A method of analysing interview transcripts in qualitative research. *Nurse Education Today*, 11(6), 461-466. [https://doi.org/10.1016/0260-6917\(91\)90009-Y](https://doi.org/10.1016/0260-6917(91)90009-Y)
- Concannon, B. J., Esmail, S., & Roduta Roberts, M. (2019). Head-Mounted Display Virtual Reality in Post-secondary Education and Skill Training. *Frontiers in Education*, 4. <https://www.frontiersin.org/articles/10.3389/educ.2019.00080>
- Concannon, B. J., Esmail, S., & Roduta Roberts, M. (2020). Immersive Virtual Reality for the Reduction of State Anxiety in Clinical Interview Exams: Prospective Cohort Study. *JMIR Serious Games*, 8(3), e18313. <https://doi.org/10.2196/18313>
- De Luca, R., Maggio, M. G., Maresca, G., Latella, D., Cannavò, A., Sciarrone, F., Lo Voi, E., Accorinti, M., Bramanti, P., & Calabrò, R. S. (2019). Improving Cognitive Function after Traumatic Brain Injury: A Clinical Trial on the Potential Use of the Semi-Immersive Virtual Reality. *Behavioural Neurology*, 2019, 1-7. <https://doi.org/10.1155/2019/9268179>
- Dugas, M. J., Gagnon, F., Ladouceur, R., & Freeston, M. H. (1998). Generalized anxiety disorder: A preliminary test of a conceptual model. *Behaviour Research and Therapy*, 36(2), 215-226. [https://doi.org/10.1016/S0005-7967\(97\)00070-3](https://doi.org/10.1016/S0005-7967(97)00070-3)
- Freitas, J. R. S., Velosa, V. H. S., Abreu, L. T. N., Jardim, R. L., Santos, J. A. V., Peres, B., & Campos, P. F. (2021). Virtual Reality Exposure Treatment in Phobias: A Systematic Review. *Psychiatric Quarterly*, 92(4), 1685-1710. <https://doi.org/10.1007/s11126-021-09935-6>
- Grealy, M. A., Johnson, D. A., & Rushton, S. K. (1999). Improving cognitive function after brain injury: The use of exercise and virtual reality. *Archives of Physical Medicine and Rehabilitation*, 80(6), 661-667. [https://doi.org/10.1016/S0003-9993\(99\)90169-7](https://doi.org/10.1016/S0003-9993(99)90169-7)
- Kvale, S. (2007). *Doing Interviews*. SAGE Publications, Ltd. <https://doi.org/10.4135/9781849208963>
- Maykut, P., & Morehouse, R. (1994). *Beginning Qualitative Research: A Philosophical and Practical Guide*. Routledge. <https://doi.org/10.4324/9780203485781>
- Pascoe, M. C., Hetrick, S. E., & Parker, A. G. (2020). The impact of stress on students in secondary school and higher education. *International Journal of Adolescence and Youth*, 25(1), 104-112. <https://doi.org/10.1080/02673843.2019.1596823>
- Perrotta, G. (2019). Anxiety disorders: Definitions, contexts, neural correlates and strategic therapy. *Jacobs Journal of Neurology and Neuroscience*, 6(1), 042.
- SLU Mental Status Exam*. Retrieved January 15, 2023, from <https://www.slu.edu/medicine/internal-medicine/geriatric-medicine/aging-successfully/assessment-tools/mental-status-exam.php>
- Spielberger, C., Gorsuch, R., Lushene, R., Vagg, P., & Jacobs, G. (2015). *State-Trait Anxiety Inventory for Adults™ (Forms Y1 and Y2)*. Mind Garden. <https://www.mindgarden.com/145-state-trait-anxiety-inventory-for-adults>
- Yip, B. C. B., & Man, D. W. K. (2013). Virtual reality-based prospective memory training program for people with acquired brain injury. *NeuroRehabilitation*, 32(1), 103-115. <https://doi.org/10.3233/NRE-130827>

## STUDENTS' BEHAVIOR ON A "MATHEMATICAL LITERACY" PROBLEM

Eleni Nolka<sup>1</sup>, & Chryssa Sofianopoulou<sup>2</sup>

<sup>1</sup>Harokopio University of Athens/PhD Candidate (Greece)

<sup>2</sup>Harokopio University of Athens/Associate Professor (Greece)

### Abstract

The construct of mathematical literacy, which has become more popular through OECD/PISA programme (Programme for International Student Assessment) recognizes the importance of students' capacity to reason mathematically, use and understand mathematical concepts while they explore real world problems. According to PISA's results, the performance of Greek 15-year-old students in mathematical literacy has not improved and has remained below the OECD average throughout the years it participated in PISA, since 2000 till today. Except PISA's general and comparable results on students' performance, students' responses on open constructed-response items and most of the items themselves are not available on PISA's open database. As a consequence, researchers cannot study them in order to analyse the way that students in Greece manage such context-based mathematics tasks and cannot comment on their difficulties which could be used as evidence to justify their steadily low performance all these years. This current study aims to explore and examine in depth the way students, who are completing compulsory education in Greece, respond in a real mathematical problem encompassing a lot of characteristics of PISA's math problems. Therefore the open constructed-response problem, which belongs to the "uncertainty and data" content category as this described in PISA's mathematics framework, was given to 650 students who complete the compulsory education in Greece (9<sup>th</sup> Grade). After decoding their answers, we comment on the different ways of dealing with the real context-based mathematics problem and clarify students' difficulties.

**Keywords:** PISA, mathematical literacy, Greece, data and uncertainty.

### 1. Introduction

"Mathematical literacy is an attribute that is on a continuum and with the potential for growth always present" (OECD, 2018b). According to mathematics' framework for the needs of the Programme for International Student Assessment, PISA 2022, mathematical literacy is defined as "an individual's capacity to reason mathematically and to formulate, employ and interpret mathematics to solve problems in a variety of real world contexts" (OECD, 2018b). This notion of mathematical literacy supports both the importance of developing a deep understanding of pure mathematical concepts and the benefits of engaging in exploration of the abstract world of mathematics (OECD, 2004; OECD, 2013; OECD, 2019). As long as there are plenty of problems and situations in real life in which the understanding of mathematics and mathematical reasoning is required, it is very important for students to have the ability to treat mathematics as a critical tool (OECD, 2013). For that reason, the extend and the way that students react on such situations and problems are important to be explored, with the ultimate goal of finding ways to develop more characteristics of mathematically literate students and individuals in general.

From 2000 till today, Greece's mean performance in mathematical literacy on Programme for International Student Assessment (PISA) has been consistently below the OECD average, with an average difference from it, of around 40 score points which corresponds to one whole school year (Nolka & Sofianopoulou, 2021; Nolka & Sofianopoulou, 2022). This stable and low status may be partly justified by the poor alignment of Greek mathematics curricula and junior high school mathematics textbooks with the PISA mathematics framework and their strong content orientation (Nolka & Sofianopoulou, 2021; Nolka & Sofianopoulou, 2022; OECD, 2018a; IEP, 2019). But apart from this theoretical explanation derived from curriculum, a different way to explain why students in Greece do not respond very successfully to real problems or why they don't concentrate so many characteristics of a mathematically literate person, is to examine the ways in which they deal with such problems and to explore the difficulties they face and what factors might be hindering this development of mathematical literacy.

One of the interrelated aspects that mathematical literacy is analysed in PISA is the mathematical content. The four content categories are: change and relationships, space and shape, quantity and uncertainty and data. In this research we choose to analyse a problem that belongs to the “uncertainty and data” category. According to statistics educator David S. Moore, the uncertainty “recognizes the importance for students to view data as numbers in a context” (OECD, 2009). According to the mathematics curriculum for lower secondary education in Greece, which includes the single cross thematic curriculum framework (DEPPS) and the detailed curricula (APS), the percentage of teaching material that deals with topics and concepts that could be included in the broader category of “uncertainty and data” is approximately 8% (P.I., 2011) in proportion to the rest of the curriculum. This element makes the results of the present research even more interesting, given that the students in the sample are not familiar with problems of such a mathematical content category.

## 2. Method

The participants of this study were 650 students from 19 high schools who are completing the compulsory education in Greece. The objective of the research was to explore and examine in depth the way students respond to this realistic context-based problem and at the same time to investigate students’ difficulties.

Table 1. The “uncertainty and data” problem.

Last year, the planet was hit by a flu pandemic. By the end of last December the number of the outbreaks and deaths from the pandemic in five countries, appear in the table below.

Country	Population	Outbreaks	Deaths
A	10,700,000	2,530,000	36,624
B	10,720,000	1,540,000	21,479
C	11,560,000	2,290,000	28,518
D	67,220,000	14,600,000	150,000
E	83,240,000	7,550,000	114,000

Looking at the table above, Vasia claims that country E had a higher rate of deaths than country A. Is Vasia right? Yes or No? Justify your answer.

The given real world problem was a subject allocated to the “uncertainty and data” content category according to PISA’s programme mathematical framework, but at the same time it was aligned to the Greek high school mathematics curriculum. The item required calculation and interpretation of data on death rates. Moreover, it required the knowledge of the basic row-column conventions of a table, as well as data – handling ability in order to choose and manage the appropriate data. Students from one side could follow all the mathematical processes of the modeling cycle described in the definition of mathematical literacy (formulate, employ and interpret) in order to relate the real context of the problem to their familiar mathematics and come up with an acceptable solution and answer. On the other hand, it wasn’t necessary for students to engage all the stages of modelling cycle but the dominant process for the specific real-problem of this research which needed to be applied was the process of interpretation, which also encompasses the notions of application and evaluation. During this process students had to interpret, apply and evaluate their mathematical outcome and at the same time it’s reasonableness in the context of the realistic problem itself.

## 3. Results and discussion

Table 2. Students’ performance on the problem.

	Frequency	Percent	Cumulative percent
Correct answer	220	33,8%	33.8%
Partial correct answer	103	15.8%	49.6%
Wrong answer	266	41%	90.6%
Missing	61	9.4%	100%
Total	650	100%	

Almost half of the students responded with a correct or a partially correct way to this real - world problem. Moreover, 1/3 of the students responded successfully to the problem, by following all the needed mathematical processes in the correct way while the 2/5 of the students failed to find the right answer in an acceptable and justifiable way.

Table 3. Frequency and percentages on students' coded answers.

Answer	Description	Frequency	Percent
<b>Correct answer – code 2.1</b>	Selects “No” and provides acceptable numerical values or numerical analysis for both countries	107	16.5
<b>Correct answer – code 2.2</b>	Selects “No” and provides an acceptable and appropriate analysis of the data without using numerical values.	113	17.4
<b>Partial Correct answer – code 1.1</b>	Selects “Yes” with supporting a “No” answer with partially correct explanation.	49	7.5
<b>Partial Correct answer – code 1.2</b>	Selects “No” and provides an explanation with or without numerical values, on one of the two countries.	20	3.1
<b>Partial Correct answer – code 1.3</b>	Selects “No” or “Yes” and compare the deaths with the outbreaks instead of the population.	34	5.2
<b>Wrong answer – code 0.1</b>	Selects “Yes” and compare only the number of the deaths.	133	20.5
<b>Wrong answer – code 0.2</b>	Selects “Yes” or “No” with an incorrect explanation.	39	6
<b>Wrong answer – code 0.3</b>	Selects “Yes” or “No” without explanation	94	14.5
<b>No answer</b>	Missing	61	9.4
<b>Total</b>		650	100

In a more detailed analysis of the students' responses, we coded them, grouping the responses for further comment on the way they approached the questions. The correct answers were grouped into two categories which were given by approximately the same percentage of students in the sample. In the first correct answer category/code, students had successfully incorporated all steps of the mathematical modeling cycle into their written answer. More specifically, they first recognized the mathematical nature of the problem and succeeded in formulating it in mathematical terms. Subsequently, they solved the problem using mathematical concepts and procedures successfully applying the process of employ. During the last step, students evaluated their solutions and interpreted them in a right way within the original and given real-world situation. Compared to the first category of acceptable answers in the second category/code of correct answers, not all procedures of the modelling cycle were used clearly. On the other hand, the final processes of interpretation and evaluation, which were allocated the problem, were very clearly written and correct, creating a fully justifiable answer in the context of the real - world problem. In both correct categories students showed an ability to handle percentages and fractions and their engagement with the processes of interpretation and reasoning.

Partially correct responses were grouped into three distinct subgroups. In the first one of them, category/code 1.1, students recognised the mathematical nature of the situation and formulated it in mathematical terms (correct or semi-correct), applying mathematical concepts (correct or with some arithmetical or mathematical mistakes) to solve the mathematically-formulated problem while in the end failing to evaluate correct or not at all the reasonableness of their mathematical solution in the context of the real-world problem. In the second category of partial correct answers an interpretation of the solution was used but not for both comparable countries and also without clear use of the previous procedures of formulation and employ. The category/code 1.3 of partial correct answers included the answers in which students followed the whole procedure of formulating, employing and interpreting but the students compared the values from the table-column deaths with the values of the table-column outbreaks instead of the population.



Furthermore, three subcategories were distinguished among students' incorrect answers. The majority of the students who gave wrong answers didn't identify the significant variables or recognise a mathematical structure, but they only compared the numbers themselves on the one table-column (deaths), without any formulation or comparison with the values from the other table-column (population). Students in this category cannot interpret or either recognise the situation in context but they only used a direct and wrong inference. On the second category/code 0.2, students used the formulation and/or the application with wrong way and they were not capable of making correct or logical interpretation of their results while at the same time they made a lot of mathematical or arithmetical mistakes. On the third incorrect answer category/code 0.3, students did not explain their answers or they did not record any of their thinking, revealing their difficulty to justify their answers in words.

Among all the preceding subcategories of correct, partially correct and incorrect answers, the largest percentages were concentrated in the first incorrect answer category (0.1) and they were followed by the two correct answers categories (2.1 and 2.2) with very similar percentages.

#### 4. Conclusion

Mathematical literacy is assessed in the context of a challenge or a problem that arises in the real world (OECD, 2014). Students in Greece, including the students in the sample of this research, according to Greek mathematics curriculum, are not systematically trained in the mathematical modelling cycle and more specifically on the mathematical processes formulate, employ and interpret, which are needed to connect the real context of the problem with the mathematics in order to solve the problem. Furthermore, students were largely unfamiliar with mathematical concepts that contain features of the category "uncertainty and data". Therefore, the ways they reacted, solved and answered the problem in this study were based basically on their general education in mathematics throughout the duration of their compulsory education.

The results of this study, which can be characterized as a positive percentage, showed that almost the half of the students were able to use some or all the mathematical processes of the mathematical modelling cycle in a correct or a semi correct way in order to solve this uncertainty and data context based and real problem. Most errors, apart from numerical errors, were traced to the students' inability to extract the essential mathematics to analyse and solve the problem, that was to formulate and moreover to their inability to reflect upon a mathematical solution, which is linked to the process of interpretation.

Exposing students in the mathematics classes to more real and context-based problems, and recognizing and familiarizing themselves with the process of mathematical modeling are some of the requirements that could help students improve their mathematical literacy skills. It may therefore be helpful for teachers to activate students and also motivate them in this direction but also for teachers themselves to be trained through specific training programs in the same direction. In addition, all these suggestions could be implemented more easily if they were included in the curriculum and in students' mathematics textbooks. A positive element is that a new curriculum (IEP, 2023) in mathematics for all compulsory education in Greece, which is already in a pilot application, is going to be in effect within the next school years, giving greater emphasis on the fields of statistics and probability and as a consequence, more problems of uncertainty and data content category will be contained. So, it will be challenging to study the results that will bring this new curriculum in the direction of improving students' mathematical literacy abilities in the future.

#### References

- IEP. (2019). *Greek Mathematics Education and PISA assessment*, Athens: Institute of Educational Policy.
- IEP. (2023). *New Curriculum*. Retrieved February and 10, 2023, from <http://iep.edu.gr/el/nea-programmata-spoudon-arxiki-selida>
- Nolka, E., & Sofianopoulou, C., (2021). Greek and Portuguese Mathematics education and Performance, through the prism of PISA. *International Conference on Education and New Developments*, 2021 (pp. 116-120). Lisboa: InScience Press
- Nolka, E., & Sofianopoulou, C., (2022). Mathematics in Southern Europe: Mathematics Education and Performance, through the prism of PISA, in Greece, Italy, Portugal and Spain. *The European Conference on Education 2022* (pp. 275-286). London.
- OECD. (2004). *The PISA 2003 Assessment Framework*, OECD Publishing, Paris: OECD. <http://dx.doi.org/10.1787/9789264101739-en>.

- OECD. (2009). *Learning Mathematics for Life. A view perspective from PISA*. Paris: OECD. <https://doi.org/10.1787/9789264075009-en>.
- OECD. (2013). *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy*. Paris: OECD. <https://doi.org/10.1787/9789264190511-en>.
- OECD. (2014). *PISA 2012 Results: What Students Know and Can Do (Volume I)*. Paris: OECD. <http://dx.doi.org/10.1787/9789264201118-en>
- OECD. (2018a). *Education for a Bright Future in Greece. Reviews of National Policies for Education*. Paris: OECD. <https://doi.org/10.1787/9789264298750-en>.
- OECD. (2018b). *PISA 2021 Mathematics Framework (Draft)*. Paris: OECD. <https://www.oecd.org/pisa/sitedocument/PISA-2021-mathematics-framework.pdf>
- OECD. (2019). *PISA 2018 Assessment and Analytical Framework*. Paris: OECD. <https://doi.org/10.1787/b25efab8-en>.
- P.I. (2011). *Single Cross Thematic Curriculum of Mathematics*. Retrieved February 10, 2023, from [http://ebooks.edu.gr/info/cps/11deppsaps\\_math.pdf](http://ebooks.edu.gr/info/cps/11deppsaps_math.pdf)

# PERSONALITY-SENSITIVE PEDAGOGIES: A MIXED METHODS ANALYSIS OF SMALL GROUP INTERACTIONS AMONG 9-10 YEAR OLDS

**Marcus Witt, & Ben Knight**

*Dr., Department of Education and Childhood, University of the West of England (United Kingdom)*

## Abstract

There is considerable evidence that working collaboratively in small groups has learning benefits (Laal and Ghodsi, 2012) and that children's participation in such activities mediates learning (Webb et al., 2014). Despite a growing interest in inclusion in education, personality has been overlooked as a possible source of exclusion. In this study we identified children who self-reported low levels of extraversion and/or high levels of neuroticism (tendency to worry) as personality traits and then observed them working in small group collaborative learning situations. Using social network analysis (SNA) as a way of understanding the group interactions, we employed a novel measure of degree centrality (influence) and coupled this with a qualitative analysis of the nature of the group interactions, establishing a genuinely mixed methods social network analysis (Froehlich et al., 2020). Findings suggest that low levels of extraversion and/or high levels of neuroticism can be, but are not always associated with lower levels of participation and that a range of other factors, notably the personality traits of the other children, affect participation. These findings could be used to suggest ways that teachers could employ more personality-sensitive pedagogies.

**Keywords:** *Personality, social-network-analysis, collaboration, participation, talk.*

---

## 1. Introduction

In classrooms in UK primary schools, pupils spend considerable time working collaboratively in small groups. There is good evidence that collaborative group work can have learning benefits (e.g. Laal and Ghodsi, 2012). Mercer (2008) outlined the importance of collaborative talk in developing children's reasoning and Littleton and Mercer (2013) further explored the importance of 'interthinking' (children collaborating and talking together in a productive way) to enhance learning. This is supported by Wells (2007) who argues for the encouragement of learners of all ages in all educational settings to engage in dialogue in order to construct knowledge together. There is evidence, therefore not only that collaborative group work can be beneficial, but also that student participation in such activity mediates learning (Webb et al., 2014).

In educational discussions at present, there is a great deal of focus on diversity and inclusion with efforts being made (quite properly) to ensure that children are not disadvantaged in their learning because of their cultural, ethnic, religious or socio-economic background. However, little attention has been given to individual personality traits as forms of diversity among school-aged learners, despite evidence that personality is often quite stable by middle childhood (Muris, Meesteres and Diederer, 2005) and that it exerts considerable influence on learning behaviours and outcomes (Gardiner and Jackson, 2015; Neuenschwander et al., 2013).

The most influential theoretical framework of personality is the 'Big Five' traits model (McCrae and Costa, 1987); personality is characterized by a position on a continuum in each of five distinct traits:

**Openness** – individuals high in openness are characterized by curiosity, willingness to try new things, imagination, and being more creative and unconventional.

**Extraversion** – individuals high in extraversion are characterized by sociability, being energized by social interaction, excitement seeking and being outgoing.

**Conscientiousness** – characterized by being competent, organized, dutiful, striving for achievement, self-disciplined and deliberate.

**Agreeableness** – individuals high in agreeableness are characterized by being trusting, straight-forward, altruistic, compliant, modest, empathetic and conflict averse.

**Neuroticism** – individuals high in neuroticism are characterized by anxiety, stress, irritability, self-consciousness, vulnerable and experiencing swings in mood.

Introversion and neuroticism are individual traits which may signal vulnerability to poor learning outcomes (Chamorro-Premuzic, & Furnham, 2003). Shyness, which may be an indication of low extraversion and high neuroticism has been shown to be correlated with poorer academic outcomes (Mjelve and Nyborg, 2019). Komarraju and Schmeck (2011) suggested that high levels of neuroticism were associated with lower academic performance. We hypothesised that pupils high in one, or both traits may be particularly at risk due to increased inhibition or marginalisation during classroom interactions, particularly during collaborative group tasks, combined with increased susceptibility to emotional instability/anxiety.

## 2. The study

The study measured the ‘Big Five’ personality traits of a group of children in a single class in Year 5 (9 and 10 year olds) in a primary school in the centre of a large city in the south west of the UK. From this data we identified children who were either low in extraversion and/or high in neuroticism; (now referred to as the ‘target children’). We then recorded the target children working with their peers on a deliberately non-cognitive collaborative task. We aimed to explore the following research questions:

- Are the ‘target children’ less influential/participatory than the other children?
- What personality factors influence the participation of the target children?
- What pedagogical lessons might be drawn that could support teachers to introduce more personality-sensitive pedagogies into their practice?

The personality data was gathered using a child-appropriate version of the well-established ‘Big Five’ self-report personality framework (Muris, Meesters and Diederens, 2005). The children answered 15 questions by selecting how they would respond in different scenarios illustrated with pictures and a small amount of written commentary. Each of the Big Five personality characteristics was assessed in three scenarios (giving a maximum score of 15 and a minimum of 5 for each trait). The questionnaires were administered by the class teacher (someone the children knew well and trusted) during a 15-minute period as part of a normal school day. A teaching assistant was also on hand to read for any of the children who had trouble with the wording of the questions. In addition, and to provide some triangulation, we asked the class teacher (who knew the children well) to identify those she deemed to be either introverted and/or prone to anxiety.

Following the administering of the personality questionnaires (and the identification of the ‘target children’) groups of children were filmed completing a short, non-cognitive collaborative task. This was done in a separate room, away from the main classroom. The groups were of 3 to 5 children and consisted of one, or two ‘target’ children working with their peers. The task was to use a set of building blocks to construct a castle with specific characteristics (a given height, containing a staircase etc.). The non-cognitive nature of the task was chosen specifically so that confidence in a particular academic domain did not confound the role of personality in the children’s participation. The children were given up to 15 minutes to complete the task. No adult was present in the room as the children collaborated but the children were aware that they were being filmed. In total eight groups were recorded. Each recorded completion of the task will now be referred to as an ‘episode’.

### 2.1. Social Network Analysis

Social Network Analysis (SNA) is an approach to investigating relations and social structures through the use of networks (Froehlich et al., 2020). Reviewing and coding the eight video-recorded episodes, we used detailed dynamic social network analysis (SNA) protocols and a novel degree-centrality measure (indicating level of influence of the individuals in the group) to analyse the frequency and type of pupil interactions. From these we were able to rank order pupils according to influence.

SNA has been criticised for its static nature (Bokhova, 2018). Our approach has sought to address this. Analysing data at regular time intervals (every minute) during each episode enabled the creation of dynamic representations from which we were able to analyse how pupils’ influence and the interactions between pupils changed over the duration of the episodes.

A second critique of SNA is its lack of attention to the qualitative nature of the interactions it seeks to model (Fuhse and Mützel, 2011; Hollstein, 2011). Froehlich et al. (2020) have proposed the idea of Mixed Methods Social Network Analysis (MMSNA) as a way of exploring both the relationship between content and group dynamics and the meaning related structural dynamics (Bruun et al., 2019). We adopted this approach; after the construction of the social networks and the quantitative ranking of

influence, we conducted further analysis of the video data. This ensured that salient features of the group interactions not coded in the SNA were described and analysed. Given our interest in the personality traits of the participants, we aimed to explore not only who was influential, or not, but how the personality traits of the participants may have affected the gaining or diminishing of influence. The study innovated on established SNA approaches to derive original contributions to the field of agent-based modelling.

## 2.2. Coding protocols

The video data was analysed both quantitatively and qualitatively. We argue that our approach is genuinely a mixed methods approach, as the quantitative analysis led directly to the qualitative and vice versa. The nature and intended target of each utterance was coded. Utterances were defined as follows:

- If one utterance is spoken without interruption – coded as a single utterance.
- If one utterance is bisected by another including a pause (as in turn taking) – coded as two utterances.
- When two different ideas are expressed back-to-back – coded as 2 utterances.
- Utterances do not include screeches, howls, speaking to oneself (externalising internal monologue – *because not intended for public consumption*), singing to oneself etc. (unless accompanied by a clear action)
- Exact repetitions are coded as two utterances.

Each video episode was watched once through in its entirety by each researcher independently. The researchers then came together to watch each episode several times. During each viewing, attention was focused on a single child and utterances coded in the following way:

- To a specific member of the group (the intended target of the utterance was recorded)
- Utterances to nobody in particular (into the ‘ether’) which did elicit a response
- Utterances to nobody in particular (into the ‘ether’) which did NOT elicit a response
- Utterances that were no intended to elicit a response (e.g. self-talk)

Any disagreements between the researchers about an utterance (e.g. whether the intended target was one of the other children, or whether it was to nobody in particular) were resolved by re-watching the utterance, looking at the body language of the other children, the context in which the utterance was made, the nature of the utterances preceding it etc. and a judgement was made.

From this coding, a ‘net in-degree’ calculation was made for each child. This was done by subtracting the number of incoming utterances from the number of outgoing utterances. The supposition is that children who are recipients of a lot of utterances are more influential and therefore more engaged in the learning than those who do not. Children who speak a lot, but whose utterances do not then generate a lot of incoming utterances are less influential. This measure was adjusted to account for children who said almost nothing but who received one or two incoming utterances (injunctions to become involved etc.) and who therefore appeared highly influential when they clearly were not. The adjustment was therefore made to include the each child’s total utterances (as speaking a lot was seen as indicative of involvement). The ‘Adjusted Degree Centrality (ADC) measure was then by adding each child’s total utterances to the ‘net in-degree’ measure.

We also explored the extent to which each participant was ignored by calculating an ‘Ignored Factor’ (IF); dividing the number of utterances to ‘the ether’ that did not garner a response by the total number of utterances. This was then expressed as a percentage.

The nature of each utterance was also coded, giving us data on the interaction/utterance types. Each utterance was assigned to one of the following categories; procedural (concerning the completion of the task, use of resources etc.); pro-social (giving compliments, resolving or averting arguments, praising an idea); anti-social (arguing, sowing dissension in the group); task knowledge (indicating an understanding of the nature and requirements of the task); subject knowledge (bringing prior knowledge to bear on the task), dominance (gaining authority, asserting an opinion, taking control of resources); subordination (acquiescing in an argument, relinquishing resources) and miscellaneous.

## 2.3. Qualitative analysis

Froehlich et al. (2020) note that both quantitative and qualitative SNA have their limitations. The detailed quantitative analysis revealed an overview of the structural properties of the network, but less of the content being exchanged or the fluctuations of the relationships. The video episodes were then analysed from a qualitative perspective. Each episode was watched again (this time independently) with attention being paid to the following features: the nature of the language used (i.e. the person of the verb (I, you, we etc.), suggestions or imperative etc.); body language; position in the room and relative to other children; on-task and off-task behaviours; dynamics between children that suggest prior relationships, or interactions. We were not limited to these but had them as prompting ideas as we watched the episodes.

Also as prompts, we had the quantitative analysis of the episodes and the personality data of each participant. In this way, the qualitative analysis was prompted by the quantitative analysis. Additionally, the observations from the qualitative analysis prompted a return to the quantitative data, for example to consider the personality data, or the influence ranking, to help us understand the episode fully. This process will now be exemplified through a consideration of one episode.

### 3. Illustrative example

Two of the four children were identified as ‘target children’\*

Table 1. Personality scores and influence calculations.

Name	E	N	O	C	A	ADC	IF
Kate*	6	10	11	13	10	62	27%
Nigel	14	8	7	11	5	54	21%
Darren	11	9	10	9	9	40	36%
Sophie*	7	6	10	12	8	15	42%

Sophie (consistent with her low E score) said little, was largely ignored and exerted little influence on the group. Kate, on the other hand, with similar personality traits, participated much more and exerted greater influence on the group. Their personality traits are similar for all five factors except for N, with Kate rating herself as considerably more prone to worry. In the episode, Sophie, while very much on the periphery seemed unperturbed by this. Kate seemed more concerned to be involved.

An analysis of the language used by the two revealed distinct patterns in their utterances. Sophie’s utterances were almost all commentary, or a repetition of something that someone else had said, e.g. *‘That’s a good archway’*; *‘Yes, we should.’*

Kate, on the other hand, made a number of suggestions. She did not use imperative language but couched her utterances in the third person plural (we) and often with a modifier such as ‘maybe’ e.g. *‘Shall we do a height test and a fit test?’*; *‘Maybe we could make it like a Jenga puzzle?’*

Kate is also highly agreeable (one of the Big Five personality traits) and acts as peacemaker when Darren knocks part of the tower over, Nigel admonishes him and it appears that an argument might ensue. Kate steps in to make sure that the group remains cohesive, using verbs in the third person plural and reassuring the whole group that the setback is not serious. Her acting as peacemaker seems to increase her influence and particularly Nigel’s receptiveness towards her suggestions.

The personality traits of the other (non-target) children in the group could also be important. Nigel, who came out as the second most influential child and who was quite dominant, was notably low in both openness and in agreeableness. His lack of openness was clear in the language that he used. He often began his utterances refuting a suggestion from one of the others;

‘No! We’re not measuring yet!’; ‘Nah, nah, nah, let’s make it build up with this.’

A lack of agreeableness suggests someone who is comfortable upsetting or inconveniencing someone else in the pursuit of a particular goal. This is seen in some of the non-verbal actions. In one instance, Sophie places a block on the structure (attempting to become more involved). Nigel immediately removes the block, which does discouraging further interaction from. Sophie.

Kate increases her participation (and influence) by taking control of some of the important resources in the room, notably a meter stick that was provided so that the children could measure the height of their castle. It could be that her high level of conscientiousness (coupled with her high level of neuroticism) prompted her to ensure that the group met the assignment brief; she was motivated to do the job well and possibly worried if the group failed to perform.

### 4. Findings and discussion

While we must emphasise that this was a small-scale, pilot study, a number of potentially important findings have been constructed from our examination of the data. Our intention is to develop these into a ‘toolkit’ to support teachers in implementing more personality sensitive pedagogies in their classrooms. The key findings are summarized below:

- Openness & Agreeableness of other group members appears to be a key mediator of participation for target children. Low O and/or A tend to produce blocking and imperative language.

- Sometimes the target pupils were isolated, not always. Some target pupils self-isolated whilst others seemed to be isolated by the dynamic (i.e. were marginalised by other participants). Neuroticism seemed to mediate comfort with isolation.
- Some pupils did fit their Big 5 profiles precisely and others did not. Complexities of friendship and pre-existing social dynamics could be mediating factors.
- Pupils become influential via different means. Children high in E and low in O achieved this by 'bossing others around' (imperative language). Children low in E but high in O, C and A gained influence and participated by making procedural suggestions.
- Resources and physical space – where these were dominated and target pupils lost out, the dominating was done by an individual who was high in E and low in A. In the group composed entirely of 'target pupils' resources and physical space were not dominated by any single child.
- Failed attempts to participate constructively (which can be for different reasons) resulted in pupils high in N resorting to eliciting influence from subversive behaviours.
- When target pupils collaborate, there was a much more even distribution of interaction, influence and participation. Co-operation levels were high, competition/clashes non-existent. The tasks were completed more quickly.

### References

- Bruun, J., Lindahl, M., & Linder, C. (2019). Network analysis and qualitative discourse analysis of a classroom group discussion. *International journal of research & method in education*, 42(3), 317-339.
- Chamorro-Premuzic, T., & Furnham, A. (2003). Personality predicts academic performance: Evidence from two longitudinal university samples. *Journal of research in personality*, 37(4), 319-338.
- Froehlich, D., Rhem, M., & Rienties, B. (2020). *Mixed Methods Social Network Analysis. Theories and Methodologies in Learning and Education*. Abingdon: Routledge.
- Fuhse, J. and Mützel, S. (2011). Tackling connections, structure, and meaning in networks: quantitative and qualitative methods in sociological network research. *Quality & quantity*, 45, 1067-1089.
- Gardiner, E., & Jackson, C. J. (2015). Personality and learning processes underlying maverickism. *Journal of Managerial Psychology*, 30(6), 726-740.
- Hollstein, B., (2011). Qualitative approaches. *The SAGE handbook of social network analysis*. London: Sage.
- Laal, M., & Ghosi, S. M. (2012). Benefits of Collaborative Learning. *Social and Behavioural Sciences*, 31, 486-490.
- Littleton, K., & Mercer, N. (2013). *Interthinking: Putting talk to work*. Abingdon: Routledge.
- McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology*, 52, 81-90.
- Mercer, N. (2008). Talk and the Development of Reasoning and Understanding. *Human Development*, 51, 90-100.
- Muris, P., Meesters, C., & Diederens, R. (2005). Psychometric properties of the Big Five Questionnaire for Children (BFQ-C) in a Dutch sample of young adolescents. *Personality and Individual Differences*, 38, 1757-1769.
- Neuenschwander, R., Cimeli, P., Röthlisberger, M., & Roebbers, C. M. (2013). Personality factors in elementary school children: Contributions to academic performance over and above executive functions? *Learning and individual differences*, 25, 118-125.
- Webb, M. N., Franke, M. L., Ing, M., Wong, J., Fernandez, C. H., Shin, N., & Turrou, A.C. (2014). Engaging with others' mathematical ideas: Interrelationships among student participation, teachers' instructional practices, and learning. *International Journal of Educational Research*, 63, 79-93.
- Wells, G. (2007). Semiotic Mediation, Dialogue and the Construction of Knowledge. *Human Development*, 50, 244-274.

# SENTENCE COMPREHENSION IN CHILDREN WITH DEVELOPMENTAL LANGUAGE DISORDERS

**Barbora Červenková<sup>1</sup>, & Gabriela Solná<sup>2</sup>**

<sup>1</sup>*Faculty of Education, Palacký University/Faculty Hospital Brno (Czech Republic)*

<sup>2</sup>*Faculty of Medicine, Charles university/Hospital Agel, Ostrava – Vítkovice (Czech Republic)*

## Abstract

*Purpose:* Language comprehension is vital to social and educational development. Difficulties in sentence comprehension can be detected in most children with developmental language disorders (DLD) using age-appropriate instruments with high sensitivity. There are two main theoretical frameworks for the characterization of difficulties in language acquisition in children with (DLD): linguistic-based and cognitive-based theories. The aim of this study is a comparison of language comprehension in children with developmental language disorder (DLD) and children with typical language development (TLD). Two types of tests referred to as main theoretical frameworks have been used (Token test and TEPO - Sentence Comprehension Test). *Sample:* We studied 101 children aged 4,3-6,9 years with (DLD) and typically developing peers (TLD). Data collection took place in the period 2021-2023. *Method:* It is quantitative research. A total of 47 children with (DLD) were compared with 54 children with (TLD) in two comprehension tests. The research goals were set as follows: 1) Correlation of TEPO test and Token test using Spearman's correlation coefficient; 2) Comparison of homogeneity of test results in TLD and DLD children using Stuart–Maxwell test; 3) Determination of the sensitivity and specificity of both tests. *Results:* There is a high dependence between the two tests, indicating a high level of correlation, with  $r_s = 0.81$  in the whole research sample. There was a statistically significant difference ( $p < 0.001$ ) between the test results based on percentile rank scores. The non-parametric unpaired Stuart-Maxwell test was used. The TEPO test has high sensitivity (95,7%) and the Token test has high specificity (90,7%). *Discussion:* Both comprehension tests have several advantages in terms of their characteristics, and they also have some limitations. The research results provide more information about the differences between the two testing methods and explain how the test results can be used in education.

**Keywords:** *Specific language impairment, comprehension, language disorders.*

## 1. Introduction

Developmental language disorder (DLD) is a neurodevelopmental disorder with a prevalence rate of approximately 7% in early childhood (Siu, 2015). DLD manifests as difficulties in expressive language or both expressive and receptive language (American Psychiatric Association [DSM-V], 2013; Tomblin et al., 1997). DLD is a heterogeneous category that has consequences in the linguistic domains: phonology, word finding and semantics, syntax, pragmatics, and discourse (Kamhi & Clark, 2013) and also in cognitive domains: selective attention, attentional shifting, working memory and verbal short term memory (Archibald & Gathercole, 2006; Lum, Conti-Ramsden, Page, & Ulman, 2012; Lum & Zarafa, 2010; Willinger et al., 2017) and is often associated to general processing limitations (e.g., Kamhi & Clark, 2013). DLD persists from childhood to adolescence and adulthood (Kamhi & Clark, 2013). Problems with language development can cause significant interference with everyday life or educational progress (Bishop et al., 2017).

There are a variety of standardized tests available to assess sentence comprehension in children with Developmental Language Disorder (DLD). Some commonly used tests include: The Test for Reception of Grammar, The Clinical Evaluation of Language Fundamentals, The Comprehensive Assessment of Spoken Language, The Peabody Picture Vocabulary Test.

The Test for Reception of Grammar – TROG-2 (Bishop, 2003) measures a child's ability to understand and use grammatical structures in sentences. It includes a series of picture stimuli that the child is asked to describe using grammatically correct sentences. The Clinical Evaluation of Language Fundamentals – CELF -5 (Semel, Wiig, & Secord, 2013) measures a range of language skills, including sentence comprehension. The test includes a variety of tasks that assess a child's ability to understand



spoken sentences, including sentences with complex syntax and semantics. The Comprehensive Assessment of Spoken Language – CASL2 (Carrow-Woolfolk, 2017) assesses a range of language skills, including sentence comprehension. It includes a variety of tasks, such as sentence completion and comprehension questions, to assess a child's understanding of complex sentence structures. The Peabody Picture Vocabulary Test – PPVT-4 (Dunn, 2018) while not specifically designed to assess sentence comprehension, this test measures a child's ability to understand and use vocabulary words in sentences, which is an important component of overall language comprehension.

It is important to note that standardized tests are just one tool used to assess a child's language abilities, and they should be used in conjunction with other assessments, clinical observations, and reports from parents and teachers to fully understand the child's language profile. A qualified speech-language pathologist can help to determine the most appropriate assessments for a child with DLD and interpret the results in the context of the child's individual strengths and weaknesses.

## **2. Design**

In the research methods of data collection, the oral speech understanding component was examined using the Token Test – TT (Bolceková, Preiss, & Krejčová, 2015) and the Sentence Comprehension test –TEPO (Solná & Červenková, 2022). Sentence comprehension tests were chosen for our research, rather than tests assessing comprehension at the level of single words, because tests based on sentence comprehension place high demands on short-term memory load due to the need to process and interpret grammatical relations, hence more complex results are obtained for children with DLD.

Our aim is to compare two tests of sentence comprehension based on different theoretical frameworks. The Token test is based on Cognitive theory. The children's performance in this test relies on short-term/working memory, attentional shifting and attentional control, inhibition and cognitive flexibility and planning (Kamhi & Clark, 2013; Willinger et al., 2017; Schmoeger et al., 2019). Although the Token test (De Renzi & Vignolo, 1962) was not originally designed to test comprehension in children, later was shown to be efficacious in the detection of language problems in children with DLD (e.g., Cole & Fewell, 1983), and in the children's version Token Test for Children –TTFC-2 (McGhee, Ehrler, & DiSimoni, 2007) is a widely used diagnostic method. In our research, we used a shortened version of TT (Bolceková, Preiss, & Krejčová, 2015). There are 35 items in total, divided into six sections. In this test, the child has to manipulate with plastic objects (tokens) which differ in size, form, and color.

Sentence comprehension test – TEPO (Solná & Červenková, 2022) is similarly to TROG 2, based on Linguistic theory and is intended for children from 3 to 8 years of age for assessing the level of language skills. The test has a multiple-choice format with lexical and grammatical foils. The child listens to a spoken sentence and must select one of four pictures to match what is heard. The items are organised into 15 blocks of 4 items, with the grammatical complexity of the blocks increasing as the test progresses. The standardized version included norms for 863 children. The administration time is 10 minutes.

## **3. Objectives**

The research questions were set as follows: 1) What is the correlation of TEPO and TT using Spearman's correlation coefficient; 2) What is the homogeneity of the results of both tests in a group of children with TLD and DLD using Stuart–Maxwell test; 3) What is the sensitivity and specificity of TEPO and TT in a subgroup of children with DLD.

## **4. Methods**

### **4.1. Participants**

Nineteen girls (40%) and twenty-eight boys (60%) aged 4-6 years ( $M = 5.9$  years) were recruited at the Hospital AGEL, Ostrava-Vítkovice. DLD was diagnosed by a speech and language therapist whereby diagnosis implied at least two below average scores out of five in standardized language tests. Furthermore, a control sample of typically developing, age-matched children, 26 boys, and 28 girls, were invited to participate from kindergarten through Grade 1 in a public school in Ostrava. Children in the control group were tested with the same set of tests as the children with DLD. They were included in this group if they achieved normal test results. The characteristics of the children are shown in Table 1.

Table 1. Characteristics of the children with developmental language disorder (DLD), and normally developing children with typical language development (TLD).

Characteristics (n = 101)	TLD (n = 54)	DLD (n = 47)	p-value
girls	26 (58%)	19 (42%)	0,436*
boys	28 (50%)	28 (50%)	
girls age in months (median, IQR)	67 (61-76)***	72 (66-83) ***	0,103**
boys age in months (median, IQR)	66 (61-71) ***	69,5 (66-76) ***	0,079**

\*chi-square test, \*\*Mann-Whitney test, \*\*\*IQR – interquartile rank (25.-75. percentile)

## 4.2. Statistic analysis

Basic descriptive statistics (median, IQR – interquartile range: 25th-75th percentile, absolute counts, %) were used for the data analysis. The Chi-square test and symmetry test for qualitative traits were used for statistical evaluation. For quantitative traits, normality was tested using the Shapiro-Wilk test. Normality was confounded, children with DLD were older than those with TLD,  $p=0.020$ , so the non-parametric Mann-Whitney test was further used for statistical testing. The dependence between the TEPO and Token test results was assessed using ordinal Spearman's correlation coefficient. Sensitivity, specificity, and predictive values were computed. Statistical tests were evaluated at the 5% significance level. Stata version 16 software was used for processing.

## 4.3. Correlation of TEPO and TT using Spearman correlation coefficient

The correlation of the TEPO test with the Token test using Spearman's rank correlation coefficient in the entire participant population is  $r_s = 0.81$ , in children without diagnosis (TLD) is  $r_s = 0.63$ , and in children with DLD is  $r_s = 0.58$ . Thus, the correlation of the TEPO Test with the Token Test according to Spearman's correlation coefficient according to the interpretation of De Vaus (2002) is moderate to substantial (0.50 - 0.69) in subgroups and substantial to very strong (0,70-0,89) in the whole research sample, all results are statistically significant.

## 4.4. Comparison of homogeneity of test results in TLD and DLD children

The distribution of children's scores in percentile ranks expressed as a percentage can be seen in Table 2.

Table 2. Comparison of TEPO and TT results by percentile ranks in the whole research sample.

TT	TEPO			Total
	Norm	5.perc.	10.perc	
Norm	43 (42,57%)	12 (11,88%)	10 (9,90%)	65 (64,36%)
5.perc.	2 (1,98%)	23 (22,77%)	0 (0%)	25 (24,75%)
10.perc	3 (2,97%)	7 (6,93%)	1 (0,99%)	11 (10,89%)
Total	48 (47,52%)	42 (41,58%)	11(10,89%)	101 (100%)

48% of children were within a normal limit in TEPO and 64 % of children in TT. 11% of children were at the 10<sup>th</sup> percentile in TEPO and 42% of children were at the 5<sup>th</sup> percentile. 11% of children were at the 10<sup>th</sup> percentile in TT and 25% were at the 5<sup>th</sup> percentile. There was a statistically significant difference in the symmetry test ( $p < 0.001$ ) between the test results based on percentile rankings.

**4.4.1. Comparison of homogeneity of test results by subgroups.** Comparison of TT and TEPO test results in TLD children: there was no statistically significant difference between the test results based on percentile rankings. For this evaluation, the Stuart-Maxwell test  $p=0.273$  was used to assess the homogeneity of the quantitative variables. Comparison of TT and TEPO test results in DLD children: there was a statistically significant difference ( $p < 0.001$ ) between the test results based on percentile rankings. For this evaluation the Stuart-Maxwell test  $p=0.0002$  was used to assess the homogeneity of the quantitative variables.

## 4.5. Sensitivity and specificity of TT and TEPO in children with DLD (n=47)

Children with DLI in TEPO: 45 children are true positives and 2 children are false negatives. Children with DLI in TT: 31 children who are true positives and 16 children who are false negatives.

TEPO: the sensitivity of the test is 95.7%, the specificity of the test is 85.2%, the positive predictive value is 84.9%, and the negative predictive value is 95.8%.

TT: the sensitivity of the test is 66%, the specificity of the test is 90.7%, the positive predictive value is 86%, and the negative predictive value is 75.4%.

## 5. Discussion

The necessity for the evaluation of sentence comprehension in preschool and school-age children with DLD using short, effective, and feasible tools is obvious. For this reason, it is recommended by the American Speech-Language-Hearing Association or the American Academy of Pediatrics (Hagan, Shaw, & Duncan, 2008; Siu, 2015) early detection of language impairments. In this research two comprehension tests were compared: TT and TEPO. Both of these tests are short enough to be used for DLD screening in preschool age.

The correlation of the TEPO Test with the Token Test according to Spearman's correlation coefficient is very strong. If children develop typically and do not have comprehension difficulties, they can be tested with both tests with similar results. However, children with DLD score significantly differently on these tests. It is therefore necessary to define what the tests actually assess.

In our study, the sensitivity of TT in the DLD subgroup is 66%, and the specificity is 90.7%. We can compare these results with the study results of a team of authors (Willinger et al., 2017). In this study, the sensitivity of TT in the DLD subgroup is 69%. This study measured the psychometric properties of a short version of the Token test (containing 50 items) as a screening tool for detecting children with DLD in preschool age (4-6 years). Because the total score of the TTFC-2 test is lower than the recommended total classification rate of 80%, the authors of this study do not recommend using this test to detect comprehension disorders in preschool children under the age of 6. According to this group of authors, this test primarily measures children's intellectual capacity because the scores of children with DLD on the TTFC-2 test correlate significantly with poorer scores on the Wechsler Preschool and Primary Scale of Intelligence -WPPSI (Wechsler, 1967), specifically on the arithmetic and verbal subtest.

A later study (Schmoeger et al., 2019) showed that in age groups 4 and 5 years, Part V of the Token Test yielded acceptable classification rates (85.1% and 80.6%) whereas the age group 6 years was not significantly discriminated by any Token Test variable. Based on these results, it is clear that TT does not cover important linguistic aspects for identifying a heterogeneous group of patients, such as DLD, in several age groups.

TEPO targets specific linguistic features and therefore has 95.7% sensitivity and 85.2% specificity. Therefore, this test can be considered a suitable screening method for DLD. The TT can be used as the second test in the sequence, knowing that it evaluates a more general developmental factor in preschool children rather than an exclusive indicator for language comprehension.

## 6. Conclusion

According to the prevalence in which DLD occurs in the population, this condition can affect about two or three children out of every classroom, which may manifest itself in difficulties in comprehension. These problems are often not obvious either for parents or teachers. They can manifest themselves in children by: misunderstanding instructions, needing simpler language than peers, and asking for multiple repetitions. If the teacher notices these difficulties, he/she should recommend an assessment by a speech and language therapist. If the comprehension disorder is confirmed, the following strategies may be considered appropriate: creating an environment conducive to communication by reducing background noise, adapting to teachers' language, attracting the child's attention before assigning a task, giving simple instructions in the order to be followed, avoid more abstract words, explaining abstract concepts, using familiar vocabulary, giving extra thinking time and processing time, inclusion pause between explaining key points and ideas, using gestures and repeating key points and summarizing of what has been said.

It is also important to encourage children to ask questions when they do not understand a word during lessons and then teach the meaning and practice it together. Encourage children to keep a record of new words that are introduced in a vocabulary book, a word wall display, or a word bank.

## References

- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Washington, DC: Author.
- American Speech-Language-Hearing Association. (n.d.). *Definitions of communication disorders and variations*. Retrieved May 22, 2023, from <http://www.asha.org/policy/RP1993-00208/>
- Archibald, L. M., & Gathercole, S. E. (2006). Short-term and working memory in specific language impairment. *International Journal of Language & Communication Disorders, 41*(6), 675–693. doi:10.1080/13682820500442602
- Bishop, D. (2003) *The Test for Reception of Grammar version 2 (TROG-2)*. London: Psychological Corporation.
- Bishop, D. V. M., Snowling, M. J., Thompson, P. A., & Greenhalgh, T. (2017). Phase 2 of catalise: A multinational and multidisciplinary Delphi consensus study of problems with Language Development: Terminology. *Journal of Child Psychology and Psychiatry, 58*(10), 1068–1080. doi:10.1111/jcpp.12721
- Bolceková, E., Preiss, M., & Krejčová, L. (2015). *Token test pro děti a dospělé*. [Token test for children] Otrokovice: Propsyco.
- Carrow-Woolfolk, E. (2017). *Comprehensive Assessment of Spoken Language, CASL-2* (2nd ed.) Torrance, CA: Western Psychological Services.
- Cole, K. N., & Fewell, R. R. (1983). A quick language screening test for young children: The Token Test. *Journal of Psychoeducational Assessment, 1*(2), 149-153.
- De Renzi, A., & Vignolo, L. A. (1962). Token test: A sensitive test to detect receptive disturbances in APHASICS. *Brain, 85*(4), 665–678. doi:10.1093/brain/85.4.665
- De Vaus, D. A. (2002). *Analyzing social science data*. Thousand Oaks, Calif: Sage.
- Dunn, D. M. (2018). *Peabody Picture Vocabulary Test* (5th ed.). San Antonio, TX: Pearson Assessment.
- Hagan, J., Jr., Shaw, J., & Duncan, P. (2008). *Bright futures: Guidelines for health supervision of infants, children, and adolescents* (3rd ed.). Elk Grove Village, IL: American Academy of Pediatrics.
- Kamhi, A. G., & Clark, M. K. (2013). Specific language impairment. In Dulac, O., Lassonde, M., & Sarnat, H. B. (Eds.), *Handbook of clinical neurology* (Vol. 111, pp. 219–227). Amsterdam: Elsevier.
- Lum, J. A. G., Conti-Ramsden, G., Page, D., & Ullman, M. T. (2012). Working, declarative and procedural memory in specific language impairment. *Cortex, 48*(9), 1138–1154. doi:10.1016/j.cortex.2011.06.001
- Lum, J. A., & Zarafa, M. (2010). Relationship between verbal working memory and the scan-C in children with specific language impairment. *Language, Speech, and Hearing Services in Schools, 41*(4), 521–530. doi:10.1044/0161-1461(2010/09-0035
- McGhee, R. L., Ehrler, D. J., & DiSimoni, F. (2007). *Token Test for Children* (2nd ed.) Austin, TX: Pro-Ed.
- Semel, E., Wiig, E., & Secord, W. (2013). *Clinical Evaluation of Language Fundamentals*. The Psychological Corporation. San Antonio, TX: Pearson Clinical Assessment.
- Schmoeger, M., Deckert, M., Eisenwort, B., Loader, B., Hofmair, A., Auff, E., & Willinger, U. (2019). Evaluating Part V of the German version of the Token Test as a screening of specific language impairment in preschoolers. *Applied Psycholinguistics, 41*(1), 237-258. doi.org/10.1017/S0142716419000493
- Siu, A. L., & US Preventive Services Task Force. (2015). Screening for speech and language delay and disorders in children aged 5 years or younger: *US Preventive Services Task Force Statement. Pediatrics, 136*(2), e474–e481. <https://doi.org/10.1542/peds.2015-1711>
- Solná, G., & Červenková, B. (2022). *TEPO-Test porozumění větám*. [TEPO - Sentence comprehension test]. Praha: Publi.
- Tomblin, J. B., Records, N. L., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M. (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech, Language, and Hearing Research, 40*(6), 1245–1260. doi:10.1044/jslhr.4006.1245
- Wechsler, D. (1967). *WPPSI Manual: Wechsler Preschool and Primary Scale of Intelligence*. New York: The Psychological Corporation.
- Willinger, U., Schmoeger, M., Deckert, M., Eisenwort, B., Loader, B., Hofmair, A., & Auff, E. (2017). Screening for specific language impairment in preschool children: Evaluating a screening procedure including the token test. *Journal of Psycholinguistic Research, 46*(5), 1237–1247. doi:10.1007/s10936-017-9493-z

## CO-CREATING AN ORGANIZATION-WIDE PEDAGOGICAL PROGRAM IN HIGHER EDUCATION

**Katri Ojasalo, & Pauliina Nurkka**  
*Laurea University of Applied Sciences (Finland)*

### Abstract

Higher education is expected to prepare students for the future and develop their competences for dealing with rapidly transforming working life. The substantial changes in the digitizing, networking, and globalizing society and working life have recently challenged the pedagogical approaches of higher education institutions. At the same time, the tightening education policy and diminishing funding of HEIs require more efficient and effective educational processes. New ways of teaching and learning are also needed to ensure the well-being of the higher education community and the joy of learning. These remarks led to a year-long open and co-creative process at Laurea University of Applied Sciences in Finland to construct a pedagogical program that brightens the collective aspiration to renew teaching and learning. The purpose of this paper is to describe the process of co-creating an organization-wide pedagogical program and to show the first outcomes of that process. The still ongoing process has progressed through an open dialogue in small thematic groups and collective co-creative workshops. The core working group has involved about 100 persons in different positions in the organization. The first outcomes of the design process describe how the selected pedagogical choices will manifest themselves in the year 2025 at four levels: at the organizational level, degree programme level, study unit level and student level. The co-creative process and vivid discussions during the process facilitate the organization-wide transformation that the new pedagogical program requires.

**Keywords:** *Pedagogy, higher education, co-creation, learning, learning by developing.*

---

### 1. Introduction

During recent years, the higher education landscape has been changing considerably due to the rapidly transforming society and working life (e.g. Goodyear, 2021). To be able to prepare student for the future, many HEIs have recognized various needs for developing their pedagogical approaches towards more learner-centered and project-based forms of learning. The transforming higher education landscape also calls for reshaped and expanded spaces for learning (e.g., Carvalho & Goodyear 2018; Goodyear 2021).

In this development path, Laurea University of Applied Sciences in Finland has been a trailblazer. The pedagogical model called Learning by Developing (LbD) was developed at Laurea already at the beginning of the century (Raij, 2007). In the LbD model, education is learner-centered and competence-based, and authentic working life projects or research, development and innovation projects form the learning environment. Thus, the LbD model effectively combines the three main tasks of a university of applied sciences, i.e., education, research and development, and regional development.

In the LbD model, students are expected to take greater responsibility for and control of their own learning, and they become equal partners with working life experts and teachers, whose main role shifts from traditional teacher roles to facilitators in the learning processes (e.g. Raij, 2018). This 20-year-old pedagogical model has lately proved to be something that society is strongly expecting from higher education institutions: the LbD model has provided a mechanism for individuals' and communities' knowledge creation and learning to keep pace with the complex transitions in the working life (e.g. Ojasalo, 2018).

Even though the LbD model is relevant and remains up to date in most aspects, the uncertainties and complex changes in the society and working life have been affecting its basic elements. Today, the world is much more technology-based, networked, and open than at the beginning of the century when the LbD model was born. Rapidly emerging new technologies and disruptive innovations are revolutionizing human life and the global economy. The physical and the digital worlds are converging,

and digital technologies are making the operational environment more open, collaborative, and global (Ojasalo, 2018). At the same time with this kind of substantial changes that widely affect universities, also the tightening education policy and diminishing funding of HEIs require more efficient and effective educational processes. New ways of teaching and learning are needed to ensure the well-being of the higher education community and the joy of learning.

These remarks led to a year-long open and co-creative process at Laurea University of Applied Sciences in Finland to construct a pedagogical program that brightens the collective aspiration to renew teaching and learning. The aim of Laurea's pedagogical program is to articulate the common understanding of the pedagogical thinking and clarify the selected pedagogical choices for the coming years. The new pedagogical program also aims to brighten the shared view of implementing the LbD model in the modern digitized, networked, and globalized society.

This paper describes the process of co-creating the organization-wide pedagogical program and shows the first outcomes of that process. The foundation for the renewal process have been the pedagogical guidelines, that are based on Laurea's strategic choices and the Learning by Developing model. Thus, the new pedagogical program aims to be aligned with the following pedagogical guidelines: all pedagogical solutions should be learner-centered, competence-based, working life oriented and flexible.

## **2. The co-creative design process**

The main principle for the year-long process of creating the pedagogical program was the notion that the process should include elements of service design, which is Laurea's strategic choice for any internal development work. The recent trend of integrating design thinking and service design into a development process makes the process collaborative, open-minded, iterative, and holistic (Ojasalo et al., 2015). The most important characteristic of service design is its user-centeredness: all development is based on deep and empathic understanding of situations, needs, wishes, and activities of service users (e.g. Dyer et al., 2011). In service design, diverse methods are used to acquire this understanding, and thus various stakeholders are directly included in the creation of new ideas with the methods of co-creation (e.g. Ojasalo et al., 2015).

The design process for co-creating the pedagogical program has highlighted open dialogue during the whole academic year 2022-2023. In line with the service design approach, the aim was to closely tie the whole higher education community in the development work. The core development group of about 100 persons has been multidisciplinary and multi-professional, and has involved teaching staff, managers and leaders, and representatives of support services. Also, students have been involved in the process. In the open dialogue, the selected viewpoints and concepts have been discussed, and the desired future state and necessary changes have been concretized.

The development of the pedagogical program has progressed through facilitated dialogues in seven theme-specific groups. The themes for the groups emerged e.g. from the strategy, pedagogical guidelines and various feedback, e.g. the national quality audit done at Laurea in 2022. The themes guiding the development work were: (1) Competence-based assessment and recognition of prior learning, (2) Incorporating actual work into studies, (3) Internationalization and multiculturalism, (4) Utilization of research-based knowledge and involvement of key partner organizations in implementing the LbD model, (5) Guidance in building well-being, (6) Digitalization and large-group pedagogy implementing the pedagogical guidelines, and (7) Anticipation in education.

From the start of the academic year until the end of it, all these thematic groups have gathered to a shared 2-hour online workshop twice a month. Between these collective workshops that have brought all the groups together, the thematic groups have had their own group meetings online. All the thematic groups have also gathered for two half-day face-to-face workshops where for example empathy maps were developed to better incorporate learner-centricity to the development work. Thus, there have been plenty of possibilities for open dialogic. Also, the shared digital working space has facilitated the discussion during the process. The whole HEI community has been openly communicated about the progress of the development work: for example, a piece of news has been published in the intranet after every online and face-to-face workshop.

## **3. The outcomes of the design process: the pedagogical program**

As a result of the year-long co-creative design process, Laurea's pedagogical program describes the pedagogical choices at four level: the whole Laurea University of Applied Sciences (UAS) level, degree programme level, study unit level and student level. According to the choices made for the pedagogical program, Laurea's pedagogy manifests itself in year 2025 in the following way.

### **3.1. UAS level choices: Common principles guiding pedagogical solutions**

At the whole university of applied sciences level, the Learning by Developing model is still Laurea's main choice for individual and community learning and for creating new knowledge. In the LbD model, the student has an active role as a learner, experiencer, developer, and researcher, together with the working life partners and higher education community. Laurea's selected key partner organizations provide students with learning environments where they can learn future working life competences and apply research-based knowledge when developing working life and society. The competence-based education also means that all students can seek recognition of prior learning. The process and methods of recognizing prior learning are familiar to students, teachers, and partners as an alternative way of developing competence.

Laurea offers both self-paced and interactive online studies for students. As the number of Laurea's students continues to grow, self-paced online learning is systematically utilized in all parts of studies where it is appropriate for learning. Automated studies and parts of study units free teachers' time for more individualized guidance in the learning process. Open digital learning materials are widely used in teaching and learning. Open teaching practices ensure the quality and impact of education. The development of the necessary pedagogical expertise to ensure high-quality learning is taken care of.

Laurea's pedagogy is based on a guidance approach. Personal pedagogical guidance for the advancement and completion of studies is implemented so that the student receives equal and timely guidance services regardless of campus or education format. The students' understanding of their own competence and its development are built in interaction in a critical dialogue. Laurea's guidance activities strengthen the student's agency and functional capacity, self-direction, participation, career planning skills, and well-being. Guidance activities produce a sense of satisfaction and achievement. Students' diverse backgrounds, needs, goals, and abilities to reflect on their own competence are recognized. Students are also guided individually as needed. Multicultural students are a resource, and Laurea supports their integration and employment in Finland.

### **3.2. Degree programme level choices: Competence-based curricula and learning environments**

The degree programme specific choices form the basis for high-quality and equal learning, appropriate resourcing, and the implementation of Laurea's pedagogical guidelines in all education. Competent pedagogical leadership ensures the implementation of the degree programme specific choices made and the necessary competence needed to implement them.

In the curriculum, the learning objectives of all degree programmes are formulated in a competence-based manner, and the objectives are clear for students, teachers, and working life partners. In addition to substantive expertise, the development of general, common work-related competences is also clearly visible in the degree programme learning objectives. The curriculum indicates how future awareness and foresight ability, international competence, sustainable development competence, and ethical competence are developed as a cross-cutting theme, strengthening the student's ability to act as an active actor and innovator in the future global operating environment. Key partner organizations selected by the degree programme are closely involved in the curriculum development. Various foresight methods, platforms, and cooperation processes support the curriculum development. An active cooperation between degree programmes supports the consideration of multidisciplinary and multi-professional opportunities in the curriculum work and the utilization of synergies in the implementation of education. The close interaction between the degree programme and the working life supports the consideration of changing competence needs also in the development of working life oriented continuous learning offerings.

The LbD model is systematically implemented in all degree programmes in cooperation with key partner organizations. The LbD model makes it possible to combine learning, work, and research in an innovative way. In all degree programs, there is an agreed amount of core and complementary studies that can be completed fully independently as automated online studies. The independent online studies meet the quality criteria and are suitable for advancing learning and progress. These studies are only available as automated studies. Additionally, at the degree programme level, there are selected studies that offer independent online learning as a form of implementation, which can also be common to different programs. The use of shared implementation templates is mandated at the education level, and their development is ensured. Selected key partners also participate in their content development, where appropriate.

Internationality and multiculturalism are a visible and recognized part of every degree programme. Each degree programme includes at least one project or study completed in genuine international cooperation. Additionally, all students can study languages extensively either at Laurea or at other higher education institutions.

### **3.3. Study unit level choices: Facilitating high-quality learning processes**

At the study unit level, the learning processes are highlighted instead of teaching processes. Everyone recognizes their role in the student's learning processes, so that student agency is strengthened. When planning learning processes, students' different backgrounds, competences, and goals are considered. The planning of study units is based on the common quality criteria. The teacher plans the workload and learning tasks of the study unit so that the student's guidance and participation can be facilitated.

The implementation of the study unit is based on a pedagogical script. The projects, assignments, learning materials, and contents of a study unit are designed so that the learning process focuses on the development of the competences stated in the curriculum. The openly shared implementation templates and existing open learning materials are used in the planning and implementation of study units. The pedagogical script also shows how Laurea's general, common work-life competencies are developed in the study unit. Learning is guided by assessing the student's competence in relation to the learning objectives of the study unit. The learning process includes assessing the level of competence at the beginning, in the middle, and at the end, using common evaluation criteria, self-evaluation and peer evaluation practices. Students are guided to give peer feedback and receive feedback. In online studies, the teacher uses available assessment tools to reliably assess the student's learning.

In the processes of identifying and acknowledging competence and in the processes of recognizing learning, the different backgrounds and needs of the students are considered. Alternative completion methods of the course are provided in the implementation plan. Recognition of prior learning is possible for both degree students and continuous learning students, and it supports lifelong learning. The recognition of competence supports the implementation of studies and the development of the individual's own competence.

### **3.4. Student-level choices: An active and responsible role as a learner**

The target is that students understand the importance of their own activity and responsibility in the learning process. The students are responsible for their own study path, and they have the responsibility to develop, recognize, and demonstrate their competencies in relation to the learning objectives of the degree programme. They feel that it is possible to shape their own learning path to support the achievement of their personal competence and career goals. The students know how acquired competencies and prior learning are recognized. Degree students can acquire competences and build personal learning paths by also utilizing educational offerings from other higher education institutions to support their professional growth and achieving their career dreams.

Laurea's key partner organizations, RDI projects, international environments and encounters, and digital platforms form a natural learning environment for the students. Self-directed digital learning solutions in selected study units allow the students to progress at their own pace and from anywhere.

The students' competence development, professional growth, and career planning are supported through regular guidance and feedback. The target is that the students develop into future-oriented actors in their field. They renew their skills and competences according to the learning objectives stated in the curriculum.

The student receives feedback on their learning and competence development depending on the method of implementation from their teachers, fellow students, and representatives from the working life. The students also learn to evaluate the development of their own competences. The students recognize the added value generated by different perspectives from teamwork in their own learning, and they are ready to openly share their own expertise with others. The students are committed to working together, agreeing on common schedules, and providing and receiving constructive feedback. The students understand that seeking guidance and supportive services for well-being is a key part of higher education and necessary in working life.

## **4. Discussion**

The pedagogical approaches used in higher education need to be discussed, evaluated, and further developed as the transformation in the world around universities is speeding up. This paper described the process of co-creating an organization-wide pedagogical program at Laurea University of Applied Sciences and showed the first outcomes of that process. The organization-wide co-creative process has ensured that the pedagogical discussion has been vivid and wide for the whole academic year. This discussion has widely enhanced the understanding of the need for changes in everyday pedagogical solutions. Consequently, the co-creative process and vivid discussions facilitate the organization-wide transformation that the new pedagogical program requires.



The pedagogical program of Laurea University of Applied Sciences will be launched at the opening ceremony of the academic year 2023-2024, and its implementation will begin immediately as a part of learner-centered educational activities. The timeline for the goals and measures described in the program is intended to extend until 2025. While the pedagogical program clarifies the ambition, shows the direction for the future, and provides a framework for the pedagogical development, also creativity, innovation, and agility in pedagogical solutions are and will be encouraged. Also in the future, the experimentation culture, using foresight methods and research-based knowledge, and a strong service design expertise as part of all pedagogical activities are the foundation of high-quality learning at Laurea.

### References

- Carvalho, L. & Goodyear, P. (2018). Design, Learning Networks and Service Innovation. *Design Studies*, 55, 27-53.
- Dyer, J., Gregersen, H., & Christensen, C. M. (2011). *The innovator's DNA: mastering the five skills of disruptive innovators*. Boston: Harvard Business School Publishing.
- Goodyear, P. (2021). Realising the Good University: Social innovation, Care, Design Justice, and Educational infrastructure. *Postdigital Science and Education*, 4, 33-56.
- Raij, K. (2007). *Learning by Developing*. Laurea Publications A-58. Vantaa: Laurea University of Applied Sciences.
- Raij, K. (2018). Summarising the basis of LbD for further development – Review. In S. Juvonen, P. Marjanen, & T. Meristö (Eds.), *Learning by Developing 2.0 – Case studies in theory and practice* (pp. 16-29). Vantaa: Laurea University of Applied Sciences.
- Ojasalo, K. (2018). Introduction – Learning by Developing in the open, networked, digital world. In S. Juvonen, P. Marjanen, & T. Meristö (Eds.), *Learning by Developing 2.0 – Case studies in theory and practice* (pp. 6-13). Vantaa: Laurea University of Applied Sciences.
- Ojasalo, K., Koskelo, M., & Nousiainen A. K. (2015). Foresight and service design boosting dynamic capabilities in service innovation. In R. Agarwal, W. Selen, G. Roos, & R. Green (Eds.), *The Handbook of Service Innovation* (pp. 193-212). London, UK: Springer-Verlag.

# DEVELOPING AN EFFECTIVE MOBILE APP FOR IMPROVING ENGLISH SPEAKING SKILLS

Eun-Ok Baek<sup>1</sup>, Qi Eyda Guo<sup>2</sup>, Tong Feng<sup>3</sup>, & Lu Jia<sup>1</sup>

<sup>1</sup>*Educational Leadership Technology, California State University San Bernardino (USA)*

<sup>2</sup>*Instructional Psychology & Technology Program, Brigham Young University (USA)*

<sup>3</sup>*Zhe Jiang Chang Zheng Vocational & Technical College (China)*

## Abstract

This study aims to create a mobile application that will facilitate learners' practice of the Test of English as a Foreign Language (TOEFL) speaking and improve their speaking skills. The study follows a design-based research (DBR) framework to delineate the phases and principles of developing the application. The TOEFL exam is a requirement for international students to apply to universities in the USA. However, challenges emerge even after international students are admitted to colleges. All lectures and discussions within classrooms are conducted in English, and students need to communicate and negotiate all daily issues with others by themselves. While there are a number of mobile apps in the market targeting English Speaking skills in general, only a small number of apps address TOEFL speaking specifically with their own limitations. The four steps of DBR-- Planning, Developing, Testing, and Redesigning-- were followed in designing the mobile application. This DBR framework proved to be a successful model for designing and developing the mobile application, which can be applied to other applications as well. The Visualize TOEFL Speaking mobile application demonstrated that its learning activities could support pedagogical goals. Students found the application engaging, useful, and interactive, and they reported that it helped them improve their English-speaking skills, particularly in the TOEFL speaking test and its sub-categories. Although the interface and functions of the mobile learning application need to be refined, it is a highly valuable tool.

**Keywords:** *Mobile app development, English speaking skills, design-based research, TOEFL speaking, mobile app design principles.*

## 1. Introduction

In recent decades, e-learning has become increasingly important in our daily lives. Mobile learning, as a part of e-learning, is prevalent in informal education, but not so much in formal education, especially in higher education. Using an application to learn and practice English is convenient for learners, for they can study anytime and anywhere through their mobile devices. Moreover, instructors can evaluate learners' performance conveniently on such platforms. There are mobile apps in the market offering English speaking training; however, only three of them specifically address TOEFL-speaking, and all three have limitations, which will be explained in detail later in this paper. The purpose of this study is to design and develop a mobile application to facilitate learners' practice of TOEFL speaking and improve their speaking skills. Using a design-based research framework, this study will delineate the phases and principles of developing a mobile application.

## 2. Literature review

### 2.1. Strategies for teaching and learning English speaking

It is obvious that language is an important vehicle for communication. Language competencies usually include four key skills: speaking, listening, reading, and writing. Speaking is the most important skill in the four key language skills because speaking skills are a primary factor in measuring whether a student is proficient in a language (Gani, Fajrina, & Hanifa, 2015). Rora (2015) proposed five key components of speaking: grammar, vocabulary, comprehension, fluency, and pronunciation. Choosing appropriate strategies can help improve learners' performance, while inappropriate strategies may lead to misunderstanding the content (Allison & Rehm, 2011; Hengki, Jabu, & Salija, 2017). Effective teaching should be learner-centered, with ample opportunities for discussion and communication in English. The predominant concepts in constructivism, such as the learner-centered approach, collaborative learning,

and authentic problems, can guide the scaffolding of the active learning process (Christensen, 2008; Driscoll & Bruner, 2021; Ertmer & Newby, 2013). Another instructional design theory that can prove beneficial to language learning is cognitive load theory. Cognitive load refers to the amount of working memory resources used. There are three types of cognitive load: intrinsic, extraneous, and germane (Reedy, 2015; Sweller, 1988, 1994, 1999).

## **2.2. Review of mobile apps for TOEFL speaking**

At the beginning of this project, we selected five existing mobile applications developed for TOEFL speaking skills to compare their features, functions, strengths, and weaknesses. The summary of the comparison will be at the conference. Among the five applications, only two, Magoosh and Xiaozhan, are dedicated to helping learners practice TOEFL speaking skills. However, Magoosh does not provide feedback from instructors, and Xiaozhan only serves Chinese students. Therefore, there is a need to develop a mobile application that can serve all learners of TOEFL speaking skills and, most importantly, provide them instructors' feedback and guidance.

## **2.3. Instructional design principles for mobile learning**

In developing instructional design principles for mobile learning, it is important to consider the advantages and limitations that a mobile environment offers to learners. Grant (2019) proposed seven mobile design characteristics of a mobile learning environment: "learner is mobile, device is mobile, data services are persistent, content is mobile, tutor is accessible, physical and networked cultures and contexts impact learning or learner, and learner is engaged" (p. 370). "Learner is mobile" refers to the key learning characteristics offered to learners in mobile learning, namely, a high initiative and being self-paced and self-adaptive; "learner is engaged" describes how learners participate in a mobile learning environment, including in formal, informal, or semi-formal learning.

## **2.4. Design based research**

The design-based research (DBR) methodology was used to guide the design and development process of this project (Design-Based Research Collective, 2003). "Design experiments" is the foundation of design-based research proposed by Ann Brown (1992) and Allan Collins (1992), which is defined as a method of conducting formative research based on principles of previous research to test and improve educational design. In this design and research methodology, researchers and practitioners collaborate in a real environment intended to improve educational practice through systematic and iterative tests through analysis, design, development, implementation, and refinement of design principles or theories (Wang & Hannafin, 2005). As an example of DBR applied in an artifact development, Makoe and Shandu (2018) purposed four-phased DBR to develop a mobile app for teaching and learning vocabulary. First, the researchers conducted a literature review and analyzed the practical problem. Second, they developed a solution based on existing vocabulary teaching and learning principles. Third, they focused on evaluating and testing the solution in practice. According to the characteristics of DBR, this phase included iterative cycles of testing. Finally, the researchers refine the design principles based on the reflection of testing. Based on the literature review, this study proposes to develop a mobile application for TOEFL speaking using the four-phased DBR methodology similar to that was used in Makoe and Shandu's (2018) project. In the process, we develop design theories/principles and define them based on the combination of designing and researching processes.

## **3. Development processes**

### **3.1. Planning**

In the planning phase, we first analyzed the target learners' and instructor's needs, and the learning contents. We identified the areas that English learners need help most in improving speaking English and functions or components that learners prefer to include in the mobile app. We went to the English Language Program classrooms at a large public university in Southern California and recruited 30 international students who volunteered to take a pre-survey and informal interviews. After the analysis of learners' needs and content, we defined our Instructional Goal to be: international students will be able to improve their TOEFL speaking skills through a self-paced mobile learning course, which includes watching tutorial videos, practicing speaking and uploading their voice. There are four learning objectives. After the three lessons, on a given topic of speaking question, learners will be able to: 1) Organize and utilize their own life experiences or stories to prepare for the speaking topics, 2) Build up key expressions and apply to the speaking tasks, 3) Compose the content structure while staying on the topic within 15 seconds, and 4) Interpret the response lucidly and fluently within 45 seconds.

### 3.2. Developing

As shown in the DBR phases figure, we developed an English speaking application through initial theory building, content development based on the theories, coding, and an application development.

**3.2.1. Initial theory building.** The mobile app was designed under the guidance of Cognitive Load Theory and Constructivism Theory, considering Grant's (2019) mobile design characteristics of a mobile learning environment, which allows learners to study at their own self-pace, and teachers scaffold students' learning based on their previous knowledge to respond to a real-world question.

**3.2.2. Content development.** In order to validate the content of each lesson, we worked with an English professor who has been teaching college English for over 15 years as our subject matter expert. The professor was involved in reviewing the lessons and recorded all the three demo lessons, because none of the designers are native speakers. The tutorial videos in this app are recorded using Camtasia. Lesson 1 introduced three aspects of TOEFL speaking tasks including content, testing time and grading rubric. Lesson 2 covered the independent speaking task. The categories of four TOEFL speaking tasks are introduced, one of them being the concept of independent speaking task, and how to compose the response under this category were explained in this lesson. This lesson also included some examples for learners to easily start practicing. Lesson 3 reviewed the content of independent speaking tasks, as well as suggesting the useful structures, expressions and related topics for students' daily practice.

**3.2.3. Prototype development.** Before programming the application, we designed the storyboard and prototype, then applied the instructional design principles in designing the prototype (Baek & Guo, 2019).

**m-IDP 1: Provide learner-centered mobile learning activities to allow learning anytime and anywhere.**

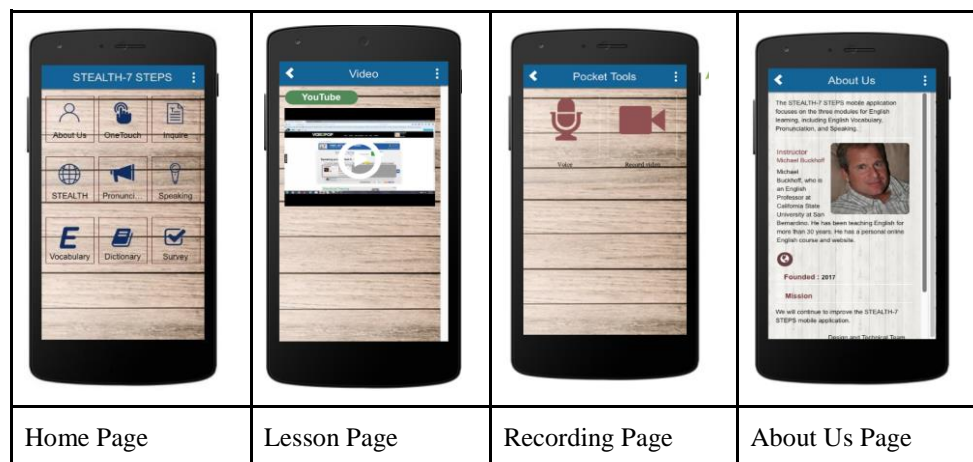
**m-IDP 2: Include mobile learning platforms to facilitate collaborations between learners.**

**m-IDP 3: Provide multimedia to engage learners.**

**m-IDP 4: Instructors provide instant feedback through mobile devices.**

**m-IDP 5: Provide variable learning context to help learners solve authentic, real-world problems.**

Figure 1. Screenshots of Main Pages in the Prototype.



**m-IDP 6: Application design should be revised iteratively based on the evaluation.**

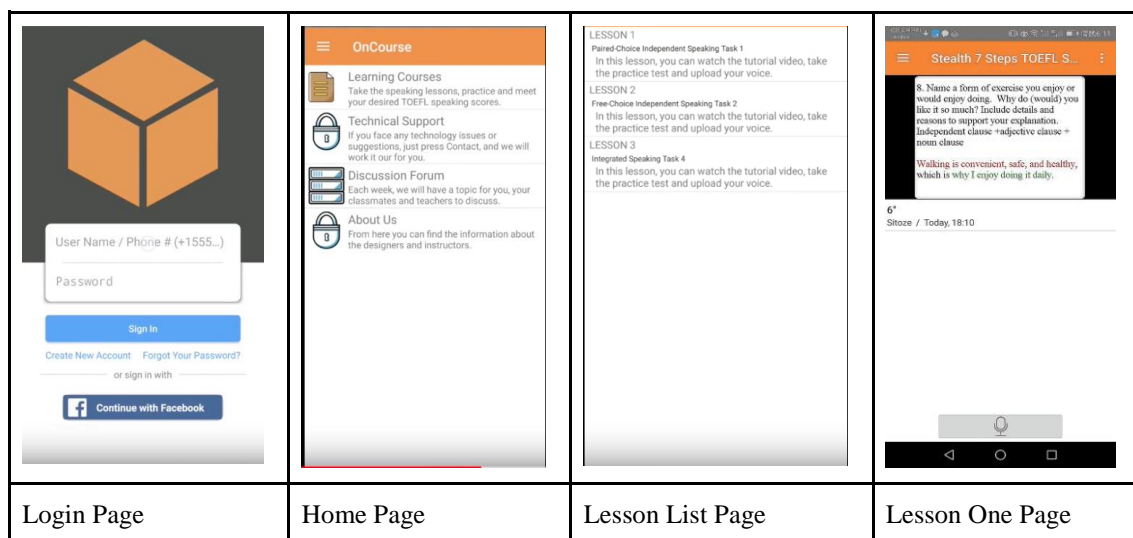
The subject matter expert (an English professor) and users (international students) were invited to provide feedback on the storyboard and prototype, which guided the direction of the mobile application development. Similar to any other instructional material, the application should be tested and redesigned until its usefulness and effectiveness reach a certain level of user satisfaction.

**m-IDP 7: Design the UI to fit mobile screens.** In our application, we used the UI arrangement to accommodate the Android system, which provided a collection of both the View and ViewGroup subclasses that offered users common input controls (buttons or text fields) and various layout models (a linear or relative layout). For instance, the buttons and text fields were convenient to use. Furthermore, a linear and relative layout was attractive for users.

**3.2.4. Coding development.** Because of the time and funding constraints, we chose to develop the application for Android as a first step due to the relative ease of publishing an app to the Android market. A technology expert was involved in building this mobile application. The mobile app was developed using Java language and created in Android studio. Amazon Web Services (AWS) is used as a server to host the application. Also, we used the User Interface (UI) arrangement in order to accommodate Android systems, all user interface elements in an Android app were built using View and ViewGroup objects.

**3.2.5. Application development.** The design and development was an iterative process. The app has been revised several times, and we will be continuing revising until it meets learners' needs and functionally performs well. We decided to build the application for Android devices as a first step due to the relative ease of publishing applications in the Android market and owing to time and funding constraints. A technology expert was involved in the building. It was developed using Java and created in Android studio. Amazon Web Services (AWS) was used as a server to host the application. We also used the UI arrangement to accommodate the Android system, and all UI elements in the application were built using View and ViewGroup objects.

Figure 2. Screenshots of the First Version of the Main Pages.



\*The last two phases: Testing & Redesign will be published in another venue.

#### 4. Discussions and implications

In this study, we designed and developed a mobile application for TOEFL speaking by following the process of DBR, we applied the initial principles in designing the prototype. The DBR framework we implemented was proven to be a successful model in designing and developing the mobile application and can be used for other applications as well. The mobile application demonstrated that the learning activities in the Visualize TOEFL Speaking mobile application could support pedagogical goals. Students noted that the application allowed them to engage with the content and interact with the instructor and that it was useful in improving their English-speaking skills. Learning through the tutorial videos helped them improve the TOEFL speaking test and its sub-categories (Clark, Strudler, & Grove, 2015). Though its interface and functions need to be polished, the mobile learning application proved to be highly valuable.

#### 5. Limitations and conclusions

Despite the benefits it offered, this study had some limitations. First, owing to time constraints, we developed the mobile application to focus only on TOEFL speaking. Also, only three sample speaking lessons were included in it (TOEFL Speaking Test Introduction, Independent Speaking Task, and review Independent Speaking Task with more useful structures and expressions). Further, due to time and funding constraints, only an Android version was designed and developed. Finally, this study only recruited 30 participants to test the mobile application and recorded their voice for the pre-test, which made the sample relatively small. We will conduct follow-up surveys and interviews at a later stage. The future direction of the project primarily includes two aspects. On the one hand, future studies could refine and apply the eight mobile learning design principles proposed for this project in other mobile learning courses, such as in

teaching English (listening, reading, and writing), mathematics, linguistics, science, and so on. On the other hand, our design team will continue adding more TOEFL speaking lessons to the application. Additionally, TOEFL reading, listening, and writing lessons will be developed in the future.

### References

- Allison, B. N., & Rehm, M. L. (2011). English language learners: effective teaching strategies, practices for FCS teachers. *Journal of Family and Consumer Sciences*, 103(1), 22-27.
- Android Jetpack (n.d). *Layouts*. <https://developer.android.com/guide/topics/ui/declaring-layout>
- Baek, E. & Guo, Q. (2019). Instructional design principles for mobile learning. In Y. Zhang, & D. Cristol, (Eds), *Handbook of Mobile Teaching and Learning* (2<sup>nd</sup> ed). Berlin: Springer. doi:10.1007/978-3-642-41981-2\_111-1
- Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions. *Journal of the Learning Sciences*, 2(2), 141-178.
- Christensen, T. (2008). The role of the theory in instructional design: Some views of an ID practitioner. *Performance Improvement*, 47(4), 25-32. doi:10.1002/pfi.199
- Clark, C., Strudler, N., & Grove, K. (2015). Comparing asynchronous and synchronous video vs. text based discussions in an online teacher education course. *Online Learning*, 19(3), 48-69.
- Collins, A. (1992). Toward a design science of education. In E. Scanlon, & T. O'Shea (Eds.). *New directions in educational technology*. Berlin: Springer-Verlag.
- Design-Based Research Collective. (2003). Design-Based Research: An Emerging Paradigm for Educational Inquiry. *Educational Researcher*. 32(1), 5-8. <https://doi.org/10.3102/0013189X032001005>
- Driscoll, M. P. & Bruner, K. J. (2021). *Psychology of learning for instruction* (4th ed.). Boston: Pearson Allyn and Bacon.
- Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance improvement quarterly*, 26(2), 43-71. doi:10.1002/piq.21143
- Gani, S. A., Fajrina, D., & Hanifa. R. (2015). Students' learning strategies for developing speaking ability. *Studies in English Language and Education*, 2(1), 16-28.
- Grant, M. (2019). Difficulties in defining mobile learning: analysis, design characteristics, and implications. *Educational Technology Research & Development*, 67(2), 361-389.
- Hengki, Jabu, B., & Salija, K. (2017). The effectiveness of cooperative learning strategy through English village for teaching speaking skill. *Journal of Language Teaching and Research*, 8(2), 306-312.
- Makoe, M., & Shandu, T. (2018). Developing a mobile application for learning English vocabulary in an open distance learning context. *International Review of Research in Open & Distance Learning*, 19(4), 208-222.
- Reedy, G. (2015). Using Cognitive Load Theory to Inform Simulation Design and Practice. *Clinical Simulation in Nursing*, 11(8), 355-360.
- Rora, A. P. (2015, February 11). *The Components of Speaking Skill*. Retrieved from <https://adeprimarora.wordpress.com/2015/02/11/the-components-of-speaking-skill/>
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning, *Cognitive Science*, 12, 257-285.
- Sweller, J. (1994). Cognitive load theory, learning difficulty and instructional design. *Learning and Instruction*, 4, 295-312.
- Sweller, J. (1999). *Instructional design in technical areas*. Melbourne: ACER Press.
- Wang, F., & Hannafin, M. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*. 53(4), 5-23. doi:10.1007/BF02504682

## **ADAPTING ARCHITECTURAL DESIGN EDUCATION FOR THE AI ERA: PRELIMINARY FINDINGS AND FUTURE DIRECTIONS**

**Chih-Wen Lan**

*Assistant Professor/Department of Architecture, China University of Technology (Taiwan)*

### **Abstract**

Architectural design courses are an essential part of many universities' curricula, offering students the opportunity to learn about building construction, building physics, mechanics, environmental ecology, and architectural aesthetics. Traditional architectural training typically starts with architectural graphics and model making by hand, which helps students understand the relationship between human scale and space scale and develops their aesthetic taste and innovative thinking. However, the rise of advanced technologies and AI products in recent years has led to a decline in students' interest in practical training. Some students prefer to use online searches to understand room size rather than taking measurements, and they would rather learn how to use 3D printers than how to make models with utility knives. This trend has prompted questions about the relevance of traditional architectural training methods to the new generation of students. Should educators abandon traditional training and adopt new technologies?

This research examines traditional architectural training methods through personal teaching experience in universities, using first-stage AI skills to compare traditional methods and adjusted methods. The study seeks to determine the adaptability of traditional training methods to face AI trends while maintaining the relevance of human scale and space scale, aesthetic taste, and innovative thinking. The findings of this research offer insights into how educators can adjust their teaching methods to provide students with the necessary skills to succeed in the current and future technological environment. The study also offers discussions and possible solutions to address the challenges faced by architectural educators for future generations.

**Keywords:** *Architectural design, AI trend, architectural training, innovation.*

---

### **1. Introduction and objectives**

The industrial revolution of the early 20th century had significant impacts on traditional hand-made crafts industries. Some individuals emphasized the value of hand-made crafts, while others embraced the new industrial technology to develop the industrial design style that emerged after the revolution. In the 21st century, digital technologies have developed rapidly, and once again, traditional practices and new technology are being impacted. Unlike the disputes of the early 20th century, individuals in contemporary society, equipped with smartphones, are not fighting against the digital technology revolution. Instead, they are seeking to optimize productivity and innovation, including architects and architectural educators (Lee & Wang, 2017). This group reflects the core of architects and architectural educators who discuss the future of construction industries and education. The central question is whether the current core of architectural education should be eliminated. Moreover, will hand drawing and architectural model-making be displaced by digital media, and can students learn architecture without physically attending universities through online learning? This research aims to investigate the impact of digital technologies on architectural education. Specifically, it will explore the implications of digital technologies, including artificial intelligence, on the traditional practices of architectural education and the future of architectural design education.

This research seeks to investigate the impact of digital technologies, specifically artificial intelligence (AI), on architectural education. To achieve this, the study will commence with an analysis of architectural education under the influence of digital technology. Preliminary findings will introduce the unique character of architectural education and its differences from other professional fields to identify the core of architectural design education. Additionally, the study will reflect on the impact of AI on the field of architectural education and explore the efforts of architects in this regard. The study will also take into account the expectations of Taiwanese stakeholders regarding AI and its impact on architectural education. By examining these factors, the research aims to identify possible ways forward and future trends for architectural education in the digital age.

## 2. Methods

The preliminary research has compiled bibliographic data, which has been analyzed to provide a comprehensive overview of architectural education in recent times. In light of the emergence of AI, the research aims to examine the perspectives and concerns of architectural educators. This investigation will provide a platform for discussing the current state of traditional architectural training and identifying future trends in the field. Ultimately, this research seeks to offer valuable insights and recommendations for architectural educators and practitioners.

## 3. Perspectives and interpretations of Artificial Intelligence

As defined by the Oxford Language, AI refers to "the theory and development of computer systems capable of performing tasks that typically require human intelligence, including visual perception, speech recognition, decision-making, and language translation."

The European Parliament (2021) provides a definition of AI as the demonstration of human cognitions, such as reasoning, learning, planning, and creative thinking, through machines. AI systems are particularly useful in quickly solving problems and achieving goals, provided that they have access to a significant amount of data to recognize and respond to various situations.

Accordingly, AI involves the simulation of human cognitive processes, such as recognition, reaction, and learning, through computer and machine-based systems, with a focus on minimizing errors. The development of AI is aimed at solving problems and enhancing learning effectiveness. In the context of architectural education, the primary goal of AI is to assist students in learning architecture design effectively. However, in practice, teachers express concerns about being replaced by AI systems and have limited time to provide guidance to their students. Students, on the other hand, tend to rely on AI to solve their design problems and perceive traditional teaching methods, such as hand drawing and model-making, as outdated. As such, exploring the impact of AI on architectural education and finding ways to effectively integrate AI technology into the curriculum while retaining traditional teaching methods is essential.

## 4. Recent architectural education in Taiwanese universities

The organization of architectural education in Taiwanese universities is divided into engineering and design colleges. Consequently, some architectural faculty is situated in engineering colleges, while others are located in art or design colleges. Despite this structural division, architectural design courses carry the highest credit points, highlighting their significance in the curriculum.

According to Chen and Hung's (2013) analysis of architectural curricula in Taiwanese universities, there are five distinct categories: history and human behavior (humanities), technology (construction and architectural physics), practice (architectural laws and budget controls), and design. Architectural design is an obligatory course and typically requires 6 to 8 hours of class time per week. Based on the group character, it is evident that architectural design is an interdisciplinary field that integrates humanities, technology, and practice. To be a successful architect, one must possess both artistic vision and the skills to bring that vision to life through practice.

The duration of the university year in Taiwan is generally four years, although some universities require five years depending on the students' future path. Students who select architectural design must complete a five-year program, while those who select planning or construction can finish in four years.

The introductory architectural design course for freshmen is called Basic Design, which is influenced by the Bauhaus tradition (Shiu, 2014). This course is not meant to teach students how to design a building, but rather to develop their sense of form, material usage, and aesthetics. Teachers use various forms of art, including movies, music, and art objects, to inspire students' creativity and innovation. During this stage, students may choose to sign out or change their majors if they feel that they lack the necessary creativity or if the course does not meet their original expectations.

The second year of architectural education in Taiwanese universities requires students to produce designs ranging from small to larger scales, starting from designing their own homes to more complex spaces such as multi-functional community centers. Typically, they must complete two to three designs per semester, with each design taking one to one and a half months to complete. During this time, students commonly inquire about using CAD or related softwares or express difficulty in generating design ideas.

The second-year students are required to study architectural laws to gain knowledge about the fundamental dimensions of architectural elements. For instance, the balcony railing should not be lower than 90-120 cm, which is a standard measurement used to verify the reasonable basic requirements of architectural design.



## 5. Design expression and possible AI design in the future

In the context of architectural education, freshmen students are required to take an obligatory course known as graphic science. The purpose of this course is to teach students the architectural languages used to communicate with other architects and builders. Students are taught to understand the various architectural signs, such as the positioning and dimensions of doors and windows. It is crucial for students to learn these signs as they are essential in creating designs that are both functional and aesthetically pleasing to the human scale. Furthermore, it is crucial that drawings are clear and easily communicable with builders, as any misunderstandings could lead to inaccuracies in the final building design.

Typical architectural drawings encompass plan, elevation, section, and perspective, which are essential for expressing the relation between space and function. Beforehand, architects would draw every floor plan to depict the building's internal spaces. The elevation and perspective drawings provide an outlook of the building, while the section drawings exhibit the room's internal dimensions. Modern drawing software like Archicad or Revit can create a 3D digital model, rendering plan, elevation, and section drawings redundant. Recently developed AI programs like MidJourney can simulate real spaces, further reducing the need for perspective drawings. Consequently, with technological advancements, students may struggle to see the relevance of the graphic science course.

*Figure 1. The generated image for the kindergarten design idea, effect is fancy but hard and expensive to build under the recent construction technology (MidJourney).*



According to Wang (1970), design is a process of transforming abstract concepts into tangible forms, making the transition from abstract to concrete an essential component of design. Architectural design differs from graphic design in that it deals with real space and human dimensions, with the latter being subject to psychological, social, and cultural differences. For instance, the inclination of roofs in Norway and Thailand reflects differences in construction methods, functions, and aesthetic preferences. As AI technology advances, should it be used to imitate these styles or create a new "AI style"?

In addition to visual aesthetics, the functionality of architectural spaces is of utmost importance. Alexander, Ishikawa, Silverstein, Jacobson, Fiksdahl-King, and Angel (1977) analyzed spatial patterns to identify the possible elements that make up good space design. These researchers use numerical patterns to suggest possible ways of organizing space to achieve specific purposes. For example, if the aim is to design a space for reading, they provide the relevant numerical patterns to guide the creation of a good reading environment. Ojala (2008) also believes that pattern language can facilitate architectural design. It is possible that AI-based architectural design could incorporate pattern language, although the limits of this approach require further examination.

Jeng (2023) argued that the current era is characterized by integration, especially with the advent of AI technology. Architects are no longer limited to creating architectural designs, but they must also consider ecological and landscape design, as well as future construction trends. Jeng proposed that the future of AI design should incorporate AI construction methods to enable a fully integrated design process, covering architectural plans, schemes, building physics, and AI or BIM (Building Information Modeling) construction.

The emergence of various design tools poses a challenge to architectural educators: should the core of architectural education be replaced by AI?

## 6. Discussion

Given the unique characteristics of architectural education and the potential impact of AI, the following questions and discussions arise:

### **6.1. Hand or computer drawing?**

The discussion of whether to use handmade drawing or computer drawing in architectural education is an ongoing debate among educators. The decision made by teachers should not solely depend on the students' computer skills, but also on the core principles of architectural design and the digital ability gap that exists among students from different social backgrounds. Recent research has shown that hand drawing remains an essential skill in the creative process (Zychowska, 2019). Therefore, educators may continue to emphasize the importance of hand drawing for freshman students, while providing them with opportunities to develop their digital skills in later stages of their education. This approach can help reduce the gap in digital abilities among students.

### **6.2. The object size? The spatial sense?**

The prevalence of social media platforms has provided students with diverse visual experiences. However, relying solely on images collected from the internet may lead to difficulties in accurately gauging the size of objects. If students are asked to generate a spatial image, they may struggle to create a concrete model. Typically, students will resort to creating a cubic form of space due to the difficulty of constructing an uncertain form. Ultimately, this may hinder their ability to fully realize their creative vision.

### **6.3. The gap of architectural thinking and its adjustment**

With the advent of new technologies and the younger generation, architectural faculties are now mostly employing new teachers between the ages of 40-50 who did not rely on computers in their studies. However, teachers must now learn new technologies in order to effectively teach their students. During this transition period, there is no integrated answer among teachers on how to approach computer training. Some believe that creation is important, and that accurate graphic drawing is an irritant. Others feel that hand drawing is basic for creation, but this method may lead to loss of patience among students. Additionally, architectural teachers must consider what students need to learn for their future careers in order to adjust the curriculum accordingly.

### **6.4. The challenge from plan to elevation drawing**

The process of traditional architectural drawing usually begins from the first-floor plan and continues to higher floor plans. However, if designers want to create unique spaces, such as a lobby that spans two or three floors, they must adjust the proportion of height and width. This adjustment requires creating an actual model to simulate the future space, and the plan and model must be adjusted simultaneously. Nowadays, students prefer to create architectural models in the final week of their training. However, with computer design, it is difficult to adjust the space through a computer screen, and the transition from 2D to 3D training is challenging to implement.

### **6.5. The drawing between architects and builders**

The traditional approach in architecture involved architects creating the construction drawing, with contractors checking its feasibility and controlling the budget. In the era of AI, however, there is a need to integrate design drawing, shop drawing, and construction drawing to enable architects and builders to work together on a unified platform to facilitate construction.

### **6.6. Copyright**

The generation of AI images requires a large amount of data, which raises questions about ownership of the generated image and associated information. The article by Architizer Editors (n.d.) emphasizes the importance of hand drawing not only in stimulating creative design and communication but also in protecting the designer's rights. As students learn about AI, they should also be educated on copyright laws to respect the original creations of others.

## **7. Conclusions**

In order for AI to learn and correct errors, it requires access to data. When dealing with challenges related to human needs, climate change, and sustainability, architects must make design decisions with consideration for their surrounding environment. AI can serve as an aid, providing architects with accurate information to inform their design choices.

Although AI can engage students and stimulate their curiosity through interaction, it should also be taken into consideration that the stability and concentration of students may be affected.

The primary objective of architectural design is to create comfortable, healthy, safe and sustainable environments for people. AI can aid in verifying compliance with architectural laws and

regulations, as well as facilitating the design of unique forms. However, the use of AI in architecture is currently limited to 2D image analysis for the general public. The introduction of new construction methods will fundamentally transform architectural education.

While students may believe that AI can solve their problems, it is essential for them to learn how to identify problems and devise solutions independently. Rather than seeking direct answers from AI, students should present the problem, describe it, and request potential solutions. This should be the focal point of architectural education. Human needs and the environment are constantly changing, and as educators in this field, it is our responsibility to train students to develop sustainable and socially responsible solutions that prioritize human and environmental well-being.

In the core of human-centered architectural design thinking, the preliminary findings suggest that AI should be considered as a tool to facilitate interactive and engaging architectural education, rather than a replacement for the role of educators. To effectively prepare future architects with the necessary skills, educators must maintain flexibility in adapting to changing human and environmental issues, as well as advancements in technology and the architectural industry. This includes providing students with up-to-date information and guidance on the appropriate use of AI, while promoting human-centered thinking with a focus on sustainability and social responsibility. Ultimately, a balanced approach that integrates AI and human expertise will enhance the quality of architectural education and prepare students for successful careers in the field.

### References

- Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I. & Angel, S. (1977). *A Pattern Language: Towns, Buildings, Construction*. Oxford: Oxford University Press.
- Architizer Editors. (n.d.). *5 Reasons Why Architects Must Not Give Up On Hand Drawings and Physical Models*. Retrieved May 14, 2023, from <https://architizer.com/blog/inspiration/stories/why-architects-must-not-give-up-hand-drawings-physical-models/>
- Chen, P. Y., & Hung, Y. C. (2013). The Relation between Architectural Curriculum and Educating. *Journal of Architecture*, 83, 37-61.
- Jeng, H. e. (2023, May 1). Intelligence Integrated Design in Education. Retrieved May 14, 2023, from <https://www.facebook.com/photo?fbid=6094128423974340&set=a.170721146315127>
- European Parliament. (March 29, 2021). *What is artificial intelligence and how is it used?* [Status update]. Facebook. <https://www.europarl.europa.eu/news/en/headlines/society/20200827STO85804/what-is-artificial-intelligence-and-how-is-it-used>
- Lee, K. F. & Wang, Y. G. (2017). *Artificial intelligence is coming*. Taipei: Commonwealth Publishing Group.
- Ojala, M. (2008). Alexander, Architecture and Systems Intelligence. In R. P. Hämmäläinen, & E. Saarinen (Eds.), *Systems intelligence: A new lens on human engagement and action* (pp. 65-79). Helsinki: Helsinki University of Technology. <http://systemsintelligence.aalto.fi/publications/roja08.pdf>
- Shiu, Y. L. (2014). An Introduction of the Spatial Concepts and Design Words Since the Bauhaus Design Education. *Journal of Architecture*, 87, 1-21. doi:10.3966/101632122014030087001
- Wang, J. T. (1970). *Architectural Design Methodology*. Taipei: Tai Long Publishing.
- Żychowska, M. J. (2019). Bauhaus - didactic experiments and their legacy. *Global Journal of Engineering Education*, 21(2), 134-138.

## HACKING THE CHILDREN'S MUSEUM: ILLUMINATING MIDDLE YEARS SOCIAL STUDIES CURRICULUM IN PERMANENT EXHIBITIONS

**Rafael Iwamoto Tosi, & Bruno de Oliveira Jayme**

*Faculty of Education, University of Manitoba (Canada)*

### Abstract

The present ongoing study, seeks to extend the educational resources that exist in the Manitoba Children's Museum's fixed exhibits by introducing social studies and arts into the educational methodology of STEM (Science, Technology, Engineering and Mathematics), where visitors learn such fields of teaching and ability to interact and play with the works of art. To be able to introduce a STEAM methodology, we will be inviting 15 5th graders from a school in Northeast-Winnipeg (Manitoba - Canada) to visit the Engine House exhibit – a true size train of the 1950's – for them to interact with the work and take notes on the relationship between the train and the place where the museum is located and the social studies curriculum of its corresponding curriculum. This is justified by the fact that the MCM is housed in a historic facility that once housed the Canadian Pacific Railway's Machine Repair Hall, which is also a significant content of the fifth-year syllabus. To introduce the Arts, we will use Museum Hacking, an active art methodology where visitors create artistic interventions such as photographs, montages and collages to present new narratives or shed light on aspects that had not been highlighted. In the case of participating students, this will be done through actions that use social studies and history that are already in their curricular system, as well as other theoretical-practical tools such as social semiotics and narrative theories. With the Engine House hack, we intend, first of all, to expand the educational possibilities of the fixed exhibitions at the MCM by introducing an important and necessary tool that is also justified by the historical importance of the place itself: the Social Sciences and the Arts. After this first initiative, we also intend to expand the actions of artistic intervention in other fixed works, to reveal new stories and expand other STEM for STEAM's, taking us to our final objective, which is to develop a new curriculum program with the MCM where other schools and other school years can also discover new narratives and new stories, using artistic-semiotic contexts. Finally, the expected result is that the artistic productions of the participating students can be organized in a future exhibition and that, also reveal important social aspects that give visibility to the excluded and provoke new ways of experiencing fixed exhibitions in other children's museums around the world.

**Keywords:** *Social studies curriculum, middle year curriculum, arts-based education, children's museum, museum hacking.*

---

### 1. Introduction

The Manitoba Children's Museum (MCM) is located in a historical building in Winnipeg. In the 1880's, this building housed the locomotive mechanical repair stations from the Canadian Pacific Railway (CPR). One of the most visited exhibits in the MCM is the Engine House; a real train engine from the 1950's, where visitors can play inside the locomotive, while learning science and mathematics and enhancing cognitive skills. STEM by design, the Engine House fails to leave behind social studies curriculum, which is an essential part of children's critical and cognitive development, because it helps children to make informed decisions for the public good.

The MCM's overall goal, which aligns with the University of Manitoba's goal, is to explore the Engine House to its full potential by including middle years social studies curriculum as part of this exhibit's design. To do so, the arts must be included in STEM design. By expanding the Engine House's STEM to STEAM (science, technology, engineering, arts and mathematics) curriculum, the MCM will be able to provide a broader curriculum support to schools. By having the arts as an equivalent course instead of supplemental to STEM courses, will foster critical thinking skills in students. This, help students to be better prepared for careers that demand problem--solving skills. Including arts with STEM

subjects in the Engine House in a meaningful manner, provides the audience with a well-rounded education with the skill sets needed to solve complex problems.

This qualitative research uses museum hack, an innovative research methodology that suggests a creative and productive disturbance by breaking into the accepted norms of particular museum narratives, and modifying them. In this study, 15 middle years students from a public school from Winnipeg, Manitoba will be invited inside the MCM to hack the Engine House. To do so, these students will create art interventions, illuminating social, historical, and geographical contexts in which Canadian society is built upon, including First People's iconography, and social markers, such as the (CPR) train tracks, which divides Winnipeg in two distinct social classes.

Our research partnership will answer the following research question: What are the potentialities of a Museum Hack as an innovative qualitative research methodology to contribute to STEAM middle years education? Framed within STEAM Education and Social Semiotics our objectives are: a) Describe and articulate the ways in which the (CPR) is a social marker that divides the city of Winnipeg in two distinct social classes; b) Unpack students' understandings of the past to tailor future social studies educational program in the MCM; c) Artistically explore with middle years students, social phenomena that make up the Canadian society, such as colonialism, immigration, marginalization, gender, and diversity; d) Create a new student-centered, inquiry and arts-based social studies educational program to the MCM that will benefit generations to follow.

The MCM will open their doors to the 15 middle years students and researchers to move freely within the building on specific days agreed upon all parties. The provision of free transit in the exhibitions allows an observational analysis to be conducted in a more competent way. In addition, the MCM, has been working with the PI in designing this project from scratch, making sure we have a shared vision. It is important to highlight that the partnership with the MCM extends far beyond the supply of the Engine House exhibition and the opening of the space for carrying out the studies.

Since our research is still under development and is expected to end only in the first quarter of 2023, the expected outcomes are: a) to highlight how CPR was an important social divider in Winnipeg and also to highlight this process in the arts produced by the participants ; b) With the students' understanding of the city's past and also of the place where MCM supports, carry out artistic provocations that lead to reflection on the themes of social exclusion and socioeconomic abuse; c) Expose the students' provocative artworks in the museum and discuss their content together with MCM curators and visitors; d) develop a new student interaction curriculum together with MCM to propose future "Museum Hacking" projects at other permanent exhibitions, also expanding their STEM curriculum to STEAM; e) Display the participants' artworks in community centers and other schools, with the aim of engaging and provoking other groups to critically think about the place where they live and its relationship with social studies.

## 2. Design of the project

Hacking the Children's Museum seeks to fill an unprecedented space in its field of study using elements of educational studies, curriculum studies, applied social studies and cultural analysis through semiotics in its design. Initially, the research takes place in partnership with MCM and takes place at the fixed exhibition Engine House. 15 Grade 5 students from a North End Winnipeg school will visit this exhibition at two different times, the first time they will interact with the work normally and the second they will carry out an artistic intervention based on the Museum Hacking methodology. Finally, data will be collected in the form of a questionnaire and also in photographs of the works of art produced during the research.

Initially, the project has as its design the realization of an expansion of the pedagogical-ludic system of STEM for STEAM at the Children's Museum of Manitoba, our partner in the research. The building of this non-governmental institution is housed in a historic facility that formerly housed the Canadian Pacific Railway (CPR) train repair shop, which historically was responsible for the expansion of modern civilization in Canada during the 18<sup>th</sup> century (Andreae, 1997.). Andreae points out that one of the main features of the civilizational expansion in the construction of railroads in Canada was due to the "exploitation of the labour force of immigrants from Eastern Europe and the East, while the clashes over territories of the first nations gradually increased" (1997, p. 80). With this, it is important to point out that the historical context of the building where the MCM is located already demonstrates the possibility of including social studies in its facilities, which are full of fixed exhibitions that highlight the importance of playful learning.

The museum uses a STEM methodology, which according to Catterall gives greater emphasis to "mathematical skills and logical reasoning that help to solve problems focused on time organization, space perception and probability calculation" (Catterall, 2017, p. 03). However, based on the

historical-cultural relevance of the place where the MCM is established, we propose the inclusion of elements from social sciences such as history and cultural studies to expand the methodology for STEAM, where the artistic aspect would be on account of the active methodology of the Hacking the Museum, which will be presented below.

In the initiative of including a group that represented the same socially “disadvantaged and marginalized” groups (Towens, 2018, p. 35) during the construction of the CPR, we established a partnership with a school in the north end of the city of Winnipeg, a socially "devoid of government attention and were the most socially vulnerable end up, such as immigrants and the poorest" (Towens, 2018, p. 40). For this, 15 students from the 5th grade are being selected, since the social science curriculum taught in this specific grade corresponds to the teaching of the construction of the CPR and also of the civilizational expansion of the city of Winnipeg itself.

The fixed exhibition selected for our research was the Engine House, a full-size 1950s locomotive that poses as an interactive work of art and seeks to entertain MCM visitors while teaching them about geometry, math and physics, all fields known to be linked to STEM. In order to encourage studies in the social sciences, our project will have as its main design the use of the active methodology “Hacking the Museum”. According to de Oliveira Jayme Museum Hacking is a "methodological innovation that puts the museum visitor in the curator's place, and intends to reveal stories that have not been told before to everyone, presenting new narratives and revealing specific choices in the structuring of a discourse of that work or show” (de Oliveira Jayme, & Gough, 2016, p. 220). This action consists of allowing the participants (in our case, our 15 students) to carry out artistic interventions in the selected work in order to present their own critical view of what is being exposed, and henceforth, unveil new narrative possibilities to understand that work of art and also to oppose the discourse that is presented initially organized by the museum itself and its curators.

In order to bring new perspectives from outside the museum into it, the artistic interventions that will “hack” the MCM are being developed by the students after the teaching of lectures given by the researchers where they present the historical-social context of both the place and the city works that support our research. With the help of theoretical-philosophical instruments such as cultural and social semiotics (Morin, 2008; Greimas, 1992; 1987), new ways of using icons and symbols that represent immigrants and the first nations of the Canadian region are being brought to students in the perspective of provoking them to carry out interventions that bring this narrative into the museum space and promote reflections about the social role that the CPR and also the MCM itself have in society.

Finally, the project that is in the execution phase will seek to carry out photographic exhibitions with all the works of art that “hack” the MCM and will also provide new results that will allow researchers to present new pedagogical plans for the museum with the inclusion of the arts in its active teaching methodology, allowing STEAM to also be applied to other permanent exhibitions at the site.

### 3. Objectives

Framed within STEAM Education (Science, technology, art, and mathematics) the overall objective of this research partnership is to, *collaboratively with grade 4–5 students, expand the Engine House, a permanent exhibit in the MCM from STEM design to STEAM design, to illuminate middle years social studies curriculum*. More specifically, working with a group of 15 middle years students, this partnership will:

- 1) Describe and articulate the ways in which the (CPR) is a social marker that divides the city of Winnipeg in two distinct social classes;
- 2) Unpack students’ understandings of the past to tailor future social studies educational program in the MCM;
- 3) Artistically explore with middle years students, social phenomena that make up the Canadian society, such as colonialism, immigration, marginalization, gender, and diversity;
- 4) Create a new student–centered, inquiry and arts–based social studies educational program to the MCM that will benefit generations to follow.

### 4. Methods of research and analysis

The methodologies applied to our study, which are being carried out until April 2023, fall within the fields of qualitative and quantitative research.

At first, vast bibliographic research was carried out on the history of the place that today houses the MCM, and consecutively on the entire process of construction of the CPR and the civilizational expansion of the city of Winnipeg. Concomitantly, a curricular survey on a school teaching in themes related to social sciences was carried out, pointing out the relationship with the contents taught for 5th

grade. Still within the qualitative field, an observational study of the Engine House fixed exhibition was carried out through photographic captures and studies related to the image and its semiotic representation, giving us dimensions about what the work is before the Museum Hacking artistic intervention and how it could look, according to the unintentionally directed choices of the research participants. Theoretical classes on the importance of imagery representations of immigrants and also of first nations will be given to participating students, as well as art instruction workshops on painting, cutting and collage for the production of the artworks that will hack the MCM.

In the field of quantitative research, the 15 selected students are undergoing two interviews that coincide with the beginning of the project and shortly after the exhibition of their artistic works. In these meetings, it is intended to verify what are the students' perceptions about the importance of social sciences and also of art in a fixed exhibition at MCM before the theoretical-critical classes and what are their perspectives about their artistic interventions after the Hacking the Children's Museum. With the data obtained in the two interviews with all the participants, it will be possible to assess whether there has been any evolution of critical thinking and the perception of the importance of historical-social references as a background for hidden narratives.

The analysis of data collection is currently under development along with the evolution of the research. We gathered the data referring to the bibliographic research on the historical-sociological context of the city of Winnipeg and the CPR and also from the first analyzes on the aesthetics of the "Engine House" and its real size 1950s train, which led us to prospect the dimension of artistic interventions of students and also how the artworks can be arranged in and around the exhibition.

## **5. Discussion and contributions**

The greatest contribution that this work brings is the opportunity to present the union of an active methodology of education - represented here by Museum Hacking - with a curricular restructuring of an education-entertainment environment that will adopt an approach that transcends STEM and becomes STEAM. In the opportunity to bring - initially - social studies and the arts to the permanent exhibition Engine House, we managed not only to provoke the curators and staff of MCM to look at the works of art from another perspective, but we were also able to invite the target audience of the space to do it. The use of Museum Hacking in an installation aimed at children is unprecedented so far and having its artistic interventions carried out by middle-aged students that will reveal new narratives and modify discourses using elements of the social sciences and art becomes an element still stronger than seeking to understand how the vision of the youngest can unveil new ways of observing the present and expanding other learnings that need space to manifest themselves.

The selection of 15 participants from grade 5 coincides with factors that go beyond the programmed content in their school curriculum that also address issues historically and sociologically relevant to understanding the MCM; the age group of these students who are between 11 and 12 years old also comprises a happy match with the age group that also frequents this same environment. By delimiting the participation of students from our partner school, which is located in one of the regions with the lowest income distribution in the city of Winnipeg, we are intentionally bringing representatives of those same peoples who originally built the CPR and the very establishment where the MCM is located today to that they can express, through art that will be included in the Engine House exhibition, all their ideas and dissatisfactions regarding the civilizing process, the distribution of income and the removal of the first nations from the city center to the peripheral regions. In addition, it will also be one of promoting new forms of educational provocation, since many of our participants had not been able to visit the MCM before due to the price of entry to the space being outside of what their families can spend on entertainment.

Finally, the way in which the artistic interventions are being designed and built are also within a transdisciplinary contribution, since elements of education are used such as curricular study, learning in the social sciences and instrumentalization of artistic knowledge with other theoretical-critical tools such as social semiotics, which proves to be an important ally in the composition of the critical perception of history and also of the imagery arts that are initially instructed to the participants and then are being developed by them. The meeting of diverse skills provides us with a unique field that richly provides material for us to understand how the shift from STEM to STEAM is important for high school students, how their active involvement in the artistic creation processes can reveal new narratives and important discussions and how theoretical instruments can provide practical materials so rich as to be shared in scientific exhibitions and articles in Canada and around the world.

## 6. Expected outcomes

Although the present research is still in the execution stage and the final data have not been completely collected, it is already possible to highlight that the innovation in using an active methodology such as Hacking the Museum in an environment aimed at children and whose artistic action is carried out by children is already something challenging and also very rich for the provision of future data.

When elaborating this research that involves fields of education and semiotics with the curricular expansion from STEM to STEAM at MCM, we proposed that the vision of middle school students could propose real changes in the permanent exhibition through their unique perspectives and discoveries of new narratives. . Even though we have not yet carried out the making of the artworks and the artistic intervention to hacking the Children's Museum, the initial data are already very encouraging since the participants themselves present numerous ideas on how to use imagery references from tribes of first nations and of immigrants from the East and East of Europe in their works of art.

Such materials can also be of great provocation to other museum visitors since they also present a cultural-semiotic reference that will reveal narratives that were hidden and that are essential to understand how that place that includes the MCM got there, what it is important in history and its responsibility for the present and the future.

## References

- Andreae, C. 1997. *Lines of country: an atlas of railway and waterway history of Canada*. Boston: The Boston Mills Press.
- Catterall, L. G. 2017. A brief history of STEM and STEAM from an Inadvertent Insider. *The Steam Journal, Volume 3: Issue 1, Article 5*. DOI: 10.5642/steam.20170301.05, 15 pgs.
- Clover, E. D., & de Oliveira Jayme, B., & Follen, S., & Hall, B. 2013. *The nature of transformation: Environment adult education*. Canada: Sense Publisher.
- de Oliveira Jayme, B., & Gough, K., & Sandford, K., & Monk, D., & Mimick, K., & O'Connor, C. 2016. Museum Hacking as adult education: teachers creating disturbances and embracing dissonances. In D. E. Clover, & K. Sandford (Eds.), *Education, museum, and art galleries: Animating social, cultural, and institutional change*, pp. 215-227. Canada: Sense Publishers.
- Greimas, A. J. 1992. *The semiotics of passion: from states of affairs to states of feelings*. Minnesota: University of Minnesota Press.
- Greimas, A. J. 1987. *De l'imperfection*. Périgueux: P. Fanlac.
- Morin, E. 2008. *Un lien a recomposer (Tome 1): Culture et société*. Paris: Attribut.
- Steward, Arthur J., & Mueller, M. P., & Tippins, D. J. 2020. *Converting Stem into Steam programs: Methods and examples from and for Education*. South California: Springer.
- Radaziwill, N. M.; & Benton, M. C., & Moellers, C. 2015. From STEM to STEAM: Reframing what it means to learn. *Tem Steam Journal, Volume 2: Issue 1, Article 3*. DOI: 10.5642/steam.20150201.3.
- Segarra, V. A., & Natalizo, B., & Falkenberg, C. V., & Pulford, S., & Holmes, R. M. 2018. STEAM: Using the arts to train well-rounded and creative scientists. *Journal of Microbiology & Biology Education, Volume 19, Number 1*. DOI 10.1128/jmbe.v19il.1360.
- Toews, O. 2018. *Stolen city: radical capitalism and the making of Winnipeg*. Winnipeg: ARP Books.





The background features a vertical gradient from light pink at the top to light orange at the bottom. A network of thin white lines connects various circular nodes of different sizes and colors (white, pink, blue, purple). Scattered throughout are small white icons: a globe, a cloud, a Wi-Fi symbol, and a four-pointed starburst.

# POSTERS



## INDUSTRY – UNIVERSITY COOPERATION – A PREREQUISITE FOR DEVELOPING COMPETENCIES 4.0

Valentina Haralanova<sup>1</sup>, Göran Fafner<sup>2</sup>, & Samir Khoshaba<sup>1</sup>

<sup>1</sup>Mechanical Engineering Department, Linnaeus University (Sweden)

<sup>2</sup>Design Department, Linnaeus University (Sweden)

### Abstract

The term Industry 4.0 represents the radical transformation that has resulted from the integration of emerging technologies and the industry. The proximity of the Fourth Industrial Revolution is observable and brings challenges arising from the ongoing automation and digitization. All companies, willing to remain competitive on the market need to go through this transformation overcoming such barriers, as the lack of qualified, skilled and talented employees to develop and manage various high-tech systems. This deficiency means that Industry 4.0 demands a change in the labour market, explicitly requiring trained professionals who have the needed competencies and skills. In this new environment, driven by new technologies and innovations the cooperation between academia and business is a prerequisite to sustainable economic growth, readiness for employment and preparedness for satisfying the new demands of the industries.

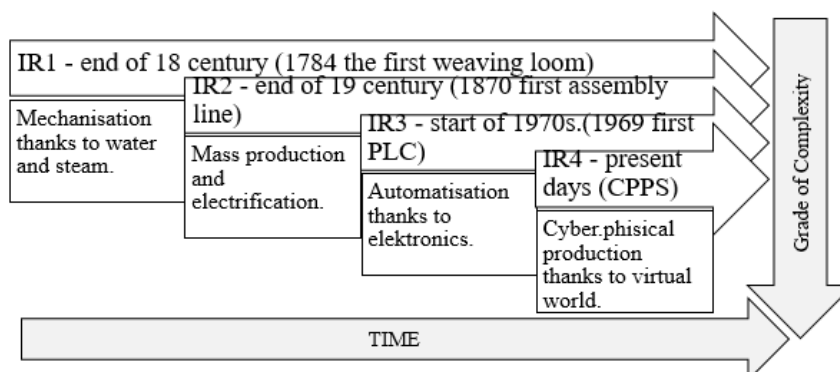
The authors are university teachers, working in Mechanical engineering department and Design department. The purpose of the presented paper is to observe the competencies and skills of mechanical engineers demanded by Industry 4.0 and to systemize the links between the industry in the region and the University aiming developing the needed competencies. Example with a project “Smart Industries”, running at the Mechanical Engineering department and Department for Computer sciences, focuses on development of expert competence within research and education areas related to the digitalization of the industry will be presented.

**Keywords:** Industry 4.0, Industry-University cooperation, Competencies 4.0.

## 1. Introduction

The history of humanity is above all a history of developing the technology and technique, because it affects the daily lives of people, their life in peacetime and in wartime. People would always use the technology they had available to help make their lives easier and at the same time try to make it better and bring it to the next level. Every era has its specific and distinctive level of developed technology and technique and this is how the concept of the industrial revolution began. Nowadays we are facing the beginning of the fourth-industrial revolution (IR4), called as well Industry4.0. A short overview of the three previous industrial revolutions will mark the path gone to the industry of today. (see Fig. 1)

Figure 1. The four IR in time and grade of complexity.



Industry 4.0, which started at the dawn of the third millennium, conceptualizes rapid change to technology, industries, and societal patterns and processes in the 21st century due to increasing interconnectivity and smart automation. In essence, the fourth industrial revolution is the trend towards automation and data exchange in manufacturing technologies and processes which include cyber-physical systems (CPS), IoT, industrial internet of things, cloud computing, cognitive computing, and artificial intelligence.

The differences and specifics of the technologies and techniques used in different eras demand different competencies from the labour forces in generally and from the engineers specifically.

## 2. Objectives of the research

The 4<sup>th</sup> industrial revolution, defined by full automation of production processes alongside with a rapid development of big data, artificial intelligence, Internet of things and increasing computing power on an unprecedented scale, will cause substantial changes in all aspects of social life worldwide and consequently will require redefinition of our approaches to education. According to the World Economic Forum (WEF) 2017 in the future, up to 47% of jobs may be withdrawn. These developments will transform the way we live, and the way we work. Some jobs will disappear, others will grow and jobs that do not even exist today will become commonplace. What is certain is that the future workforce will need to align its skillset to keep pace. According to the WEF in 2020 the main ten competences needed for the future jobs were listed and rated as follows in Table 1.

Table 1. Competences 4.0 from 2020 divided by types according [Lamri, 2019].

	Competences 2020	Behavioural and motivational	Cognitive and thinking	Social and psychosocial	Digital and technical (Specialized skills)
1	Complex problem solving		☞		Product design and development, System design and engineering, Machine design, Design and manufacturing engineering, Ergonomics and human factors, Design for sustainability etc.
2	Critical thinking		☞		
3	Creativity		☞		
4	People Management	☞			
5	Coordinating with others	☞			
6	Emotional intelligence			☞	
7	Judgment and decision making		☞		
8	Service orientation	☞			
9	Negotiation			☞	
10	Cognitive flexibility			☞	

According to [Lamri, 2019], the competences are defined and divided in four types, shown in Table 1. Behavioural and motivational, they determine how individuals react in different situations; Cognitive; Social, they determine how an individual perceives society and how he/she relates to the society; Technical (specialized skills), they are acquired through learning and experience (competences in ranking order in Table 1).

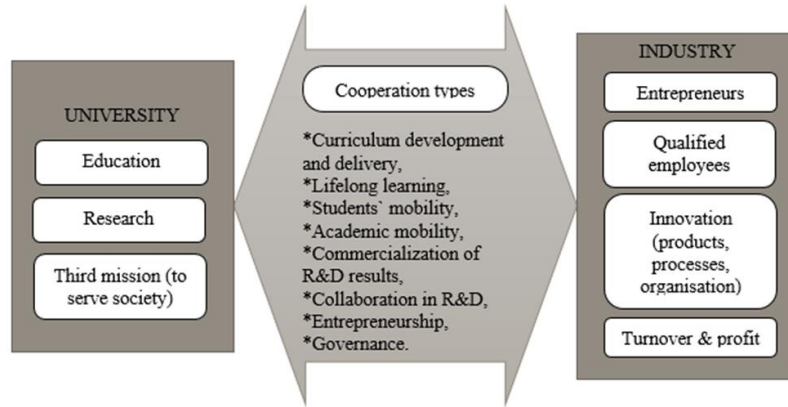
## 3. Methods

Competencies 4.0 are emerging from Industry 4.0. The classical role of the Universities as centres of knowledge, know-how and learning could be redefined so that universities around the world need to respond to the new economy and associated trends such as digital disruption and radically changing labour markets. Such vision of the Universities can be called University 4.0. In (Dewar, 2017) such universities are defined as “university for others' outward looking, deeply connected to industry and the communities around it, and committed to serving the needs of its students”. The intensified collaboration with the society as such and the cooperation with business and industry in particular finds its reasoning in the Swedish higher education act from year 1977. According it, Universities have three main tasks. Two of the tasks are teaching and research, and the third one is formulated as “The universities' task must include cooperating with the surrounding society and informing about their activities, as well as working to ensure that research results obtained at the university are useful”. [Act 2009:45]. The ‘third mission ‘of universities refers to the commercial application of universities’ knowledge to serve socioeconomic development by fostering links with knowledge users and facilitating technology transfer.

### 3.1. Industry – University cooperation

The cooperation between industry and university is related to the missions of the University and the needs of the industry and has change over time. According to research, there are eight types of university-industry cooperation. (see Fig.2)

Figure 2. Industry-university cooperation related to the missions of university and needs of industry.



### 3.2. Examples from Mechanical engineering department at LNU

Curriculum development and delivery is one type of university-industry cooperation, which aim is to develop human resources with competencies relevant to modern society and Industry 4.0. The companies are participating both in the development of curriculum according the needed competencies. They are taking also part in the delivery of it by being guest lecturers in different courses and programs. Another way companies are involved in is delivering their companies' catalogues for using them in projects and design work. It has become a tradition in Sweden that the projects for project-based courses are provided by the companies. Working on such projects students learn what is to work in real company and are building the needed competencies.

Lifelong learning is also one way of developing human resources, but here the students are adults, who acquire additional skills, knowledge or attitudes. At mechanical engineering department we work on a project called "Smart Industry". In the motivation of the project is said: "As a nation of knowledge, Sweden has for many years been a leading country with access to high expert competence, both in industry and from the higher education sector. However, the industry's need for competence must also be ensured in the future, and the focus on continuing and further education for professionals must increase." There is a broad competence regarding different parts of Industry 4.0 and smart industry, which spans both mechanical engineering and computer science. Based on that within "Smart industry", five focus areas are identified: Material and structure characterization, Modelling and simulation, Production and production control, Smart maintenance, Data management.

Another result of an Industry-university cooperation is EPIC a lab-hall with the newest manufacturing technology and test and experimental equipment was built. It is used not only by the students and personals from companies but also by the pupils from the technicum.

For universities and industry, there is a growing need for collaboration in order to survive in a highly competitive marketplace. The traditional culture of universities is evolving, not only with the development of universities but also because of the big diversity of the linkages between universities and industry.

### References

- Davos (2016). *The 10 skills you need to thrive in the Fourth Industrial Revolution*. Retrieved 24 January 2023 from <https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/>
- Dewar, J. (August 2017). *University 4.0: Redefining the Role of Universities in the Modern Era*. Retrieved 27 January 2023 from <https://www.thehighereducationreview.com/magazine/university-40-redefining-the-role-of-universities-in-the-modern-era-SUPG758722027.html>
- Khoshaba S., & Haralanova V. (2022). *University - Industry Collaboration Experiences from Linnaeus University. ICERI2022 Proceedings* (pp. 4525-4533).
- Lamri, J., Barabel, M., Meier, O., & Sirbey B. (2019). *The 21st Century Skills: How soft skills can make the difference in the digital era*. The Next Society publisher.

# THE PREFERENCES OF STUDENTS AND THEIR VIEW ON THE EDUCATION OF ECONOMIC AND MANAGEMENT SUBJECTS AT A TECHNICALLY ORIENTED UNIVERSITY

Ivan Katrencik, & Monika Zatrochova

*Institute of Management, Slovak University in Bratislava (Slovakia)*

## Abstract

The contribution is a partial output of KEGA research task no. 011STU-4/2022 "Creating a model of education supporting the increase of competencies of students of a non-economically oriented university in the field of innovative, entrepreneurial thinking and business support" conducted at the Institute of Management of the STU in Bratislava. The research presented in this article was conducted on a sample of 45 students of the Slovak University of Technology in Bratislava, Faculty of Chemical and Food Technology, who successfully completed the master level of education in 2022. The students were presented with a questionnaire consisting of 6 questions. The questionnaire contained both open and closed questions and its objective was to find out the preferences of students and their view on the education of economic and management subjects at a technically oriented university. Data collection took place online, through the Academic Information System - AIS, and in person on the basis of printed questionnaires that students received at their final exams. The results of the survey were compared with a similar survey conducted in 2017 and we found that up to 20% more students than in 2017 think they do not have sufficient knowledge of economic and managerial subjects for their future career. Even fewer students think (77%) that they do not have enough knowledge to start a business, despite the fact that almost 49% of them consider that they would like to start a business in the future.

**Keywords:** *Business education, survey, entrepreneurship, research.*

---

## 1. Introduction

The results published in this article are a partial output of a larger research carried out at the Slovak Technical University at the Faculty of Chemical and Food Technologies. The aim of this research is to analyze the current situation among students and, based on the requirements of practice, to innovate the teaching of economics and management subjects at a technically oriented university.

In general, we can observe the lack of interest of students of technologically oriented universities in studying management and economic subjects (Zatrochova & Fabova, 2018). On the other hand, the demands of the labor market are gradually changing and more and more emphasis is being placed on soft skills and education in the economic and managerial fields of graduates of technical universities. (Chodasova et al., 2015; Zavadsky & Olexova, 2022)

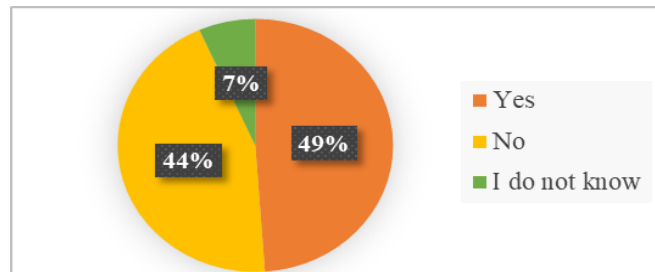
## 2. Methodology

The paper presents the results of primary research that was performed at the Slovak University of Technology in Bratislava (STU) at the Faculty of Chemical and Food Technologies (FCHPT). The research aimed at finding out the opinions of graduating students in the field of economic and management education. The students were asked a questionnaire with four open questions and one closed question. Some of the respondents were asked the questionnaire online through the Academic Information System and some were given the questionnaire in printed form. The students completed the questionnaire after the end of the year. A total of 45 students participated in the questionnaire. All materials and data found during the research have been progressively analyzed and evaluated. General methods of scientific work such as abstraction, induction, deduction, analysis, synthesis, and standard statistical methods were used in the processing. Some of the results were compared with similar research that was conducted in 2017 at the same university in a sample of 120 students.

### 3. Results

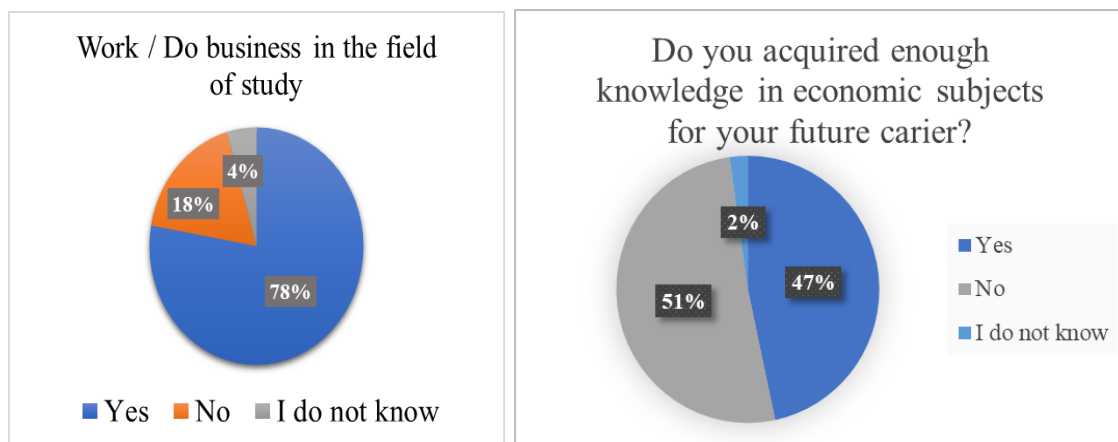
The first question of the questionnaire concerns the respondents' interest in doing business in the future. Almost 49% of them state that they are interested in starting a business in the future. 7% said that they do not know if they want to start a business, and 44% do not think they would like to start a business in the future.

Figure 1. Would you like to start a business in the future?



We found out whether the graduating students plan to stay working or start a business in the field. Most of them (78%) confirmed that they want to work or start a business in the field they graduated from. Only less than a fifth think that they will work/do business in another field. When asked whether they think they have acquired enough knowledge and skills for their future career while studying economic subjects, the majority (51%) answered that they did not think they have enough knowledge. 20% fewer students answered negatively on a similar question in 2017. (Plchova & Zatrochova, 2017). Detailed results of these questions are shown in Figure 2.

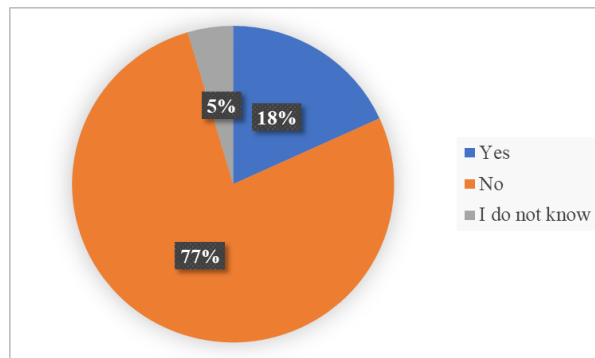
Figure 2. The interest of the respondents to stay work / do business in the field of study and their opinion on acquired knowledge in economic subjects for their future carrier.



Another part of the research was devoted to finding out whether, in their opinion, students have sufficient knowledge to start a business. The results show that the overwhelming majority (77%) think that they do not have enough knowledge to start a business. Only 8 respondents consider their knowledge sufficient to start a business. Although the students first said that they acquired sufficient knowledge of economic subjects during their studies for their future career, 38% of them answered that they did not have sufficient knowledge for entrepreneurship. Of the students who said they would like to start a business in the future, only a third said they had sufficient knowledge to start a business. Only one student responded that he did not want to start a business and that he had sufficient knowledge to start a business.



Figure 3. Do you think you have enough knowledge to start a business?



Almost two-thirds of the students answered that during their studies they did not have sufficient information about the possibility of choosing and the content of subjects with an economic focus. We find similar results with students who are still studying.

The last question of the questionnaire was open and in it we asked what recommendations the respondents would suggest to be introduced in teaching in the field of economic focus and entrepreneurship. The most frequent answers consisted of including more teaching in the field of financial literacy, investing, and entrepreneurship and focusing on the application of economic subjects in the chemical and food industries.

#### 4. Conclusions

The research results point to the fact that students of a technically oriented university are interested in entrepreneurship. More students responded that they would like to start a business but do not have enough knowledge to start a business. The reasons can be identified as the reluctance of students at a technically oriented university to study subjects in the economic and managerial fields. We also see a problem in students' lack of information about study options and the content of the subjects offered.

We are increasingly identifying a trend in teaching that tends to use modern tools that are interactive and interesting for the student. Reducing the time of lectures and actively involving the student in the lesson appears to be a suitable way of obtaining positive references with an emphasis on increasing the competence of students in the taught material.

Most of the students want to stay working or start a business in the field they studied, and yet almost half of them answered that they did not acquire sufficient knowledge in the field of economics and management. Thus, it can be observed that students consider education in the economic and managerial fields to be necessary even in technically oriented directions. This is also evidenced by the trend in the labor market, which places more and more emphasis on soft skills.

*The contribution is a partial output of the KEGA research task no. 011STU-4/2022 "Creating a model of education supporting the increase of competencies of students of a non-economically oriented university in the field of innovative, entrepreneurial thinking and business support" conducted at the Institute of Management of the STU in Bratislava.*

#### References

- Chodasova, Z. et al. (2015). Education of students and graduates of technical schools for contemporary requirements of practice. *5th International Conference on New Horizons in Education (INTE)*. Paris: Elsevier Science BV.
- Plchova, J. & Zatrochova, M. (2017). An example of the innovative education of the university students of chemistry aimed at the business success in Slovakia. *9th International Conference on Education and New Learning Technologies (EDULEARN)*. Barcelona: IATD.
- Zavadsky, C. & Olexova, C. (2022). Kompetencie zamestnancov pre potreby industry 4.0. *Manažment v teórii a praxi 1/2022*. Košice: Ekonomická univerzita v Bratislave.
- Zatrochova, M. & Fabova, L. (2018). The interest of the technical university students in business education. *11th Annual International Conference of Education, Research and Innovation (ICERI)*. Seville: IATD.

# THE SCHOOLIFICATION OF COMPUTER GAMING – IDENTIFYING THE ROLE OF ESPORT IN SCHOOL SYLLABI

**Björn Sjödén, & Kalle Jonasson**

*School of Education, Halmstad University (Sweden)*

## Abstract

The aim of this project is to examine the educational dimensions of esports as part of the course syllabi in secondary education. An increasing number of schools on the upper secondary level (in Sweden: gymnasium) are offering three-year programs with an “esport profile” within aesthetics and media. School marketing suggests that esports can work as a bait for potential students who are interested in playing computer games, but the scholastic values of computer gaming remain to be clarified. Whereas “gamification” is an established term for transforming educational (and other formal) practices into game-like activities, little has been said about its counterpart “schoolification”: how originally playful and informal practices are transformed to fit within school curricula and syllabi for achieving academic goals. A number of unanswered questions follow. For example, teachers have observed that students in the esports program are less motivated in schoolwork but are highly motivated gamers. Is this a question of what students learn, or how they learn? How do the students themselves perceive esports performance in relation to academic performance? What are their driving factors and can motivation in one domain transfer to another? How do students perceive fear of failure, gains of winning, competition and success, across esports and traditional school topics? Here, we address the challenges and procedures of setting up a practice-based research program where the practitioners (i.e. students, teachers, an esports coach and school leaders) collaborate with researchers in investigating the relationship between computer gaming and traditional teaching-and-learning activities in the classroom.

**Keywords:** *Esport, secondary education, computer gaming, gamification, schoolification.*

---

## 1. Introduction

This project takes its point of departure in the intersection between learning and education in the broadest sense, and the cultural phenomenon of e-sports. Esports is used as a collective name for all competitions that take place in a virtual environment. It can thus be about video games, computer games, Virtual Reality (VR), Augmented Reality (AR) or mobile games. Globally, it is estimated that close to 200 million people practice or follow competitions that take place in virtual, electronic environments. In Sweden, it is estimated that approximately 100,000 young people are organized and active in esports. Considerably more – and not only young people – engage in e-sports on their own and yet more people consider themselves “gamers”.

Research on esports has increased exponentially in recent years and since the seminal book on video games and learning by Gee (2003), but only exceptionally is education weighed into the discussion of this phenomenon's culture, industry and/or ecology (depending on which metaphor is used). Therefore, there are good conditions to begin the mapping of how esports and education can fit together at different levels and forms of education. A number of variants have emerged on how e-sports can constitute both goals and means in education at different levels, both in Sweden and internationally (Harvey & Marlatt, 2021; Jenny et al. 2021; Scott et al. 2021). The term “scholastic esports” (Harvey & Marlatt, 2021) is a theoretical starting point. Above all, the literature on scholastic esports has focused on what is learned in computer games, how digital tools contribute to the motivation of learning, and what possible career paths it offers (and thus how curricula, courses and training plans should be designed). Here, we address some challenges with and procedures of setting up a practice-based research program, in the local context of an upper secondary school in Sweden (gymnasium) which offers a three-year program with an “esport profile” within aesthetics and media.

Our overall aim is to develop a practice-based collaborative research project between researchers and practitioners – students, teachers, an esports coach and school leaders – for investigating the relationship between computer gaming and traditional teaching-and-learning activities in the classroom. This collaboration is planned to be carried out over the years 2023-2025, and is under development at the

time of writing, starting with this opportunity for input from the educational research community. First, we describe the motivation and theoretical rationale for setting up the project with respect to the scholastic role of esports in the present, national and local, context. We then discuss the concept of “schoolification”, as the theoretical reverse of “gamification”, with respect to how the informal practices of computer gaming are transformed to fit within formal school curricula and syllabi for achieving academic goals.

## **2. Motivation and rationale for the project in the present context**

Based on national statistics, there should be approximately 1,000 actively organized esports players just in the immediate vicinity of the university where the authors of this paper are based. Since 2021, the university itself hosts an “esport lab”, which besides to the interest of researchers and students, is adapted to young people with disabilities. A nearby school offers a three-year program on the upper secondary level (high school) with a particular esports profile, where computer gaming has a pronounced role. For example, on the school’s website, their educational program is marketed as stemming from “knowledge of a gamer’s needs” in order to “...create a gamer profile linked to a training program to make you the best gamer you can be” (translated from Swedish, [www.lbs.se/programinriktning/e-sport/](http://www.lbs.se/programinriktning/e-sport/)). In short, the vast general interest in esports, its scholastic relevance and local conditions beneficial to research, triggered our interest in further investigating the relatively recent role of computer gaming in traditional educational programs and processes.

### **2.1. From gamification to schoolification**

Two types of transformative processes, significant of the digitalisation and the 21<sup>st</sup> century and important for the present discussion, are those of *gamification* and *schoolification*. Both terms were coined in the aughties, at the start of the millennium. The former, gamification, has gained more fame, as a process pervading many societal sectors, from education to marketing. The latter, schoolification, is lesser known. Mostly as a pendant to the increasing academic character of early childhood education, schoolification is a term coined to describe when curricular content begins to pervade educational institutions, where prior freer forms of learning had reigned. An intensification of adult transfer of knowledge is also part of the definition of schoolification (Gunnarsdottir, 2014).

Although well developed as a cultural grassroots phenomenon and potent commercially potent industry, esports lacks formalization and distinction in the education level (Jenny et al. 2021; Scott et al. 2021). This creates a need to understand how features and efforts attract its target group, manage and develop the target group's knowledge, as well as prepare it for further studies, and professional practice within different parts of the sector. In addition, an investigation of these relationships with a focus on specific cognitive concepts and principles (cf. Gee, 2003/2007) could map and discover what scholastic esports has to offer that is not done within the framework of educational programs without computer games and gaming in the syllabus.

### **2.2. From learning “what” to learning “how”**

Whereas formal education is typically divided into subject areas (e.g. math, history, biology) and domain-specific skills (e.g. sports, handicraft, creative arts), it can be argued that the scholastic values of computer gaming is more about *how* students learn than *what* they learn. The factual content of a game, whether in an historically apt setting or a futuristic fantasy, is seldom important for learning skills or making progress in the game. Still, the gamer needs to attend to, process and take proper action to various informational sources and events on screen. Above all, students need to make choices (sometimes within fractions of a second, depending on the type of game) as to what, when, where and how to learn.

The function of instant feedback to the player’s choices likely has a vast impact on the player’s motivation and willingness to make efforts, especially in contrast to non-interactive, non-social environments where no or much delayed feedback is given (such as when reading a book is eventually followed by a test, and a subsequent test result). It was therefore not surprising when our initial contacts with teachers revealed that students in the esports program were highly motivated gamers, but less motivated in traditional schoolwork. Such observations motivated us to look further into how the students approached the different domains of gaming and schoolwork. Research in this field is scarce, but one study (Trotter et al, 2022), allegedly the first longitudinal study of its kind, found that the positive psychological development of students enrolled in a school esports program did not decrease when compared to a control group. However, because the study was impacted by the COVID19 lockdown, the specific effects on motivation are hard to distinguish. This points to that the virtual context of esports education has some pedagogic potential to unpack (or: some unlocked levels to explore).

Perhaps most importantly from an educational point of view, we wondered whether students could learn to apply some principles from their gaming activities also to improve their schoolwork, not by transforming the actual school tasks (reading, writing, doing math, etc.) but rather transforming how students think about, and hence approach, the same tasks. For example, constructs such as winning/losing may be explicit and repeatedly present in a computer game (and often crudely so, as the game character survives/dies), with a clear effect on the player's efforts and motivation to try again. On the other hand, in school subjects such as math or physics, one's construct of success/failure may be an implicit, even unconscious, motivating factor of performance. Hence, the differential effects on students' motivation and skills might not be due to the topic itself, but to the process of how students approach and learn the material. The role of esport in school in school syllabi – its schoolification – would then reside in its potential to offer more, and previously non-existent, ways of interacting with learning material that ideally broaden students' study skills. A precondition to such successful learning is, however, that there are opportunities to apply similar goals and strategies across settings and disciplinary boundaries.

### 3. Challenges to setting up a practice-based esport research program

If there is a common message from the recent literature on integrating esports in education (Harvey & Marlatt, 2021), it seems to be the importance of active involvement and engagement of the relevant stakeholders in the gaming ecosystem. This makes a complex challenge for researchers, not to detach research activities from educational goals and interests. We took the following steps:

1. Resource identification: what physical resources and competences are needed and available.
2. Establishing contact with stakeholders: students, teachers, mentors, esport coach and headmaster.
3. Invested interest: formal agreement on co-financing of the project by the school and university.
4. Maintaining collaborative practices: regular meetings with teachers, mentors and school leaders.
5. Co-design with stakeholders: pilot testing of instruments using mixed methods, such as interviews, questionnaires and quantitative data of gaming practices and school performance.
6. Communication plan: involving the research community at an early stage (e.g. conferences and other collaborative assemblies), research findings to be published in open access journals.

#### 3.1. Conclusions for discussion

As researchers, rather than esport program developers, we conclude that some major questions about the scholastic role of esport remain unanswered and thus warrant further investigation. For the research project ahead, we will focus on the following:

- How do the students themselves perceive esport performance in relation to academic performance?
- What are the students' driving factors and can motivation in one domain transfer to another?
- How do students perceive fear of failure, gains of winning, competition and success, across esport and traditional school topics?
- How does the identified knowledge, acquired and developed within esport programs on the upper secondary school level, correspond to the Digital Competences Framework by the EU?

#### References

- Gee, J. P. (2003/2007). *What video games have to teach us about learning and literacy*. New York: St Marin's Griffin.
- Gunnarsdottir, B. (2014). From play to school: are core values of ECEC in Iceland being undermined by 'schoolification'? *International Journal of Early Years Education* 22 (3), 242-250.
- Harvey M., & Marlatt, R. (2021). *Esports research and its integration in education*. Hershey, PA: IGI Global.
- Jenny, S. E., Gawrysiak, J., & Besombes, N. (2021). Esports. edu: An inventory and analysis of global higher education esports academic programming and curricula. *International Journal of Esports*. <https://hal.science/hal-03731250>
- Scott, M. J., Summerley, R., Besombes, N., Connolly, C., Gawrysiak, J., Halevi, T., ... & Williams, J. P. (2021). Foundations for esports curricula in higher education. In *Proceedings of the 2021 Working Group Reports on Innovation and Technology in Computer Science Education* (pp. 27-55).
- Trotter, M. G. Coulter T. J. Davis P. A. Poulus D. R., & Polman R. (2022). Examining the impact of school esport,s program participation on student health and psychological development. *Frontiers in Psychology* 12. <https://doi.org/10.3389/fpsyg.2021.807341>

# TEACHERS' STRESS AS A MODERATOR OF THE IMPACT OF POMPEDASENS ON PRESCHOOL CHILDREN'S SOCIAL-EMOTIONAL LEARNING

Maryam Zarra-Nezhad<sup>1</sup>, Ali Moazami-Goodarzi<sup>2</sup>, Joonas Muotka<sup>3</sup>, & Nina Sajaniemi<sup>1</sup>

<sup>1</sup>*School of Applied Education Science and Teacher Education, University of Eastern Finland (Finland)*

<sup>2</sup>*Department of Psychology and Speech-Language Pathology, University of Turku (Finland)*

<sup>3</sup>*Department of Psychology, University of Jyväskylä (Finland)*

*Funded by the Academy of Finland for Ph.D. Maryam Zarra-Nezhad (grant number 330960)*

*Finnish National Agency for Education to Prof. Nina Sajaniemi (grant 33/2178/2018)*

## Abstract

This study examines the extent to which the impact of a universal intervention program, i.e., POMPedasens, on children's early social-emotional learning (SEL) is different depending on early childhood education (ECE) teachers' stress at work. The POMPedasens program aims to promote children's (5–6-year-olds) SEL by supporting ECE teachers' engagement and emotional availability. The intervention effectiveness has been monitored using an 8-month randomized controlled trial design with an intervention (IG; 26 teachers and 195 children) and a waiting control group (CG; 36 teachers and 198 children) that provided the data before and after the program implementation. The ECE teachers in the IG are trained to implement the intervention program in their early childhood education and care groups. Latent change score analysis suggests that the program increases children's prosocial behavior in the IG when teachers show a low level of stress. No significant results were found for the IG regarding a change in antisocial behavior. Unexpectedly, when teachers showed a high level of stress, an increase in prosocial behavior and a decrease in antisocial behavior were only found for children in the CG. The results suggest a promising application of the POMPedasens program for promoting prosocial behavior in early childhood when teachers have low stress. The intervention will likely need a longer time to display the moderating effect of ECE teachers' well-being on children's antisocial behavior change. The stress in CG might mean that the teachers were doing their best at the cost of their own well-being.

**Keywords:** *Early childhood, social-emotional learning, universal intervention program, professional development, teachers' stress.*

---

## 1. Introduction

Social-emotional learning (SEL) is recognized as an essential part of early childhood education and care (ECEC) and vital for supporting children's development, well-being, and mental health to become well-functioning adults (e.g., Jones et al., 2015). Early childhood education (ECE) teachers play an essential role in promoting SEL in early childhood when children undergo rapid developmental growth (Rodríguez et al., 2020). Yet, ECE teachers are often inadequately prepared to meet the expectations and fulfill the challenges of pedagogical work that are explicitly and implicitly required from them, which may expose them to high-stress levels (Ugaste & Niikko, 2015). Although the literature suggests that professional development (PD) can equip ECE teachers with a sense of capability and agency, improving their self-efficacy, reducing their emotional exhaustion, and fostering children's SEL, previous research involves at least two limitations. First, gaps remain in examining the impact of universal PD interventions on preschool children's SEL in Nordic countries (Fonsén & Ukkonen-Mikkola, 2019). Second, empirical studies that have examined the moderating role of ECE teachers' stress on the impact of early interventions on children's SEL are lacking.

### 1.1. The intervention program

"POMPedaSens", a universal PD intervention program, was recently developed in Finland (2019) to support ECE teachers' PD, engagement, and emotional availability, promote a sense of belonging, and overall quality of teacher-child interactions at the group level, children's self-regulation, peer relationships, and group involvement, and reduce the risk for cumulating behavioral problems and bullying. POMPedasens' principles stem from theories of positive psychology and developmental neurosciences, combined with pedagogical knowledge of high-quality interaction in the context of ECEC.

## 1.2. The present study

The present study aims to investigate the extent to which the impact of POMPedaSens, on preschool children's (5–6-year-olds) SEL is different depending on the ECE teachers' stress at work.

## 2. Method

### 2.1. Participants and procedure

The POMPedaSens intervention program was carried out in 22 ECEC centers in Finland (September 2019–December 2020). The program professionals trained teachers in the IG on implementing the program through ongoing education and nine workshops. The teachers in the IG were trained to develop activities and renew practices to promote children's SEL through inclusive learning environments and responsive and supportive interaction. Teachers also had face-to-face meetings to support and maintain training quality and implementation reliability. The intervention effectiveness has been monitored using an 8-month randomized controlled trial design with an IG and CG that provided the data before and after the program implementation (Table 1).

Table 1. Baseline demographic and characteristics of the IG and CG.

	IG	CG	p-value
<b>Children (n)</b>	195	198	
Gender (n)			.05
Female	105	87	
Male	90	111	
Age (years mean $\pm$ SD)	5.98 $\pm$ 5.75	6 $\pm$ 5.92	.47
Multicultural background			.94
No	160	163	
Yes	35	35	
Special education needs			.77
No	155	155	
Yes	40	43	
Group size	18.07	20.25	<.001
<b>ECE Teachers (n)</b>	36	26	

Note. Values are n / mean  $\pm$  SD

### 2.2. Measures

*Multisource Assessment of Social Competence Scale* (MASCS; Junttila et al. 2006). ECE teachers rated MASCS on a 4-point scale (1 = never, 4 = very frequently) at the pre-and post-test for the IG and CG. In the present analysis, the domain scores of social competences (i.e., prosocial behavior and antisocial behavior) were used.

*Teachers' Stress*. Teaching stress was measured using a modified version of the Parental Stress Inventory (Gerris et al., 1993; see Pakarinen et al., 2010). The three items measure feelings of stress in teaching and powerlessness in handling teacher–child situations. Teachers rated on a 5-point scale (1 = not applicable, 5 = very applicable) at the pretest for the IG and CG.

## 3. Results

Latent change score (LCS) analysis using structural equation modeling (SEM) techniques with the Wald test was used to analyze The group  $\times$  time  $\times$  moderator interaction. An overall significant group  $\times$  time  $\times$  stress interaction was found regarding prosocial behavior (Wald test (1) = 9.752,  $p = .002$ ) and antisocial behavior (Wald test (1) = 8.837,  $p = .003$ ). The estimated mean change in the prosocial behavior was significant for both the IG and the CG. That is, teachers' stress moderated the effect of change in prosocial behavior in both the IG and the CG. A significant increase in the rate of prosocial behavior over time was found for the IG ( $\beta = 0.141$ ,  $p = .041$ ) only when teachers' level of stress was low ( $-1SD$ ). No significant change was found for the prosocial behavior in the CG ( $\beta = -0.035$ ,  $p = .480$ ) when teachers showed a low level of stress ( $-1SD$ ). However, when teachers' stress level was high ( $+1SD$ ), prosocial behavior showed a significant increase only in the CG ( $\beta = 0.109$ ,  $p = .049$ ) and not in the IG ( $\beta = -0.063$ ,  $p = .373$ ). Further, the estimated mean change in antisocial behavior was significant only for the CG. Teachers' stress moderated the effect of change in antisocial behavior for the CG. A significant decrease in the rate of antisocial behavior over time was found for the CG ( $\beta = -0.157$ ,  $p < .001$ ) only when teachers' level of stress was high ( $+1SD$ ). No significant change was found for the

antisocial behavior in the IG ( $\beta = -0.062$ ,  $p = .293$ ) when teachers showed a high level of stress (+1SD). When teachers' stress level was low (-1SD), no significant change in the rate of antisocial behavior over time was found for the IG ( $\beta = 0.095$ ,  $p = .297$ ) and the CG ( $\beta = -0.026$ ,  $p = .566$ ).

#### 4. Discussion

Our results suggested that when teachers showed a low level of stress, prosocial behavior increased for children only in the IG. This is consistent with the prosocial classroom model (Jennings & Greenberg, 2009), indicating the fundamental role of teachers' well-being and competency in SEL skills contribute to their ability to develop a positive teacher-child relationship, healthier classroom settings, and implement children's SEL interventions. The POMPedasens program has equipped teachers with adequate strategies to implement effective classroom management techniques and responsive and nurturing teacher-child interactions to create a positive learning environment and support children's well-being and social-emotional behaviors. Further, when teachers showed a high level of stress, prosocial behavior increased only for children in the CG. The increased prosocial skill in CG when teachers report high stress could be a consequence of demands for accountability and expectations toward prosocial behavior in the ECEC without supporting teachers' PD and well-being. No significant effects were found for the IG regarding a change in antisocial behavior. However, when teachers showed a high level of stress, antisocial behavior decreased for children in the CG. One explanation could be that the relatively short time between pretest and post-test measurements could not reveal the moderating role of teachers' stress on possible changes in children's problem behaviors in the IG. On the other hand, the decrease in children's antisocial behavior in the CG may have been due to more restrictions and control over children's behaviors in challenging situations that are loading for teachers. Decreased antisocial behavior in the CG could thus be due to increasing obedience instead of maturing children's SEL, such as their self-regulation skills which can be a short-term outcome.

#### 5. Conclusions

The results suggest that compared to the CG, the POMPedasens intervention program increases children's prosocial behavior in the IG only when teachers show low-stress levels. The results suggest a promising impact of the intervention in promoting early prosocial behavior by supporting ECE teachers' PD. However, no significant effects were found regarding the change in antisocial behavior in the IG compared to the CG. This result suggests that changes in antisocial behavior may require a long learning period, and the intervention needs a relatively long time to display the moderating effect of ECE teachers' well-being on children's antisocial behavior change. For the CG, children's prosocial behavior increased when teachers showed a high level of stress. Further, a decrease in the rate of antisocial behavior was found for the CG when teachers' stress was high. The stress in CG might indeed mean that the teachers were doing their best at the cost of their own well-being (high stress).

#### References

- Fonsén, E., & Ukkonen-Mikkola, T. (2019). Early childhood education teachers' professional development towards pedagogical leadership. *Educational Research*, 61(2), 181-196.
- Jennings, P. A., & Greenberg, M. T. (2009). The Prosocial Classroom: Teacher Social and Emotional Competence in Relation to Student and Classroom Outcomes. *Review of Educational Research*, 79(1), 491-525.
- Junttila, N., Voeten, M., Kaukiainen, A., & Vauras, M. (2006). Multisource assessment of children's social competence. *Educational and psychological measurement*, 66(5), 874-895.
- Jones, D. E., Greenberg, M., & Crowley, M. (2015). Early Social-Emotional Functioning and Public Health: The Relationship Between Kindergarten Social Competence and Future Wellness. *American Journal of Public Health*, 105(11), 2283-2290.
- Pakarinen, E., Kiuru, N., Lerkkanen, M.-K., Poikkeus, A.-M., Siekkinen, M., & Nurmi, J.-E. (2010). Classroom organization and teacher stress predict learning motivation in kindergarten children. *European Journal of Psychology of Education*, 25(3), 281-300.
- Rodriguez, V., Lynne Solis, S., Mascio, B., Kiely Gouley, K., Jennings, P. A., & Brotman, L. M. (2020). With Awareness Comes Competency: The Five Awarenesses of Teaching as a Framework for Understanding Teacher Social-Emotional Competency and Well-being. *Early Education and Development*, 31(7), 940-972.
- Ugaste, A., & Niikko, A. (2015). Identifying the problems that Finnish and Estonian teachers encounter in preschool. *European Early Childhood Education Research Journal*, 23(4), 423-433.

## THE DEVELOPMENT OF FORMAL THINKING

**Ghada Wattad, & David Chen**

*School of Education, Tel Aviv University, Tel Aviv (Israel)*

### Abstract

In the current study we have investigated the development of logical and mathematical reasoning among mature population, following Piaget's theory of cognitive development. The purpose of the present study is examining if continued biological development and/or continued accumulation of life experience, learning and education can develop into formal operation. The findings indicate that, only about 25% of the population moves to the formal operational stage, and this is before the age of 20. Furthermore, learning was affected by domain specificity. Our findings show that about one fifth of illiterate population have the ability of performing formal thinking. This percentage is close to that of literate population thus suggesting that development of formal operation is regulated innately.

**Keywords:** *Cognitive development, concrete thinking, formal thinking, education, mathematical reasoning.*

---

### 1. Introduction and Aims

The present paper is based on the theory of stages by Piaget and Inhelder (Inhelder & Piaget, 1969; Piaget, 1972) which deal with the cognitive development of students in their transition from the concrete operational stage into the formal one. According to Piaget, the course of development is linear and continuous. The stages of the cognitive development are universal.

Shayer & Adey's (1981) study of the cognitive levels, which included 12,000 students from junior and high schools in England, found that only about 30% of students are in the formal operational stage, while 70% of students are at the concrete level of thinking. These findings show that not all junior and high school students reach the formal level of thinking as expected by Piaget's developmental theory.

The research also found a gap between the requirements of the curriculum and the level of development, which can explain the learning difficulties and the low achievements among students in subjects that require abstract thinking.

While Piaget focused on the cognitive development of the individual, a series of extensive studies, which were conducted around the world and examined the distribution of the cognitive levels within a population of junior and high school students, found that cognitive development attains a universal pattern until the end of the concrete operational stage at the age 12. After that, a section of the population does not continue with the normative development with the timeline and so the cognitive development stopped at the concrete stage. (Alon, 2003; Herbst, 2006; Iqbal and Shyer, 2000, Green, 1983; Shayer & Adey, 1981; Engler and Bond, 2001).

At the basis of this research lies the following question: does the section of the population who could not reach the formal thinking until the age of 17 develops this ability at an older age? If so, then this means postponing the cognitive maturation to a later age. If the answer is no, then what is the role of all the learning and the experience acquired during the entire life?

In the current study we have investigated the development of logical and mathematical reasoning among a mature sample following Piaget's theory of cognitive development. The purpose of the present study is examining if continued biological development (the increase in age) and/or continued accumulation of life experience, learning and education can develop thinking that contributes to the transition to the stage of formal operational thinking.

Our research tested the following questions:

1. Does cognitive development continuous during adult life?
2. Is Cognition driven by general intelligence or by modularity of the mind (Domain's specificity)?
3. What drive cognitive development – schooling, genetics or both?
4. Does illiteracy prevent transformation to formal thinking?



## 2. Method

The present research is based on two populations: The first consists of one thousand literate subjects, aged between 18-76 (M= 39). The sample is heterogeneous in terms of culture, gender, education and age. The second consists of one hundred and three illiterate adults.

For data collection purposes, we used a quantitative-correlative layout to examine the cognitive level according to Piaget's cognitive theory and to understand the functional relationships between the cognitive level and other background variables.

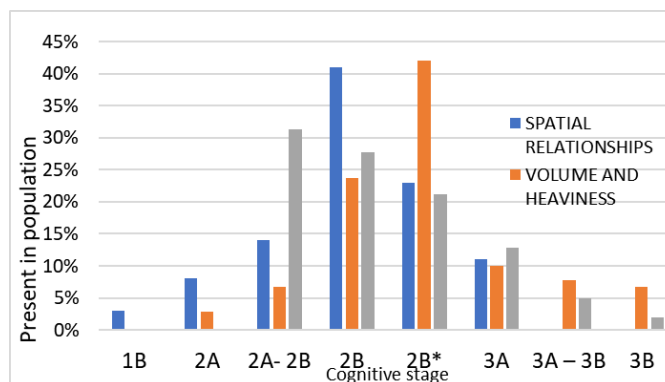
We used a series of three tests developed by "Mathematics and Science Perceptions in High School" at Chelsea College, University of London, between 1973 and 1978. We received the tests directly from Prof. Shayer, with guidance and counseling in regard to the processing of the data. These tests were validated and adapted to fit the norms of the population in the U.K.

## 3. Findings and discussion

Our findings show that during the long period of adult life (20-70 y) there was no further cognitive development. Only about 25% of the population moves to the formal operational stage, and this is before the age of 20. Culture, sex, and age had no significant effect on the distribution of cognitive levels within the population studied. The very nature of the distribution of cognitive development within the literate population indicate a polygenic model of control.

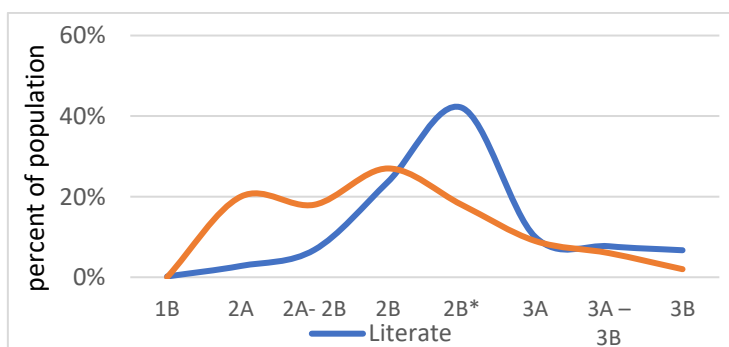
On the other hand, Domain specificity did change the distribution of cognitive functioning, both in the literate and the illiterate populations. This finding support Fodor's modularity model and the Core knowledge model of Spelke and Carey rather than the kovas – Plomin general intelligence model of information processing.

Figure 1. The distribution of cognitive levels in three domains.



The findings show that about one fifth of illiterate population have the ability of performing formal thinking. This percentage is close to that of literate population. This finding presumably affirms the dominance of the genetic factor in cognitive development and refutes the assumption that illiteracy means ignorance. It can be argued that people, who attain the formal stage through the mediation of the school, have the inherited basis and the cognitive tools necessary for the development of formal operations. However, we also found that school contributes significantly to transferring most of the students to the end of the concrete stage, but not beyond it.

Figure 2. The distribution of cognitive levels in of both the literate and illiterate groups.



We therefore suggest distinguishing between cognitive development and cognitive growth. The cognitive development is universally regulated intrinsically by the genome (Innately) and thus cannot be "accelerated". Cognitive growth, however, is the product of learning and is continues in time. It is the kind of knowledge acquired that is constrained by the developmental stage and the specific modules that were differentiated.

On the basis of our findings, we suggest a working model of the genetic regulation of cognitive development. In this model the first three stages from sensorimotor to concrete, are under the control of a single QTL, as all the population complete its maturation of this development phase. The third and fourth stages (FPF) are under a separate QTL present only in a third of the population.

This model is subject to further research.

### *References*

- Alon, T. (2003). The relationship between cognitive level according to Piaget's model of cognitive development and the degree of use of intuitive rules in solving scientific and mathematical problems, PhD thesis, Tel Aviv University.
- Endler, L.C. & Bond, T.G. (2001). Cognitive development in a secondary science setting. *Research in Science Education*, 30(4) 403-416.
- Green, D. R. (1983). A Survey of probability concepts in 3000 pupils aged 11-16 years. In D. R. Gery, P. Holmes, V. Barnett, & G. M. Constabale (Eds.), *Proceeding of the first international conference on teaching statistics*. Sheffield, U.K.: Teaching Statistics Trust.
- Huppert, J. (2006). Computer simulations in the high school: Students' stages science process skills and academic achievement in microbiology. *International journal of Science Education*, 24, 803-8.
- Inhelder, B. & Piaget, J. (1969). *The early growth of logic in the child*, w.w, Norton & company inc.
- Iqbal, H.M., & Shyer, M. (2000). Accelerating the development of formal thinking in Pakistan secondary school students: Achievement effects and professional development issues. *Journal of Research in Science Teaching*, 37(3), 259-274.
- Piaget, J. (1972). *Psychology of intelligence*. Totowa, Littlefield Adams.
- Shayer, M., & Adey, P. (1981). *Towards a science of science teaching*. London, U. K.: Heinemann Educational Book.

## **EMBEDDING TRAUMA-INFORMED CARE PRACTICES INTO SPECIAL EDUCATION PERSONNEL PREPARATION PROGRAMS**

**Catherine Corr**

*Ph.D, Department of Special Education, University of Illinois, Urbana-Champaign (USA)*

### **Abstract**

Children with disabilities experience trauma (i.e., neglect) at alarming rates. There is a critical need to provide interdisciplinary trauma-informed care (TIC) for children with disabilities, however, many special education professionals are unprepared to implement TIC practices. Trauma-informed care (TIC) utilizes an understanding of how the effects of trauma impact both physical and mental health. Participants will be introduced to key elements of TIC, ways to use those principles in their pre-service special education teacher preparation programs, and how pre-service special education teacher education programs can move towards a trauma-informed framework. This poster is relevant for faculty or other professionals who prepare teachers, specifically special education teachers. This poster will focus on how one program at the [name of university] is maximizing the value of pre-service special education teacher programs to ensure that children and families who have experienced trauma are at the core of their work. This poster will provide examples of how TIC principles have been embedded into existing evidence-based programming for children and families. The poster will also discuss how pre-service professionals across disciplines consider TIC principles and how these principles intersect with the primary goals of their professional role. Finally, this poster will highlight the importance of working across disciplines support children with disabilities in educational settings.

**Keywords:** *Trauma informed care, special education, early childhood, teacher preparation.*

---

### **1. Objectives**

Trauma negatively impacts young children's development. One way to mitigate the impact is through trauma-informed care. Studies that have examined the experiences of ECSE professionals related to trauma-informed care have found they do not feel prepared to implement trauma-informed care. Research shows that children who receive trauma-informed supports have better outcomes, and the need for a well-trained workforce is an essential feature of providing trauma-informed care. Therefore, ECSE teachers play an important role in creating this environment and need to understand trauma and trauma-informed care in order to better support children in their classrooms. First, this poster will focus on enhancing pre-service preparation programs with TIC strategies. By doing so, future early care and education professionals will feel confident and competent in supporting children and families who have experienced trauma. Second, TIC strategies are intended to enhance current practices, with the goal of better supporting children who have experienced trauma. Children who have experienced trauma are more likely to display developmental delays in all areas of functioning, and therefore will work with ECSE providers in multiple settings. Finally, TIC strategies align well with DEC practices. By incorporating TIC strategies with the DEC recommended practices, we will provide examples of ways soon-to-be- ECSE teachers can support children who have experienced trauma. Participants in this poster session will be introduced to the reported knowledge base of ECSE teachers related to trauma-informed care. First, participants will understand the current areas of knowledge related to trauma-informed care and areas of professional development. Additionally, participants will learn about reported barriers and facilitators in implementing trauma-informed care.

## **2. Children with disabilities**

Young children experience trauma at high rates, and children with disabilities are at a greater risk of experiencing it. This content will help ECSE professionals design and implement teacher preparation and professional development opportunities about trauma-informed care, which in turn will increase the quality of care that children with disabilities receive.

## **3. Project Ti3**

By attending this poster, participants will learn about the reported knowledge base of ECSE teachers related to trauma-informed care, including content they know, areas they want to learn more about, and training experiences related to trauma-informed care. By understanding this, teacher preparation courses and professional development opportunities can be tailored to meet these gaps, which in turn increases the quality of care that children who have experienced trauma will receive.

This poster is relevant for faculty who prepare ECSE professionals and is intended to highlight areas of professional development related to trauma-informed care. Trauma-informed care principles can be used to enhance evidence-based teaching for children in ECSE classrooms. Additionally, it is relevant for practitioners as they will learn what type of content should be included in professional development opportunities related to trauma-informed care.

# REVOLUTIONIZING MSI TO R1 GRADUATE PATHWAYS THROUGH DISTRIBUTED TEACHING

**Dwayne C. Joseph**

*Department of Physics & Dual Degree Engineering Program, Morehouse College (USA)*

## Abstract

Morehouse College's Dual Degree Engineering (DDE) program has leveraged its relationship with Michigan Robotics to introduce its students to University of Michigan's undergraduate Robotics curriculum through the development of the Distributed Teaching Collaborative (DTC). The DTC connects students and faculty from Historically Black Colleges and Universities (HBCUs) and other minority serving institutions (MSIs) with doctoral universities that have very high research activities (R1 institutions) to deliver a unifying classroom experience, share distribution of resources, and prepare students for careers in AI. Since Fall of 2022, University of Michigan established a Robotics Department with an undergraduate program that emphasizes excellence in equity. A compelling feature of the department is its highly innovative approach to a robotics curriculum that allows for national scalability through collaborative distributed teaching. The curriculum, developed through active partnerships between Michigan Robotics and several MSIs, is adaptable to the teaching styles of MSI faculty, creating onramps to a robust robotics and artificial intelligence education that prepares students for R1 research experiences and graduate programs regardless of their background or where they are enrolled.

The aim of the DTC model is to build MSI-R1 pathways to graduate programs at R1 universities by establishing collaborative teaching courses that have at least a 90% completion rate due to their social- interactions through student-student, student-instructor, and instructor-instructor interactions. The success of this project will be viewed through the number of students that complete DTC courses, matriculate in graduate programs, and maintain successful careers in STEM longitudinally.

**Keywords:** *Innovation, collaboration, robotics, curriculum.*

---

## 1. Introduction

Since 1969, Morehouse College has offered students the option of studying engineering through the DDE program, which allows them to receive a liberal arts degree from Morehouse and an engineering degree from several engineering institutions with whom Morehouse has a cooperative agreement, including the University of Michigan. Many students choose our DDE program because it allows them to embrace the culture of an HBCU as it instills value of self and confidence, and the opportunity to earn an engineering degree from an R1 institution. Although DDE has been the third largest major at the college for incoming freshmen for the last ten years, very little has been done to update its curriculum since the Cold War ended, which leaves little room to adequately prepare students for rapidly growing technological fields of study.

While our program does well in exposing students to mathematical concepts, principles that govern the universe, and programming languages, little is done to expose our students to the real-world applications of those theories. It has been reported that theory-based courses results in passivity in the classroom, and lack of motivation (Felder, 1993). DDE is the third largest major at the college and yet the retention rate for freshmen DDE students has ranged from 40% - 50% for the past three years. Studies show that poor performance in entry-level science, technology, engineering, and math (STEM) courses is directly proportional to retention in STEM (Dika, *et al.*, 2016). With respect to DDE students, less than 40% of Morehouse freshmen are enrolled in Calculus I which ostensibly increases the number of courses they are required to take and therefore prolongs their transfer process. And the longer their process is prolonged, the less likely they are to remain in the program.

The DDE program's relationship with Michigan Robotics has introduced its students to an undergraduate Robotics curriculum through the development of the Distributed Teaching Collaborative (DTC). DTC, established by Michigan Robotics, connects MSI students and faculty with R1 institutions to deliver a unifying classroom experience, share distribution of resources, and prepare students for careers in AI. The curriculum, developed through active partnerships between Michigan Robotics and several MSIs,

is adaptable to the teaching styles of MSI faculty, creating onramps to a robust robotics and artificial intelligence education that prepares students for R1 research experiences and graduate programs regardless of their background or where they are enrolled. Currently, the DTC has three main objectives:

- Develop and offer Robotics courses at MSIs to serve as a pathway to careers in robotics and AI.
- Develop and promote Robotics Research Experiences for undergraduates (REUs) and offer immediate acceptance to MSI students who have excelled in DTC courses.
- Add more MSIs and R1 institution to the DTC.

## 2. Project goals & approach

The primary goal of the DTC model is not simply to introduce new courses to the DDE curriculum but to change the manner in which they are instructed. Our partnership with the DTC allows our DDE program to reimagine the way mathematics is introduced to engineering undergraduates by integrating various science-based disciplines, thus providing real-world engineering projects. This curricular innovation prepares students to experience computation, mathematics, and science as tools that have them constructing better, safer, more reliable machines while mitigating barriers they may face on the way to a degree.

Studies have identified factors associated with achievement gaps in academic coursework and research experiences supporting scholarly socialization (Posselt et al., 2021). As a result, a longstanding disparity exists in graduate applications and matriculations between undergraduates from MSIs in comparison to other colleges and universities. The introduction of these courses into the DDE curriculum along with the DTC shall address this disparity and produce a replicable model for realizing meaningful systemic change in the innovation ecosystem.

### 2.1. Distributed Teaching Collaborative

The DTC model promotes social interactions through new student-student connections, as well as student-instructor and instructor-instructor interactions. We wish to underline that courses in the DTC are completely different from massive open online courses. The first two offerings in DTC were ROB 101: *Computational Linear Algebra* in partnership with Morehouse College and U-M Robotics in fall 2020; and ROB 102: *AI and Programming* in partnership with Berea College and U-M Robotics in fall of 2021. Even during the heart of the pandemic, 10 of 10 Morehouse students and 34 of 36 Berea students completed these courses. Remaining at a 90 to 95% level of engagement to completion requires a focus on student well-being and success. There is direct communication with faculty across MSIs and partnering R1s to ensure that students have a connected and supportive experience. Financial and technical support is provided for teaching assistants at MSIs as well as providing access to Michigan teaching assistants throughout the day and late into the evening. Moreover, there is access to chat tools, such as Piazza, that encourage students to help one another.

We predict that we will see improved retention in our proposed robotics curriculum due to increased student self-efficacy about engineering tasks and a decision by students to choose an engineering path, as predicted by expectancy-value theory (Wigfield & Eccles, 2000). We are particularly interested in the concrete nature of our integrated robotics curriculum in attracting students from other majors, such as Computer Science, Math, and Physics.

### 2.2. Distributed collaborative courses

Table 1 consists of the proposed courses that will be added to revolutionize our DDE curriculum in the upcoming academic years along with its partnered R1 affiliate. Students who participate in integrated engineering curricula tend to have higher retention rates and report satisfaction (Olds & Miller, 2004). Notably, the effect can be measured explicitly for white women and racial minority students (Frair & Watson, 1997) (Quinn, 1995).

**EGR 151 Programming in Robotics:** This course is designed to show how mathematics and computation are unified for analyzing data and making discoveries about the world. Linear algebra and programming are rapidly becoming the essential foundation for the modern engineer in a computational world. Our DTC aims to break the stranglehold that calculus has on the success rates of our students. As such, this first year course provides students with insights into the applications of linear algebra and its realization in practical computational tools. The mathematical content covered will be built around systems of linear equations, their representation as matrices, and numerical methods for their analyses. These methods will be given life through projects including building 3D maps for robot navigation from LiDAR data and controlling a planar model of a Segway using optimization, and other compelling applications of robotics. ‘

Table 1. Proposed DDE Courses.

Proposed Morehouse Course	Date of Implementation	Partnered R1 Course	Host R1 Institution/Department
<ul style="list-style-type: none"> <li>• <input type="checkbox"/> EGR 151: Programming in Robotics</li> <li>• <input type="checkbox"/> EGR 201: Autonomous Navigation</li> <li>• EGR 351: Applied Optimal Control</li> </ul>	<ul style="list-style-type: none"> <li>• Spring 2024</li> <li>• Spring 2024</li> <li>• Spring 2025</li> </ul>	<ul style="list-style-type: none"> <li>• ROB 101: Computational Linear Algebra</li> <li>• ROB 102: Introduction to AI and Programming</li> <li>• EML 4316: Applied Optimal Control</li> </ul>	<ul style="list-style-type: none"> <li>• U-M/Robotics</li> <li>• U-M/Robotics</li> <li>• FAMU-FSU/Mechanical Engineering</li> </ul>

**EGR 201 Autonomous Navigation:** Students acquire programming skills in the context of robot path planning and navigation which allows robots to observe their environment and then get from point A to point B. The course builds towards providing a broader conceptual foundation for modeling problems as graphs and inferring solutions through search. In artificial intelligence, search algorithms are just as important as data-driven machine learning solutions when it comes to reasoning with machines, and in many cases, a search-based solution is one’s best bet. Students will learn about the foundations of modern intelligent systems through the lens of computational and programming tools.

**EGR 351 Applied Optimal Control:** This course serves as a portal to upper-level mechanical/computer engineering courses with a robotics concentration. It introduces students to numerical applications of optimal control techniques by applying multivariable calculus to a number of dynamical systems. Topics include trajectory/convex optimization, linear-quadratic methods, and model- predictive control with real-world engineering applications.

### 3. Conclusion

The success of our DTC initiative will be measured by:

- The number of Morehouse students that complete DTC courses.
- The diversity of their majors.
- The number of students that matriculate in graduate programs.
- The number of graduates that maintain successful careers in STEM longitudinally.

By completing one of our DTC courses students will be well-prepared for research experiences across robotics. Students completing multiple DTC courses will have exposure to robotics topics at the level of a common Engineering major – approximately constituting a Robotics minor. We will provide opportunities for Morehouse students who participate in DTC courses to connect with research experiences and maintain a sense of community. For interested DTC partners, we will work to establish best practices for implementing robotics curricula, certifications, and degree programs that leverage DTC courses. We envision that this effort will enable robotics degree pathways to be more widely available to more students at more schools within constraints for manageable teaching bandwidth.

### References

Dika, S. L. & D’Amico, M. M. (2016). Early experience and integration in the persistence of first- generation college students in STEM and non-STEM majors. *J. Res. Sci. Teach.* 53, 368-383.

Felder, R. (1993). Reaching the second tier: Learning and teaching styles in college science education. *J. College Science Teaching*, 23(5), 286-290.

Frair, K. & Watson, K. (1997). The NSF foundation coalition: Curriculum change and underrepresented groups. *ASEE Peer.* 2.421.1-2.421.7

Olds, B. M. & Miller, R. L. (2004). The effect of a first-year integrated engineering curriculum on graduation rates and student satisfaction: A longitudinal study. *J. Eng. Educ.* 112(2), 23-35.

Posselt, J., Baxter, K., & Tang, W. (2021). *Assessing the landscape for diversity, equity, and inclusion efforts in U.S. STEM graduate education: A Systematic literature review.* University of Southern California, Pullias Center for Higher Education.

Quinn, R. (1995). Implementing large scale curriculum changes – The Drexel experience. *Proceedings of the 1995 Frontiers in Education Conference.*

Wigfield, A. & Eccles, J. (2000). Expectancy-value theory of Achievement motivation. *Contemporary Educational Psychology*, 25(1), 68-81.

## EXPLORATION OF THE TEACHING METHOD OF THE COURSE "CIRCUIT ANALYSIS AND ANALOG CIRCUITS"

Hua Fan<sup>1,2,3</sup>, Tianchi Yang<sup>2</sup>, Jianming Liu<sup>4</sup>, Zonglin Li<sup>4</sup>, Xinkai Guo<sup>3</sup>, & Yan Sun<sup>3</sup>

<sup>1</sup>Chongqing Institute of Microelectronics Industry Technology, UESTC, Chongqing (China)

<sup>2</sup>School of Integrated Circuit Science and Engineering, University of Electronic Science and Technology of China, Chengdu (China)

<sup>3</sup>Institute of Electronic and Information Engineering of UESTC in Guangdong, University of Electronic Science and Technology of China, Dongguan (China)

<sup>4</sup>Chengdu Sino Microelectronics Technology Co., Ltd., Chengdu (China)

### Abstract

The "Circuit Analysis and Analog Circuits" is an important course for electronics majors. The content of the course is the foundation of many senior courses and has a wide range of applications. The theoretical knowledge is usually taught in the classroom, but simulation and practice are completed in the experimental course. This paper attempts to propose some improvement methods which can effectively combine theory with practice, and at the same time, it is more beneficial to the cultivation of students' engineering practice ability.

**Keywords:** Analog Circuit, curriculum design, simulation, engineering skills.

---

## 1. Introduction

The "Circuit Analysis and Analog Circuits" course for undergraduates is usually difficult to obtain a better teaching effect due to its difficulty, wide range of knowledge, and strong practicality. In the traditional teaching method of this course, the theory teaching is usually carried out first, then the simulation is completed through homework, finally carries out the verification experiment of the circuit function module in another experiment course. This has brought certain difficulties for students to master this course. If we can put theoretical teaching, simulation, and physical verification closer together, it will enhance teaching in engineering practice, improve learning efficiency.

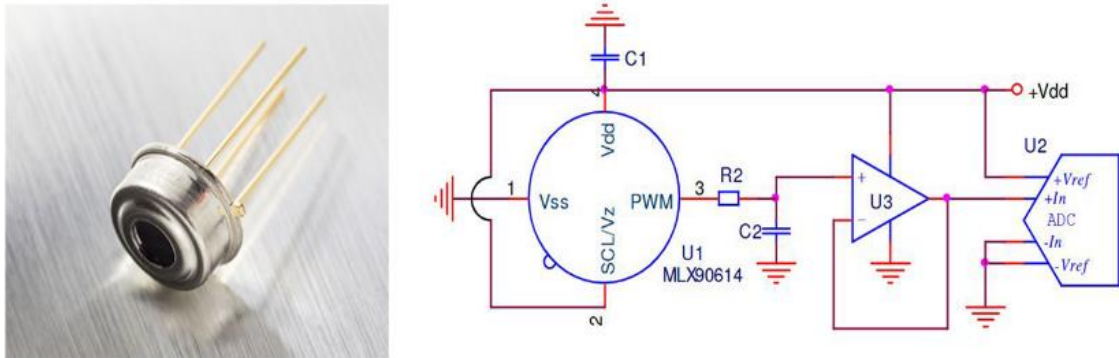
## 2. Improvement of teaching methods in the classroom

### 2.1. Preview

"Circuit Analysis and Electronic Circuits" course has many contents and out of practice. When introducing topics, some practical applications close to daily life are usually used to arouse students' interest. Operational Amplifiers (Op-Amp) (Konar, Sahu, and Kundu, 2019) are widely used in analog circuits and can be found in many electronic devices. In the design of integrated circuits, Op Amp, as a necessary basic module, also plays a wide range of roles. It is often integrated into many other chips such as Analog-to-Digital Converters (ADC), etc. For example, before the lecture on "Active low-pass filter composed of Op-Amp (Rong, Yu, and Luo, 2010)", we used the case of the infrared digital thermometer in the tutorial. Due to COVID-19, non-contact temperature measurement has become an effective help to control the spread of the virus. Figure 1 shows an application circuit given in the application manual when using the analog output mode of the Melexis MLX90614 sensor for non-contact temperature measurement. This example can immediately let students understand how the course they are about to learn will change real life.



Figure 1. MLX90614 (left) and its application circuit with LPF (right).



## 2.2. Perform circuit simulation effectively

In each class, we will select some important circuits for simulation. After explaining how this circuit works, to make it convenient for every student to experience the simulation immediately in the classroom, a new classroom teaching method based on EasyEDA simulation was put into practice. EasyEDA is a circuit design, simulation software that runs in a modern browser without installation.

Figure 2. Run simulation on mobile phone with EasyEDA (Screenshots).

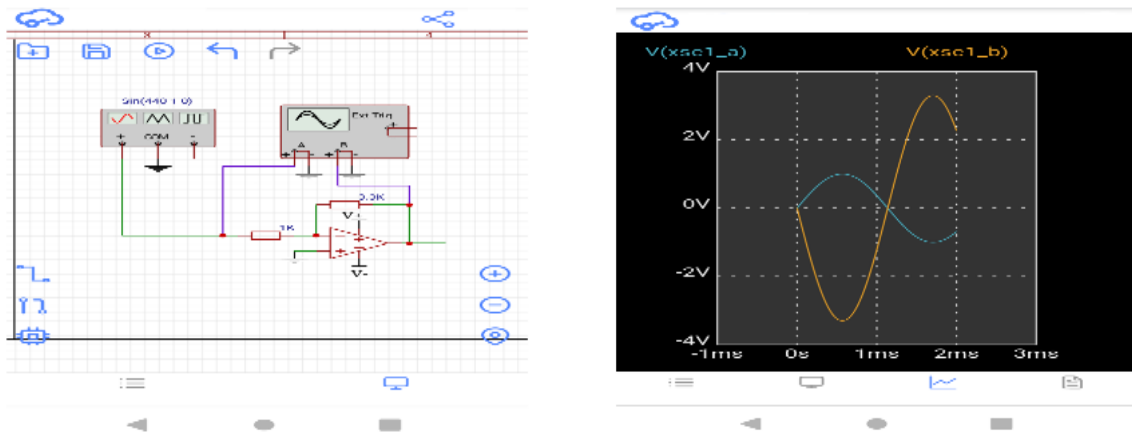


Figure 2 shows the effect of opening a circuit designed by EasyEDA in a mobile browser. This circuit is an amplifier made with an Op-Amp. Compared with playing simulation video on ppt, or just showing simulation by the teacher, this can bring students closer to the circuit, allowing students to understand the circuit as soon as possible through their hands.

## Acknowledgements

The work of Hua Fan was supported by Sichuan Science and Technology Program under Grant 2022YFG0164 and supported by Medico-Engineering Cooperation Funds from University of Electronic Science and Technology of China under Grant ZYGX2021YGLH203, and supported by general project of Chongqing Natural Science Foundation under Grant 2022NSCQ-MSX5348, and supported by Guangdong Basic and Applied Basic Research Foundation under Grant 2023A1515010041.

*References*

- Konar, M., Sahu, R. and Kundu, S. (2019). Improvement of the Gain Accuracy of the Instrumentation Amplifier Using a VeryHigh Gain Operational Amplifier. 2019 *Devices for Integrated Circuit (DevIC)*, pp. 408-412.
- Rong, F., Yu, J. and Luo, A. (2010). Reference Current Computation Method Based on Adaptive Low-Pass Filter for Active Power Filter. 2010 *International Conference on Measuring Technology and Mechatronics Automation*, pp. 996-999.

## MEASURING SELF-REGULATED LEARNING IN STUDENTS WITH/WITHOUT CARE-RESPONSIBILITIES TO PUSH GENDER EQUITY

**Luzi M. Beyer, & Annina Böhm-Fischer**

*Department for Methods of quantitative research in social and health care,  
Alice Salomon University of Applied Science (Germany)*

### Abstract

Online Learning can be an opportunity to improve equity for students with caregiving responsibilities, who are mostly females. However, whether there are differences in learning preferences (e.g., desire for self-directed learning), academic self-assessment (e.g., assessing one's own progress), and motivation to learn (e.g., interest in learning new things) in digital courses is poorly understood. Therefore, it is difficult to address the needs of caregiving students, as their commitments and needs are often invisible in eLearning courses.

For this reason, a self-regulated learning questionnaire (24 questions in total) was compiled from existing questionnaires, supplemented with demographic questions, and collected in 3 consecutive semesters (N = 195).

Unfortunately, not all three facets had acceptable internal consistencies (Cronbach's alpha learning preferences = .654, academic self-assessment = .869, motivation to learn = .670). The intercorrelations were all positive as expected and only the intercorrelation of learning preferences and learning motivation was not significant.

The study revealed that students with care responsibilities (n = 32) do not differ in learning preferences and academic self-assessment. Thus, they cope with the demands of eLearning as well as their peers. However, they had significantly higher learning motivation than students without care-responsibilities (n = 163).

The results suggest that for students, time (rather than learning preferences or self-assessment) is a primary barrier to studying, and institutional awareness of the needs of students with care obligations needs to be raised so that they are not demotivated by unnecessary hurdles. This would improve equity and gender equality.

**Keywords:** *Student diversity, higher education, elearning, self-regulated learning.*

---

### 1. Introduction

One factor that has long caused discrimination is the dissolution of typical successive definable life stages such as study and parenthood (Wilson & Rosen, 1999). There has long been evidence that parenthood, especially for women, leads to a prolongation of studies (Cornelissen & Fox, 2007), poverty during studies, and higher dropout rates (Lörz & Mühleck, 2019). When considering not only caregiving responsibilities for children, but informal caregiving in general (e.g., for elderly, ill, and/or dependents in need of assistance), caregivers in the higher education context are significantly more likely to identify as female overall (Armstrong-Carter et al., 2022). Time is cited as a limiting factor for study by these students (Lindsay & Gillum, 2018). Study difficulties often result from time and formal constraints, compulsory attendance, and submission deadlines (Terzieva et al., 2016).

Current figures also show that caregiving responsibilities during the pandemic have reduced spatial and temporal flexibility and resulted in overlapping responsibilities (Parrish, Negi, & Mogro-Wilson, 2021). To estimate the relevance of the topic for the future, it is also important to consider that the proportion of students with caregiving responsibilities will continue to increase due to demographic changes and cost trends for child care and nursing positions (Schwinger, 2022). These students benefit from inclusive course offerings such as blended learning (Andujar & Nadif, 2022).

If a course offers more flexibility and freedom, this goes hand in hand with the fact that students have to organize and structure themselves independently and learn by themselves. Under the German

concept "Selbstlernkompetenz" (self-learning competence) the abilities and skills for independent planning, realization, evaluation and adaptation of learning processes are united (Aisenbrey, et al., 2003).

## 2. Methods

The German concept of self-learning competency has great overlaps with the construct "self-regulated learning" (SRL) rooted in cognitive psychology and "self-directed learning" (SDL) rooted in adult education. Therefore, all items of the two established SDL questionnaires (SDLRS and OCLI) as well as two accepted questionnaires to assess SRL (MSLQ and LASSI) were included in the primary item pool. Furthermore, the two German questionnaires KKB and KL-SLK were included in the primary item pool. In a joint iterative workshop of the authors, items focusing on motivation, metacognition, and self-regulation were extracted, outdated wording was removed, and duplications were eliminated. The final questionnaire had 24 questions in total (9 questions on learning motivation, 9 questions on learning-related self-assessment/metacognition, and 6 questions on learning preferences/self-regulation) and was supplemented with demographic questions and questions about caregiving responsibilities as well as work commitments and other stresses (e.g., chronic illnesses). Due to data protection regulations, the questions were voluntary and could only be answered with "yes/no" as the response format. In three consecutive semesters (summer semester 2021 and 2022 and winter semester 2021), 201 questionnaires were collected, 195 of which were filled out with questions about caregiving responsibilities (N = 195).

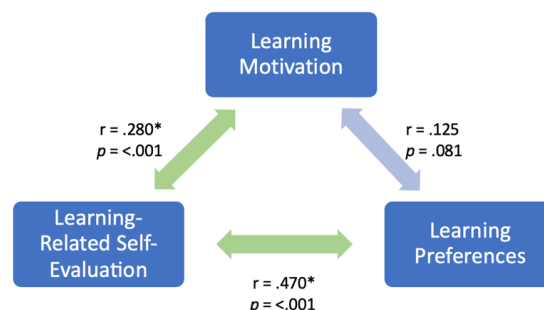
## 3. Results

The learning motivation scale achieved an internal consistency of .670 (Cronbach's alpha, N = 195) when all 9 items were evaluated together. Omitting the ninth item ("I study because I have to take an exam.") could increase the internal consistency to .691 (Cronbach's alpha, N = 195).

The Learning-Related Self-Assessment scale (9 items, N = 194) had a Cronbach's alpha of .869, which would not be increased by omitting individual items.

The scale Learning Preferences (6 items, N = 194) contains one item that is negatively poled in terms of content (desire for self-directed learning) ("For me, a predetermined structure is helpful."). This item was re-poled before further calculations. The Learning Preferences scale (6 items) had a Cronbach's alpha of .654, which would increase to .666 if one item ("For me, a predetermined structure is helpful.") was omitted. The shortened Learning Motivation scale had an overall mean of 4.64 (SD = 0.88, N = 195), Learning-Related Self-Evaluation had a mean of 4.66 (SD = 1.04, N = 194), and the shortened Learning Preferences scale had a mean of 3.25 (SD = 0.62, N = 195). The shortened total learning motivation scale (8 items), the learning-related self-assessment scale (9 items), and the shortened total learning preferences scale (5 items) were used to calculate intercorrelations. The Learning Motivation scale correlated significantly positively with the Learning-Related Self-Evaluation scale ( $r = .280$ ,  $p < .001$ , N = 194). Learning-Related Self-Evaluation correlated significantly positively with Learning Preferences ( $r = .470$ ,  $p < .001$ , N = 194). As expected, the correlation of the scales Learning Motivation and Learning Preferences is mildly positive but not significant ( $r = .125$ ,  $p = .081$ , N = 195, see Figure 1).

Figure 1. Intercorrelations of the three scales incl. significances (significant intercorrelations are green, non-significant intercorrelations are grey).



The subsequent t-test compared students with care responsibilities (n = 32) with students without care responsibilities (n = 163). This showed that students with and without care responsibilities do not differ in their learning preferences  $t(193) = -0,629$ ,  $p = .265$ , and in their academic self-assessment,  $t(192) = -0,680$ ,  $p = .249$ . However, students with care responsibilities had significantly higher learning motivation than students without care responsibilities,  $t(193) = -1,851$ ,  $p = .033$ .

#### 4. Discussion / conclusions

It is worth discussing that two of the three scales have only insufficient internal consistencies. This is regrettable, but unfortunately not surprising. For example, the LASSI has some inconsistent and unstable scales (Flowers, 2003), in the OCLI the factor structure is unclear (Mottonen, 2019), in the MSLQ the reliability coefficients are sometimes low (Taylor, 2012), and the postulated component structure of the SDLRS has not been empirically confirmed (Straka, 1995).

The insufficient internal consistencies are worth discussing. They could be responsible for the fact that the intercorrelation between the scales learning motivation and learning preferences did not become significant. Furthermore, it is possible that the t-test only became significant for one facet of self-learning competence because of the lack of internal consistency. Nevertheless, the results suggest that students with supervisory responsibilities cope with the demands of eLearning just as well as their peers, and they are highly motivated.

Together with the current results, this raises the question of whether self-reports are suitable for exploring self-regulatory processes and perceptions. Furthermore, the question arises whether and to what extent (internal and external) processes and (non-) learnable competencies can be researched independently of each other. The difficulty of this distinction is also shown by the sometimes synonymous use of the terms "self-regulated learning" (SRL) and "self-directed learning". It is therefore concluded that the acceptance of diversity by students is extremely important, because only when difficult learning situations are taken into account, a university is inclusive. Diversity should not only be seen as an advantage by the students themselves but there should be more awareness of the actual benefits to all students as well as to the university and research should continue to be done to ensure that diversity does not lead to disadvantages.

#### References

- Aisenbrey, P., Dürr, W., Heinz, W., Jäger, R., Jäger-Flor, D., Knoll, J., & Nicklas, F. (2003). 2. Zwischenbericht der wissenschaftlichen Begleitung des BLK-Modellversuchsprogramms „Lebenslanges Lernen“.
- Andujar, A., & Nadif, F. Z. (2022). Evaluating an inclusive blended learning environment in EFL: a flipped approach. *Computer Assisted Language Learning*, 35(5-6), 1138-1167.
- Armstrong-Carter, E., Panter, A. T., Hutson, B., & Olson, E. A. (2022). A university-wide survey of caregiving students in the US: Individual differences and associations with emotional and academic adjustment. *Humanities and Social Sciences Communication*, 9(1), 1-10.
- Cornelissen, W., & Fox, K. (2007). *Studieren mit Kind: Die Vereinbarkeit von Studium und Elternschaft: Lebenssituationen, Maßnahmen und Handlungsperspektiven*. Wiesbaden: VS Verlag für Sozialwissenschaften.
- Flowers, L. A. (2003). Test-retest reliability of the learning and study strategies inventory (LASSI): New evidence. *Literacy Research and Instruction*, 43(1), 31-46.
- Lörz, M., & Mühleck, K. (2019). Gender differences in higher education from a life course perspective: transitions and social inequality between enrolment and first post-doc position. *Higher Education*, 77(3), 381-402.
- Mottonen, A. L. (2019). Self-Directed Learning: A Unitary Or Multidimensional Construct? *Conference of the Canadian Society for the Study of Education*.
- Parrish, D. E., Negi, N., & Mogro-Wilson, C. (2021). The hidden cost of caregiving during the pandemic. *Journal of Social Work Education*, 57(2), 211-214.
- Ruff, L. (2021). *Examining the Experiences of Social Belonging and Campus Integration for Parenting Undergraduates*. Capella University: Doctoral dissertation.
- Schwinger, A. (2022). Die Langzeitpflege nach der Wahl: Kommt sie nun, die „große Pflegereform“? *Gesundheits- und Sozialpolitik (G&S)*, 75(6), 50-57.
- Straka, G. A. (1995). *Problems of Measuring Self-Directed Learning Readiness*.
- Terzieva, B., Dibiasi, A., Kulhanek, A., Zaussinger, S., & Unger, M. (2016). *Zur Situation behinderter, chronisch kranker und gesundheitlich beeinträchtigter Studierender: Quantitativer Teil der Zusatzstudie zur Studierenden-Sozialerhebung 2015; Endbericht*. Institut für höhere Studien.
- Wilson, S., & Rosen, R. (1999). Work, study, family: Undergraduates with dependent care responsibilities. *The Canadian Journal of Infancy and Early Childhood*, 7(4), 349, 7(4), 349-356.

# GENERATIONAL INTELLIGENCE AS AN INTEGRAL ASPECT OF PRE-SERVICE TEACHERS' INTERPERSONAL COMMUNICATION COMPETENCE

**Tai-Fen Chen, Daniel Chia-En Teng, & Ho-Yuan Chen**  
*Graduate Institute of Education, Tunghai University (Taiwan)*

## Abstract

Interpersonal communication is widely recognized as an important skill for success in personal and professional settings and is listed as a core competency in many educational frameworks around the world. Interpersonal communication is also a critical skill for teachers to establish and maintain cooperative relationships. As several East Asian countries have made the transition to an aging society, intergenerational communication has become a pressing need for teachers, as many students' primary caregivers are their grandparents, which is especially the case in rural areas.

Teacher education usually emphasizes communication with students, their parents, and colleagues. However, interaction with older people is neglected. Clearly, teachers of the younger generation should have intergenerational knowledge and skills. This article reviews publications on intergenerational communication and presents an example of a communication accommodation theory to cultivate college teachers' perspectives when interacting with a heterogeneous group of people, the elderly. The results and findings of the activities shed light on the design of interpersonal communication activities in teacher education.

**Keywords:** *Generational intelligence, intergenerational communication, interpersonal communication, Communication Accommodation Theory.*

---

## 1. Background

Countries worldwide are gradually moving toward aging societies. According to population statistics from EUROSTAT (2020), countries such as Germany (22%), France (20.7%), Sweden (20.1%), Italy (23.5%), and Japan (28.7%) already have an older population of over 20%. In addition, countries such as Spain (19.8%), the Netherlands (19.8%), Austria (19.2%) and Taiwan (17.7%) are experiencing rapid increases in the aging population. As the elderly population increases in various countries, it also becomes an urgent issue in education reforms. Promoting awareness and understanding of the elderly through education systems is essential.

Generational intelligence (Biggs, Haapala, & Lowenstein, 2011) refers to the ability to understand and communicate effectively with people from different generations. It involves understanding the values, beliefs, and communication styles of different generations. In teaching, generational intelligence is crucial, as it helps teachers communicate effectively with their students, colleagues, and students' parents/grandparents from different generations. Generational intelligence involving multiple generations with purposeful and progressive methods that lead to mutual learning outcomes is beneficial to all relevant generations (European Association for the Education of Adults, 2012), especially in an aging society.

The transmission of knowledge, skills, and values from one generation to another fosters reciprocal and mutual relationships through intergenerational partnerships. Intergenerational interactions have the capacity to reduce the sense of unfamiliarity the younger generation may have towards the elderly. Those who frequently interact with elderly individuals are more likely to have a positive attitude towards them. Consequently, intergenerational activities that facilitate sharing of knowledge and skills are essential in constructing a harmonious society based on respect and understanding among different generations (Wermundsen, 2007).

Interpersonal communication refers to the exchange of information between two or more individuals, usually within the same age group or social circle. It has been identified as a critical communication skill (Dede, 2010; Pearlman, 2010; Trilling & Fadel, 2009) and considered a foundational

effort of organizational success and human relations, which focused on building and maintaining relationships between individuals (Frantz & Misal, 2016).

Intergenerational communication, on the other hand, involves communication between individuals from different age groups, often with different cultural backgrounds and experiences (McCann, Giles, & Ota, 2017). Intergenerational communication is more complex and multifaceted, involving a range of factors such as language, culture, and social norms, while interpersonal communication is more focused on building and maintaining relationships between individuals (Frantz & Misal, 2016). In educational settings, intergenerational courses necessitate educators to develop skills in guiding individuals from different generations to engage in effective communication and interaction. Teachers who provide young students with an understanding of older people can help reduce ageism and stereotyping. Teachers need to have generational intelligence that goes beyond generational conflict or unity to explore intergenerational capacities. They should guide students to take a perspective from different age groups (Biggs & Lowenstein, 2011) and encourage intergenerational communication and interaction (Worthington, Nussbaum, Bergstrom, 2018).

The Communication Accommodation Theory (CAT) is a multifunctional theory that focuses on the characteristics of group and interpersonal relationships, making it a cross-cultural communication theory (Gallois, O'Garra, Giles, 2005). What distinguishes CAT from other communication theories is its expanded focus, encompassing both convergence and divergence/maintenance as regulatory strategies, which lead to the production or reception of certain internal or external concepts. These strategies extend to the entire communication process within a multi-generational environment and contribute to integrating and interpreting communication situations between different generations (Coupland, Coupland, & Giles, 1991; Williams & Nussbaum, 2001).

This study explored how the researcher incorporated learners from different age groups in the class and guided intergenerational communication activities. It was found that pre-service teachers' attitudes toward the elderly changed, and their understanding and empathy toward the elderly were improved. The insights of the findings shed light on future studies of generational intelligence that pre-service teachers should have as an integral part of their interpersonal communication skills.

## **2. Methodology**

Seventeen undergrad pre-service teachers and 15 community-dwelling elderly aged 55 and above participated in the course. The course was to create opportunities for extensive dialog, mutual learning, and respect through intergenerational learning strategies to understand better one's own perceptions, emotions, and attitudes toward the elderly over the 18-week curriculum. The researcher and a trained assistant conducted classroom observations and follow-up interviews.

Mixed-age groups were formed that focused on various activity designs, including thematic discussions and on-site learning to create opportunities for intergenerational interactions and conversations. Discussion topics included social context issues, value sharing, inheritance of experiences, meaning of life, and travel learning. This allowed for communication between generations to understand the various conceptual differences and learn to understand and respect each other's points of view. By reflecting on the experience, students had the opportunity to examine their own insights, emotions, and attitudes about intergenerational communication.

## **3. Research findings**

Based on the observation and interview, the researchers found the intergenerational learning process in the course. And pre-service teachers of the young generation did cultivate generational intelligence.

While having expectations for the course, pre-service teachers may still be concerned about potential barriers with older adult learners. However, some students have realized that there are valuable insights to gain from them and have experienced the proactive and enthusiastic attitudes of the older generation surpassing their own.

The elderly students were more willing to share and tap into pre-service teachers' preference for learning. Through intergenerational interactions, young students are able to gain a wealth of implicit knowledge related to the workplace from the sharing of older adults.

Values were derived from the context of generational backgrounds. Because the impressions of older adults were mostly formed by pre-service teachers' experiences in their own families, they tended to develop preconceived stereotypes about the elderly. Some young students seemed to be struggling to perceive the older generation's early lifestyle and work experiences. However, through empathy and understanding, they could appreciate older adults' thoughts and values and construct their own

perspectives on aging individuals. Similarly, when older adult learners expressed stereotypical impressions of young people, it can easily be led to young students rekindling negative attitudes toward older individuals, especially when discussing the topics like friendship and marriage.

Through students' weekly journals, it was found that pre-service teachers realized some inherent similarities in perspectives or behaviors between elderly classmates and their own family members. Interacting with elderly students in the class also led to reflections on their own ancestral relationships and the roles and responsibilities they have not yet fulfilled as the younger generation. This process generated empathy and allowed them to perceive the values and experiences of the elderly students, thereby influencing themselves.

#### 4. Conclusion

Teachers nowadays should be aware of intergenerational desires for societal recognition and willingness to share ideas. They should fulfill the needs of cross-generational parents/grandparents in terms of conversation and interaction and appropriately guide the communication alongside the topics they are proficient in. When facing a cross-generational audience, teachers should understand the concerns and limitations of interaction with different generations, especially when they observe deviations in verbal or non-verbal expressions in cross-generational messages. They should be able to recognize the emotions in the interactions and seize appropriate opportunities to facilitate dialogue between cross-generational parties.

#### References

- Biggs, S., Haapala, I., & Lowenstein, A. (2011). Exploring generational intelligence as a model for examining the process of intergenerational relationships. *Ageing & Society*, 31(7), 1107-1124.
- Dede, C. (2010). Comparing frameworks for 21st-century skills. In J. Bellance & R. Brandt (Eds.), *21<sup>st</sup> Century Skills: Rethinking How Students Learn* (Chapter 3). Bloomington, IN: Solution Tree Press.
- European Association for the Education of Adults(2012).*European Network for Intergenerational Learning* .[https://:eaea.org](https://eaea.org)
- EUROSTAT (2020). *EU key indicators*. [https://:www.ec.europa.eu/eurostat](https://www.ec.europa.eu/eurostat)
- Frantz, A., & Misal, A. (2016). Essential generic skills for human resources in hospitality: A literature review. *International Journal of Business and Administrative Studies*, 2(5), 124-128.
- Gallois, C., O'Gay, T., & Giles, H. (2005). Communication accommodation theory: A look back and a look ahead. In W. B. Gudykunst (Ed.) *Theorizing about intercultural communication*. (pp.121-148). Thousand Oaks: Sage.
- McCann, R. M., Giles, H., & Ota. (2017). Aging and communication across cultures. In L. Chen (Ed.), *The handbook of intercultural communication* (pp. 289–306). Berlin: Mouton de Gruyter.
- Pearlman, B. (2010). Designing new learning environments to support 21st-century skills. In J. Bellance & R. Brandt (Eds.), *21<sup>st</sup> Century Skills: Rethinking How Students Learn* (Chapter 6). Bloomington, IN: Solution Tree Press.
- Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. San Francisco, CA: Jossey-Bass.
- Wermundsen T. (ed.) (2007). *Intergenerational Learning in Europe: Policies, programmes & Initiatives*. Erlangen: FIM-NewLearning, University of Erlangen-Nuremberg.
- Williams, A., & Nussbaum, J. F. (2001). *Intergenerational communication across the life span*. Lawrence Erlbaum Associates Publishers.
- Worthington, A.K., Nussbaum, J. F., Bergstrom, M.J. (2018). *Intergenerational Communication*. Oxford Bibliographies. doi: 10.1093/OBO/9780199756841-0217



## ENTREPRENEURSHIP COMPETENCIES IN HIGH SCHOOL STUDENTS: EFFECTS OF AGE AND GENDER

Eric Yergeau, & Marcelle Gingras

*Faculty of Education, University of Sherbrooke (Canada)*

### Abstract

Entrepreneurs are more than ever very important economic actors in all societies. In many countries such as Canada, governments are mobilizing school curricula to include activities aimed to develop entrepreneurship competencies in high school students. However, there is no clear data on the actual level of these competencies among high school students. This comparative study examines levels of entrepreneurship qualities in a sample of  $n=5527$  high school students from the province of Québec and compares results with  $n=5309$  adult subjects. Entrepreneurship is measured with the Entrepreneurship Qualities Questionnaire (EQQ, L'Heureux, 2000) which contains 59 items grouped in 6 continuous scales (Commitment, Motivation, Result-oriented, Creativity, Self-competition, Leadership). Results of univariate ANOVAs show a clear and strong linear relationship with age on all entrepreneurship scales. High school students have the lowest scores and older adults have the highest. There is some small effect of gender. These results suggest the importance of entrepreneurship contents in high school curricula in order to give opportunities for students to develop the fundamental competencies for becoming successful entrepreneurs.

**Keywords:** *Entrepreneurship, high school students, gender effect, age effect, quantitative measure.*

---

### 1. Context

Entrepreneurship competencies refer to the skills, knowledge, and abilities that individuals need to successfully start, manage, and develop a business venture. These competencies have been widely studied in the academic literature, and several frameworks have been proposed to categorize them. One commonly referenced framework, proposed by Audretsch and Lehmann (2005), identifies eight core entrepreneurship competencies: opportunity identification, innovation, proactiveness, autonomy, risk-taking, self-efficacy, networking, and learning. Another framework, proposed by Stevenson (1985), identifies four key competencies for entrepreneurs: conceptual, human, network, and financial. Additionally, a more recent study by Edelman, Watson and others (2015) defines the following 8 entrepreneurship competencies: 1) opportunity recognition, 2) business acumen, 3) creativity and innovation, 4) interpersonal and communication skills, 5) strategic thinking and planning, 6) resilience and persistence, 7) networking and relationship-building and 8) financial management. All these frameworks, however, underline that it is a combination of various abilities and traits that make an entrepreneur successful. These models have inspired some high schools to offer some basic training in entrepreneurship to students.

The Quebec Secondary School Training Program (MEES, 2019) contains various components related to entrepreneurship that overlap with the forementioned frameworks. These include the General Domain of Vocational and Entrepreneurship Training, which is used to contextualize the students' learning; cross-cutting skills such as Effective Work Methods, Cooperation, and Problem Solving; the Entrepreneurship Awareness Domain of Learning; and pedagogical approaches such as project-based learning. Other devices related to the school curriculum, such as the *OSEntreprendre* challenge (<https://www.osentreprendre.quebec/>), also allow students to learn about entrepreneurship and showcase their entrepreneurial initiatives. However, except for a few studies (Champy-Remoussenard and Starck, 2018; Fayolle, 2012; Lapointe et al., 2010; Pepin, 2011; Samson and Morin, 2013; Surlemont and Kearny, 2009), little research has been conducted to evaluate the entrepreneurial characteristics of students beforehand or afterwards. Such studies are of great importance in developing a sense of entrepreneurship among young people and, above all, in better preparing them to face the challenges of the job market and society. Question remains though regarding the role of age and gender on development of entrepreneurship competencies. This study aims to examine these relations.

## 2. Methods

The participants have answered voluntarily and anonymously to the online version of the ECQ between 2016 and 2023. The ECQ is available free online to the general population and is often suggested by teachers and guidance counselors. All scores are computed electronically. There has been no subject recruiting, so this is a convenience sample of 10,836 persons who answered the online questionnaire on entrepreneurship. 5527 were youth, 2284 are young adults (18-30 y/o) and 3025 persons are over 30 years old. There are 6464 women and 4372 men.

The Entrepreneurship Competencies Questionnaire (ECQ; L'Heureux, Dupont & Gingras, 2016) is a self-reported instrument including 59 items assessing a range of perceived behaviors and attitudes related to entrepreneurship. Respondents must determine the level of self-correspondence for each item on a 4-point scale from "not at all" to "totally" corresponding. The ECQ results in a total score and 6 specific scales scores: 1) Energy/commitment, 2) Motivation, 3) Results oriented, 4) Initiative/creativity, 5) Self-competition and 6) Leadership. The higher the score on a scale, the more competency on that dimension is being perceived by the subject. The ECQ total score has a very good homogeneity ( $\alpha=.95$ ) as the 6 dimensions scores with Cronbach's alpha between .75 and .86.

All analysis is made with SPSS25 and consist of classic descriptive statistics with table means having the gender and age variables as factors. Effects of gender and age are examined with individual models of ANOVA factorial design (2 x 3) including both simple effects of factors and the interaction of these factors (gender x age). Six models are produced for each of the ECQ scales and one model is produced for the total score.

## 3. Results

Table 1 presents means of each ECQ scale for the entire sample and for subgroups of age and gender category. Visual appreciation of descriptive results shows that ECQ scores do not vary much due to gender but it seems scale scores are higher for adults comparing to younger subjects. Variation coefficients for all distributions oscillate around 15%.

Table 1. Descriptive statistics of ECQ scales by age group and gender (n=10,836).

Scales	Age group			Gender		Total
	High School	Young adults	Adults	M	F	
<b>1. Energy/Dedication</b>	27.7 (4.9)	28.0 (4.9)	29.5 (4.7)	28.3 (4.9)	28.2 (4.9)	28.3 (4.9)
<b>2. Motivation</b>	40.5 (6.1)	41.5 (6.1)	43.1 (5.9)	41.4 (6.4)	41.5 (6.1)	41.4 (6.2)
<b>3. Results oriented</b>	39.9 (6.2)	40.7 (6.1)	41.9 (6.1)	40.6 (6.4)	40.6 (6.1)	40.6 (6.2)
<b>4. Initiative/Creativity</b>	31.4 (5.7)	32.5 (5.7)	34.4 (5.5)	32.6 (5.8)	32.4 (5.8)	32.5 (5.8)
<b>5. Self-competitiveness</b>	21.4 (3.9)	22.0 (3.7)	22.5 (3.6)	21.8 (3.9)	21.9 (3.7)	21.8 (3.8)
<b>6. Leadership</b>	18.4 (3.7)	18.6 (3.6)	19.2 (3.4)	18.5 (3.7)	18.8 (3.5)	18.6 (3.6)
<b>7. Total score</b>	179.3 (26.3)	183.3 (26.0)	190.6 (25.7)	183.3 (27.4)	183.3 (26.0)	183.3 (26.5)

Table 2 reports summary results of the set of factorial ANOVA done on the 6 ECQ scales and total score. All models are statistically significant ( $p<.001$ ). Results show an overall highly significant effect of age on every perceived competency, some effect of gender and only one significant interaction effect. For all scales, post hoc analysis reveal that the age effect reflects significantly higher scores for the older adults regarding the high school youth and young adult groups. The two younger groups have similar lower mean scores. Partial eta-square suggest small to medium sized effects. The effect of gender on scores is significant but trivial (eta-squares around 0.001) due to the high statistical power inherent to such large sample. The only significant interaction implies that men are slightly more creative than women in the two youngest groups but this difference disappears in the oldest group. The effect size of this interaction is trivial (eta-square = 0.001).

Table 2. Summary of factorial ANOVAs on ECQ scales and total score (n=10,836).

Scales	Source of variation (F values)			
	AGE	GENDER	AGE x GENDER	Model
1. Energy/Commitment	127.94***	14.96***	1.01	63.32***
2. Motivation	164.06***	13.91***	1.85	77.56***
3. Results oriented	83.61***	6.46**	1.09	40.44***
4. Initiative/Creativity	230.28***	30.32***	6.02**	118.96***
5. Self-competitiveness	80.63***	1.29	1.20	38.51***
6. Leadership	440.24***	58.15	1.67	21.88***
7. Total score	157.84***	10.41***	2.19	77.48***

Note: \* p<0.05 \*\* p<0.01 \*\*\* p<0.001

#### 4. Conclusion

There is a clear effect of age on perceived levels of all entrepreneurship competency scales. Even if the effect size is relatively modest due to the enormous statistical power of the study design, it appears that maturation and experience are related to stronger entrepreneurship competencies. The very small effect of gender suggests that entrepreneurship competencies are developed largely in a similar fashion and level by both men and women through all age categories. This study supports the relevance of implementing high school programs with academic contents and projects related to developing entrepreneurship competencies. Higher perceived competencies at a younger age would probably equate with more entrepreneurial activity in young adults.

#### References

- Audretsch, D. B., & Lehmann, E. E. (2005). *Handbook of entrepreneurship research: An interdisciplinary survey and introduction*. Springer.
- Champy-Remoussenaud, P. & Starck, S. (dir.). (2018). *Apprendre à entreprendre. Politiques et pratiques éducatives*. Bruxelles: De Boeck.
- Edelman, L. F., Watson, J. & al. (2015). Entrepreneurship education: known worlds and new frontiers. *Journal of Small Business Management*, 53(4), 479-496.
- Fayolle, A. (2012). *Entrepreneuriat. Apprendre à entreprendre*. Paris : Dunod.
- Lapointe, C., Labrie, D. & Laberge, J. (2010). *Les effets des projets entrepreneuriaux à l'école sur la réussite scolaire et professionnelle des jeunes : l'expérience québécoise*. Rapport de recherche soumis au Secrétariat à la jeunesse, Québec, Centre de recherche et d'intervention sur la réussite scolaire (CRIRES), Université Laval.
- L'Heureux, D., Dupont, P. & Gingras, M. (2016). *Évaluation de mes qualités entrepreneuriales*. Québec : Septembre éditeur, Centre de transfert pour la réussite éducative du Québec (CTREQ) et Collectif de recherche en counseling et développement de carrière (CRCDC) de l'Université de Sherbrooke. Document disponible à l'adresse <https://www.monemploi.com/eqe>.
- Ministère de l'Éducation et de l'Enseignement Supérieur (2019). Programme de formation de l'école québécoise secondaire. Québec : Gouvernement du Québec. Document disponible à l'adresse <http://www.education.gouv.qc.ca/enseignants/pfeq/secondaire/>
- Pepin, M. (2011). L'entrepreneuriat en milieu scolaire, de quoi s'agit-il ? *McGill Journal of Education / Revue des sciences de l'éducation de McGill*, 46(2), 303-326.
- Samson, G. & Morin, D. (2013). *Les retombées de l'entrepreneuriat éducatif. Du primaire à l'université*. Québec : Presses de l'Université du Québec.
- Singh, I. (2014). Role of Demographic Variables in the Formation of Entrepreneurial Intention. *Journal of Business and Management*, 16, 20-25.
- Surlemont, B. & Kearney, P. (2009). *Pédagogie et esprit d'entreprendre*. Bruxelles : de Boeck.
- Stevenson, H. H. (1985). A paradigm of entrepreneurship: Entrepreneurial management. *Strategic management journal*, 6(2), 17-27.

# DESIGN OF POWER ELECTRONIC SYSTEM WITH VARIABLE TOPOLOGY OF THE MAIN CIRCUIT FOR EDUCATIONAL SUPPORT OF LABORATORY EXERCISES OF POWER SEMICONDUCTOR CONVERTERS

**Michal Frivaldsky**

*Department of mechatronics and electronics, Faculty of electrical engineering and information technologies, University of Zilina (Slovakia)*

## Abstract

Power electronics emerges more and more within daily life. Its use is widely increased within many application areas, at the same time, industries are emerging in which this technology is being involved for the first time ever. Regarding this trend, there is need for qualified and experienced people with the knowledge of the power electronic systems. This contribution presents the way how to support educational process of the power electronics, while the focus is given here on the experimental-laboratory training. We have developed a unique power electronic system experimental board, which is equipped with necessary electronic components to be able to form standard and advanced topologies of power semiconductor converters. The students can understand operational principles of power rectifiers, DC/DC switched regulators, isolated DC/DC converters, while open loop and closed loop operation can be studied as well. Final paper will contribute with key construction aspects, main circuit components and circuit topologies with their operational principles and examples from measurements. The paper should inspire more university professionals working in this field, i.e. it supports the idea how to increase the practical way of the university study in the field of electrical engineering.

**Keywords:** *Power semiconductor device, power semiconductor converter, power electronics, topology, control.*

## 1. Introduction

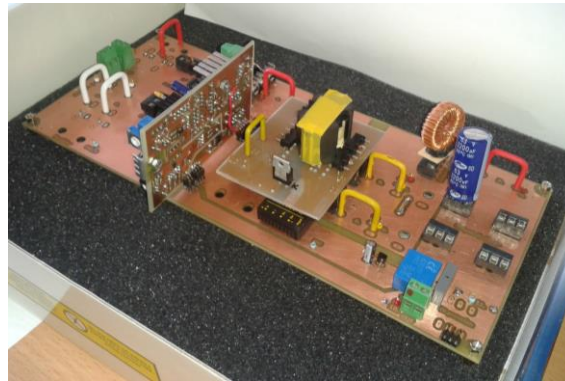
A sample of a universal measuring device with a variable topology of the main circuit is a device that serves as an educational aid for students. The student can accept his own designs of non-isolated and isolated topologies of DC/DC converters. With the help of measuring points and measuring bridges, the student has access to the important course of the given topologies. The work was created from the following versions of some functional as well as visual optimization devices. This work serves as a manual for a universal measuring device. It contains a theoretical description of the functions of individual topologies of DC/DC converters and the manual for the device itself, with the help of which the student should be able to implement his design of the given converter into this device and set all the functional blocks of the device according to his design.

## 2. Design

The device will serve as a teaching aid for students attending teaching courses dedicated to the design of power semiconductor converters. This universal power converter system is intended for the so-called "rapid prototyping learning", where students can test their design of a power semiconductor converter in a short time. Individual power circuits are configured flexibly, i.e. the choice of investigated topology is implemented using plug-in modules, which are designed in such a way that after connecting the selected plug-in module, it completes the missing connections on the main board and thus the preferred topology.

The control board is implemented as a plug-in module and is connected to the main power board using connectors (jumpers). The power board also contains a variable input rectifier that can work in node or bridge connection. The wiring configuration is done by inserting the jumper wire into the terminal block located on the board next to the power terminal block, creating a rectifier bridge connection. The design of the main power board is provided in such a way that the measurement is possible separately on the rectifier or in common connection with the DC/DC converter.

Figure 1. Physical prototype of power electronic system with variable topology of the main circuit.



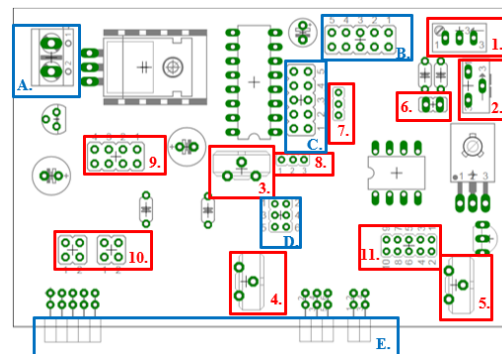
### 3. Methods

The designed system enables to understand basic and advanced operational principles of the most common power semiconductor circuits, i.e. rectifiers, DC/DC regulators – SMPS (buck, boost, buck/boost), isolated DC/DC converter (flyback and forward) and half and full bridge topologies of DC/DC converters. By the experimental measurements, the students became familiar with physical operation, thus they are able to confirm the theoretical expectations on the given topology operation. Working with such system requires user guide, so here a key functionality is presented. The control board enables to define:

Table 1. Functionality description of control card

Setting components/functionality	
1.	$R_T$ – switching frequency ( $f_{sw}$ )
2.	Setting the deadtime value ( $t_d$ )
3.	Setting the duty cycle ( $D$ )
4.	Setting the value of overcurrent protection (0 – 12 A)
5.	Output voltage value for feedback loop regulation
6.	Switching frequency range
7.	Feedback loop enable
8.	Selection for fixed or variable value of duty cycle ( $D$ )
9.	Setting of maximum duty cycle (50% or 100%)
10.	Control system (external/internal)
11.	Selection of the output voltage
Connectors	
A.	Power supply for control board (15V)
B.	Connector for capacitor of the PI regulator of feedback loop
C.	Connector for resistor of the PI regulator of feedback loop
D.	Connector for external control DSP or $\mu C$
E.	Connectors for control board and power board

Figure 2. Control board layout indicating key component for functionality setting.



The control board is designed as a plug-in module, which is connected to the main power board using connectors. The control board contains the circuits necessary to control the switching elements on the power board, it also contains evaluation circuits of the protections that are implemented in the device. Figure 2 shows the layout of the components of the control board, with the adjustment elements (red) and terminal blocks (blue) marked. The table 1 briefly describes the meaning of individual setting elements and connectors. By using this simple jumper positioning, the student can flexibly modify circuit topology and control functionality as well.

The main power board contains all the necessary parts to revive the designed power converter. It contains the circuits of the input rectifier, the main circuit of the DC/DC converter (after the implementation of the relevant plug-in module determining the converter topology), various types of protections. The main board has measurement points and measurement bridges for easier work when measuring electrical variables important for specifically selected topologies of the DC/DC converter or input rectifier. Figure 3 shows the distribution of the components of the main board with marked connection terminals and elements of the initial setting of the board before experimenting. The explanation of individual elements is in the table 2.

Figure 3. Power board layout indicating key component for functionality setting.

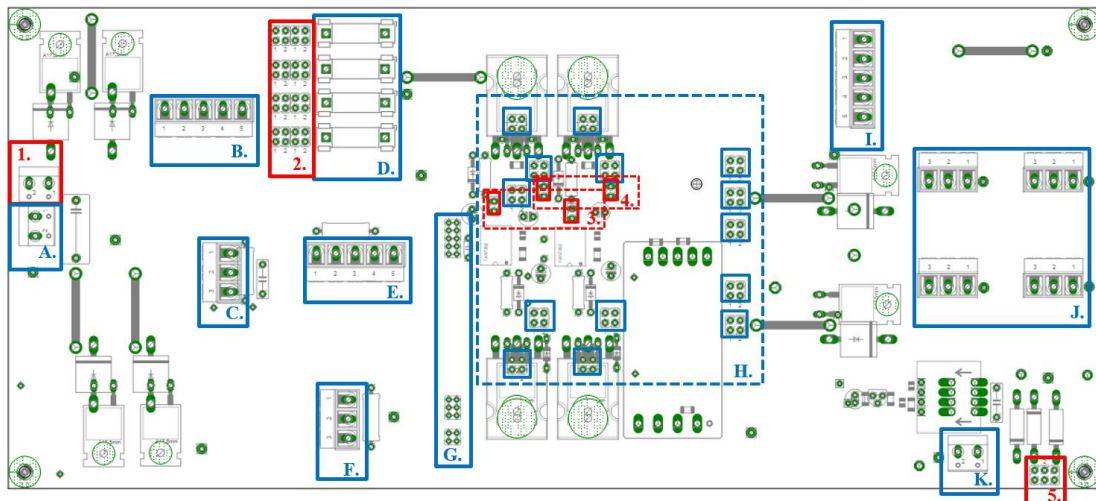


Table 2.

Setting components/functionality	
1.	Topology selection of rectifier
2.	Connectors for fuse selection
3.	Connectors between drivers and power transistors
4.	Connectors between drivers and transistor emitters
5.	Connector for selection of overvoltage protection value
Connectors	
A.	Connector for power supply of rectifier
B.	Connector for inductive rectifier filter
C.	Connector for capacitive rectifier filter
D.	Fuse field
E.	Connector for boost converter inductor and/or capacitive divider of half-bridge converter
F.	Connector for capacitive divider of half-bridge converter
G.	Connector for control board connection
H.	Connector for slot modules determining topology
I.	Connector output inductive filter connection
J.	Connector for output capacity connection
K.	Connector for load connection

#### 4. Conclusion

Power electronic systems are becoming essential part of any advanced electronic system regarding industrial, energy or customer segment. It is therefore very important that electrical engineering studies, provides flexible tool to find innovative education process, focused on the experimental findings of the basic principles of power electronic converters. This paper provides description of universal measuring system, which enables to become familiar with operational principles of standard power converter topologies.

#### References

- Hockicko P, Tarjanyiova G (2020) *Lab-Based learning in university for primary school students focused on acoustics*. AKUSTIKA: STUDIO D-AKUSTIKA SRO.
- Pavlascek P, Hargas L, Prandova A (2019) *Effective flexible education concept: virtual education environment support of students creativity, flexibility, activity*. EDULEAR 19 International conference.
- Tarjanyiova G, Hockicko P, Kopylova N, Dyagilev A, Ivanikov A (2020) *Comparison of Physics study results at the technical universities in different countries*. ELEKTRO 2020 International conference.
- www.ti.com 2008 Power Supply Topologies.

## EDUCATIONAL TECHNOLOGY IN PROBLEM-BASED LEARNING

**Petra Pejić Papak, Jasminka Mezak, & Lidija Vujičić**  
*Faculty of Teacher Education, University of Rijeka (Croatia)*

### Abstract

The problem-based approach to teaching aims to enable students to understand and evaluate the content taught. Organizing activities that involve problem solving includes: Creating a problem situation, defining the problem, selecting a problem-solving method, analyzing the results, drawing conclusions, and applying the acquired knowledge to new problem situations. Active learning with the help of technology enables faster implementation of planned activities. The main task of the teacher in problem-based teaching is to ensure conditions for creative and research activity of students in all the mentioned phases. The Faculty of Teacher Education in Rijeka, Croatia participated as a partner in several European projects aimed at implementing problem-based methods using educational technology in the learning and teaching processes of students, preschool educators and primary school teachers.

The goal of these projects was to contribute to the development of creativity and logical thinking in children so that they can apply what they have learned to new problem situations. The most important activities of the project included the teaching of students as well as the professional development of educators and teachers in various innovative teaching methods using information and communication technology. This paper presents the educational activities for solving problems in practice with the aim of achieving the planned learning outcomes.

**Keywords:** *Problem-based learning, educational technology, educational activities, educator, teacher.*

---

### 1. Introduction

The modern technological society, the rapid progress of technology and new learning strategies have become challenges in the education of new generations. This is a complex task for teachers who are expected to successfully teach these future generations. Teachers and educators need to be up to date with 21st century competencies and skills and be able to select appropriate activities and digital tools for their students (Hoić\_Božić et.al., 2019). Using digital educational tools, teachers conduct new, more engaging activities for students that encourage active learning. Through the correct use of digital educational content, we adapt the teaching process to the abilities and needs of the students and meet different learning outcomes. The use of digital educational content, as well as its creation, depends on the didactic approach to teaching, in which the student is actively involved. Therefore, the role of the teacher is also changing, who develops the self-confidence of the student by accompanying the student in learning, motivates him, advises him and leads him to the goal. In order to improve the quality of pedagogical practice, teachers are increasingly using a problem-based learning with use of digital tool in the teaching process.

### 2. Problem-based learning

Problem-based learning is a student-centered approach in which students learn about a subject by working in groups to solve an open-ended problem. The problem-based approach to teaching aims to enable students to understand and evaluate the content taught. As reported by Tawfik et al. (2021) given the dynamic nature of domain practice, educators are looking for ways to better develop problem solving, and one of the most common strategies is problem-based learning, which provides learners with the opportunity to solve the different types of problems.

Problem-based learning is defined by the following principles: active process related to the learner's role, student-centered and self-directed engagement, engaging in collaborative activities and an individual drive toward problem-solving, iterative non-linear learning process related to structure, reflective observation or engagement. It is important for childrens to understand the nature of a problem

and the implications of it. Students should be encouraged to formulate a problem in their own words. Creativity thinking is necessary to come up with ideas to solve the problem and find new approaches, so teamwork is often a key component in problem solving. The organization of problem-solving activities includes: creating a problem situation, defining the problem, choosing a problem-solving method, analyzing the results, drawing conclusions and applying the acquired knowledge gained to new problem situations. Teachers can play a new role in the teaching process to support a student and change the learning task to allow the student to solve problems or complete tasks that would otherwise be unattainable. The teacher intervenes in context at the right time for a given student, which increases the student's ability to solve the task (Mezak & Pejić Papak, 2019). The ICT can also provide access to a variety of information, including digital libraries, data for analysis, tools for organizing ideas and for presenting ideas. Digitization is already helping student to develop problem-solving skills by using fun educational games.

### **3. Projects aimed at implementing problem-based methods using educational technology**

The Faculty of Teacher Education in Rijeka, Croatia, participated as a partner in several European projects aimed at implementing problem-based methods using educational technology in the learning and teaching process of students, preschool educators and primary school teachers.

The Erasmus+ Algolittle project was created with the aim of increasing the competences and acquiring knowledge and skills of undergraduate students of early and preschool education related to the use of algorithmic thinking skills through game-based learning. The main goal of the project was to prepare a course program and teaching materials for teaching algorithmic thinking skills in all areas of preschool education, as an innovative approach for students, future teachers (Mezak et.al., 2021). Following lessons that introduced students to ways in which algorithmic thinking can be integrated into all developmental areas of preschool education, our students created a written preparation as a scenario for encouraging algorithmic thinking skills through play-based activities.

The activities within the Erasmus+ GLAT project aimed to strengthen the competences of classroom teachers to apply innovative teaching approaches using information and communication technology. Emphasis was placed on the application of game-based learning combined with other approaches such as problem-based learning, project-based learning, learning through questions to encourage logical thinking, creativity and the development of problem-solving skills in students. The teachers were introduced to the concept of game-based learning, had the opportunity to try out tools for creating learning scenarios (LePlanner) and were made familiar with different tools for creating digital teaching materials. They analyzed problem-based learning that develops logical thinking through quiz examples and logical tasks using tools Kahoot, Wizer.me, Match the memory. They were introduced to the concept of inquiry-based learning and the basic concepts of programming. They have tried out all the forms of learning mentioned with the help of educational technology in their pedagogical practice with their students and have reflected on their work.

#### **3.1. Problem-based learning activities**

As examples of good practice from the GLAT project (Table1.), we list the best learning scenarios that teachers have independently created and implemented with their students in the classroom for problem-based learning and digital storytelling. To use digital tools in the problem-solving process, teachers designed learning scenarios with problem solving and knowledge acquisition in logic games.

In the activity of designing a digital story with game elements, teachers guided their students through the process of designing a story with game elements. The children described the plot and decided on the names and appearance of the characters in the story. After researching the topic and gathering the necessary information, students also designed game elements that would allow players to develop algorithmic thinking skills (e.g., sorting games, puzzles, moving through the maze, etc.). In addition to these game elements, children were involved in defining the scene, sequencing events, and establishing logical conditions for the game. Since these were teachers from practice who did not have sufficient knowledge and skills to program independently and students in lower elementary grades, students, future computer science teachers, helped by creating digital stories in the Scratch programming language according to the instructions of the teachers and their students.



Table 1. Learning scenarios from the GLAT project.

Learning scenario Title	Subject and grade	Implementation links
Addition to 5 <a href="https://glat.uniri.hr/wp-content/uploads/2019/09/Lanca_WS2_Learning_scenario_ENG.pdf">https://glat.uniri.hr/wp-content/uploads/2019/09/Lanca_WS2_Learning_scenario_ENG.pdf</a>	Mathematics 1st grade	Example 1 – Mathematical warming up: <a href="https://learningapps.org/display?v=p82852wi318">https://learningapps.org/display?v=p82852wi318</a> Example 2 – Kahoot! Quiz: <a href="http://tiny.cc/n3v2vz">http://tiny.cc/n3v2vz</a> Example 3 - Worksheet: <a href="https://app.wizer.me/learn/55YALZ">https://app.wizer.me/learn/55YALZ</a>
Months of the year <a href="https://glat.uniri.hr/wp-content/uploads/2019/09/Stambulic_WS2_Learning_scenario_ENG.pdf">https://glat.uniri.hr/wp-content/uploads/2019/09/Stambulic_WS2_Learning_scenario_ENG.pdf</a>	Science 2nd grade	Kahoot! quiz: <a href="http://tiny.cc/s3v2vz">http://tiny.cc/s3v2vz</a> Match the Memory game: <a href="https://matchthememory.com/mjeseciugodinimelita">https://matchthememory.com/mjeseciugodinimelita</a>
Spatial orientation <a href="https://glat.uniri.hr/wp-content/uploads/2019/09/KristinaUjcicCucak_WS2_Learning_scenario_ENG.pdf">https://glat.uniri.hr/wp-content/uploads/2019/09/KristinaUjcicCucak_WS2_Learning_scenario_ENG.pdf</a>	Science 3rd grade	STAPLE <a href="https://matchthememory.com/orijentacijakika">https://matchthememory.com/orijentacijakika</a> TREASURE HUNT <a href="https://learningapps.org/display?v=p05tz96fn18">https://learningapps.org/display?v=p05tz96fn18</a> Kahoot! <a href="http://tiny.cc/u3v2vz">http://tiny.cc/u3v2vz</a> Wizer.me <a href="https://app.wizer.me/learn/OY2KVJ">https://app.wizer.me/learn/OY2KVJ</a>
Nutrition <a href="http://tiny.cc/x3v2vz">http://tiny.cc/x3v2vz</a>	Science 2nd grade	<a href="https://scratch.mit.edu/projects/325739167">https://scratch.mit.edu/projects/325739167</a>
The fruits of the seasons <a href="http://tiny.cc/y3v2vz">http://tiny.cc/y3v2vz</a>	Science 1st grade	<a href="https://scratch.mit.edu/projects/326888540/">https://scratch.mit.edu/projects/326888540/</a>
Playing and calculating up to 20 <a href="http://tiny.cc/04v2vz">http://tiny.cc/04v2vz</a>	Mathematics 1st grade	<a href="https://scratch.mit.edu/projects/326503995/">https://scratch.mit.edu/projects/326503995/</a>

As examples of good practice from the ALGOLITTLE project (Table 2.), we cite written preparations designed by students, only some of which have been used in work with children. In a holistic approach, unplugged activities are designed to solve problems and promote algorithmic thinking. The goal of task design is to foster children's ability to analyze, find basic actions that lead to solving problems, and learn and work according to rules or models.

Table 2. Written preparations from the ALGOLITTLE project.

Written preparation Title	Game activities
What does the aircraft need to fly? <a href="http://tiny.cc/eyu2vz">http://tiny.cc/eyu2vz</a>	constructive games and building games (plane, helicopter, balloon) functional games ("Fly, fly" game) symbolic games (pilot and flight attendant game) games with the rules
Why is washing your hands important? <a href="http://tiny.cc/jyu2vz">http://tiny.cc/jyu2vz</a>	"Bacteria Memory" game dance game "This is how you wash your hands" game "Let us build a bacterium". creation and performance of the play "How to expel bacteria?"
I am the wind, I raise the air! <a href="http://tiny.cc/lyu2vz">http://tiny.cc/lyu2vz</a>	A motor skills game "The wind can raise..." A game with cards showing the weather Interactive board "Weather conditions" Car race with plastic cups

## References

- Hoić-Božić, N., Mezak, J., & K. Tomljenović (2019). Enhancing Teachers' Computational Thinking Skills Through Game Based Learning. *CEUR Workshop Proceedings, Volume 2494*. Retrieved December 12, 2022, from: <https://degames.uniri.hr/wp-content/uploads/2019/10/SLET2019.pdf>
- Mezak, J., & Pejić Papak, P. (2019). Problem Based Learning for Primary School Junior Grade Students Using Digital Tools. In Skala, K. (Eds.) *42st International Convention on Information and Communication Technology, Electronics and Microelectronics* (805-810).IEEE.
- Mezak, J., Pejić Papak, P., & Vujičić, L. (2021). The integration of algorithmic thinking into preschool education. In Gómez Chova, L., López Martínez, A., & Candel Torres, I. (Eds.), *13th International Conference on Education and New Learning Technologies* (8182-8187). Valencia, Spain: IATED Academy.
- Tawfik, A. et al. (2021). How K-12 Teachers Adapt Problem-Based Learning 2. *The Interdisciplinary Journal of Problem-based Learning, Volume 15(1)*. Retrieved December 12, 2022, from: [www.ijpbl.org](http://www.ijpbl.org) (ISSN 1541-5015)

# THE RELATION BETWEEN PARENTS' CHARACTERISTICS/PRACTICES AND CHILDREN'S EARLY LITERACY SKILLS DURING THE COVID-19 PANDEMICS

**Jerusa Fumagalli de Salles, Gabriella Koltermann, & Érica Prates Krás Borges**

*Institute of Psychology, Graduate Program in Psychology, Federal University of Rio Grande do Sul (Brazil)*

## Abstract

Relations between parental variables and children's early literacy skills allow for preventive interventions and effective public policies in health and education. The present study aims to investigate the relation between parents' characteristics (parental literacy expectations and attitudes, number of books at home) and parents' practices (formal and informal literacy activities - shared book reading - and parental involvement) and children's early literacy skills (word/pseudoword reading, spelling, knowledge of the alphabet, oral language) during the Covid-19 pandemic. Thirty-five first grade children aged between 6 and 7 years old ( $M = 6.29$ ;  $SD = 0.45$ ) from private Brazilian schools took part in this study. The number of books at home predicted 16% of the variance in shared book reading frequency between parents and children. Moderate positive correlations were found between shared book reading frequency and phonological awareness and oral language performances. Parental involvement was strongly correlated with pseudoword reading performance, word/pseudoword spelling, letter writing and phonological awareness. Shared book reading explained 16.5% of the variance in phonological awareness performance and 11.8% in oral language. Parental involvement explained 28% of the variance of children's performance in phonological awareness. Family practices, especially shared book reading and parental involvement in children's learning processes seem to promote phonological awareness and oral language skills development during a period of school closures and remote teaching/learning. These metalinguistic and oral language skills are important predictors of success in learning to read and spelling and can therefore be promoted through parenting practices.

**Keywords:** *Parenting, reading, spelling, children, pandemic.*

## 1. Introduction

Contributions of the family environment to children's specific predictors of linguistic, reading and spelling skills are commonly referred to as home literacy environment (HLE; Niklas & Schneider, 2013). The characterization of the components of family literacy environment is still not unanimous and different components of this construct tend to associate in different ways with cognitive-linguistic outcomes in childhood, depending on the family's socioeconomic status (SES), the school context, the assessed outcome, and the child's age, for instance (Niklas et al., 2021). The frequency of enriching activities which parents get involved with their children, such as book reading, number or letter practice and sharing observations about the world, is associated with parents' endorsement to statements related to early education. Although parents' attitudes result in actions such as getting involved in enriching activities with their children, they may be limited by the socioeconomic context, showing complex relations among these variables (Hendry et al., 2022). Opportunities for children to explore and learn at home, including the availability of books, toys and materials to play with, is one of the pillars for children's early development. Children's books available at home are likely to promote stimulating interaction between the caregiver and the child, developing literacy skills (Manu et al., 2019).

Family factors have the potential to promote learning in childhood. Relations between parental variables and children's early literacy skills promote preventive interventions and effective public policies in health and education. During the Covid-19 pandemic and school closure, the participation of families was even more decisive in order to make children follow their reading and writing learning process (Laguna et al., 2021).

## 2. Objectives

The present study aims to investigate the relation between parents' characteristics (socioeconomic status – SES -, components of home literacy environment – HLE-, parental literacy expectations and attitudes, number of books at home) and parents' practices (formal and informal literacy activities - shared book reading - and parental involvement) and children's early literacy skills (word/pseudoword reading, spelling, knowledge of the alphabet, oral language) during the Covid-19 pandemic.

## 3. Methods

Thirty-five first graders aged between 6 and 7 years old ( $M = 6.29$ ;  $SD = 0.45$ ) from private Brazilian schools took part in this study. All of them were Brazilian Portuguese speakers, with no record of neurodevelopment alterations or uncorrected visual/auditory impairments (reported by parents/guardians). The access to the Internet and computer to participate in the survey were also considered as inclusion criteria in the study. Due to the Covid-19 pandemic, all data collection was carried out remotely and online in 2021 (May to October), partly synchronous and partly asynchronous. The parents answered questionnaires about socioeconomic status - SES and components of the home literacy environment - HLE). Children was assessed through tasks about emergent writing (write the alphabet letters; spontaneous word spelling), alphabet knowledge (letter names and sounds), expressive vocabulary (naming figures), phonological awareness (alliteration, syllabic manipulation) and written language (word/pseudoword reading and spelling). The whole assessment with the children was carried out on a videoconference of about 50 minutes. Spearman correlations were performed within and between family and children variables. Subsequently, Multiple Linear Regression analyses were carried out with the previously correlated variables in order to estimate the impact of family variables on children's performance.

## 4. Results

The number of books and the socioeconomic status (SES) were associated with the knowledge of parents/guardians of what is expected for the development of literacy before the child starts first grade. The number of books at home predicted 16% of the variance in shared book reading frequency between parents and children. The number of books seems to be a variable that promotes the highest frequency of shared reading between parents-children, and vice versa. Moderate positive correlations were found between shared book reading frequency and phonological awareness and oral language performances. Parental involvement was strongly correlated with pseudoword reading performance, word/pseudoword spelling, letter writing and phonological awareness tasks. Phonological processing skills, such as phonological awareness and reading of pseudowords (i.e., the phonological route of reading) and spelling (spelling of letters, spontaneous writing and words/pseudowords spelling) were the most influenced by family factors, mainly socioeconomic status (SES) and family practices. Shared book reading explained 16.5% of the variance in phonological awareness performance and 11.8% in oral language. Parental involvement explained 28% of the variance of children's performance in phonological awareness.

## 5. Discussion and conclusions

Family practices, especially shared reading books and parental involvement in children's learning processes seem to promote phonological awareness and oral language skills development during a period of school closures and remote teaching/learning. These metalinguistic and oral language skills are important predictors of success in learning to read and spelling and can therefore be promoted through parenting practices.

It is important to remember that these children have been through pre-school as Emergency Remote Teaching and were starting their literacy process during the Covid-19 pandemic (year 2021), having their exposure to environments outside the family setting limited. The effects of this situation may have been maximized due to the pandemic setting and the closure of schools and Emergency Remote Teaching - ERT (Laguna et al., 2021; Panaoura, 2020). Especially in the Covid-19 pandemic setting, a study (Bao et al., 2020) demonstrated that daily book reading in the family context would reduce by 10.5% the loss of literacy skills during the school closure period (Bao et al., 2020). Evidence from previous studies have already suggested that shared book reading between parents and children supports a number of cognitive-linguistic skills, such as phonological awareness (Grolig, 2020).

A meta-analysis review (Bondt, Willenberg & Bus, 2020) which gathered studies that investigated distribution programs of family books concluded that they promote a literacy family environment (effect size = 0.31). The participation of the family in a book donation program has a significant effect on children's behavior (interest in reading) and literacy skills (effect size = 0.29). The authors of the meta-analysis study support the theory that the early start of book reading promoted by book distribution programs brings about a "snowball effect", i.e., they foster children's early literacy skills which, presumably, increase children's interest in book reading and may encourage parents to keep book reading routines within the family context (Bondt et al., 2020). Interventions that provide access to books and promote positive family practices, such as shared book reading, are necessary for the development of reading and spelling skills in children. This study presents some limitations, such as a small sample (n = 35, especially in the parental involvement variable, n = 17), limiting the statistical analyses.

### References

- Bao, X., Qu, H., Zhang, R., & Hogan, T. P. (2020). Modeling reading ability gain in kindergarten children during COVID-19 school closures. *International Journal of Environmental Research and Public Health*, *17*(17), 6371.
- Bondt, M., Willenberg, I. A., & Bus, A. G. (2020). Do book giveaway programs promote the home literacy environment and children's literacy-related behavior and skills? *Review of Educational Research*, *90*(3), 349-375.
- Grolog, L. (2020). Shared storybook reading and oral language development: A bioecological perspective. *Frontiers in Psychology*, *11*, 1818.
- Hendry, A., Gibson, S. P., Davies, C., Gliga, T., McGillion, M., & Gonzalez-Gomez, N. (2022). Not all babies are in the same boat: Exploring the effects of socioeconomic status, parental attitudes, and activities during the 2020 COVID-19 pandemic on early Executive Functions. *Infancy*, *27*(3), 555-581.
- Laguna, T. F. D. S., Hermanns, T., Silva, A. C. P. D., Rodrigues, L. N., & Abaid, J. L. W. (2021). Educação remota: desafios de pais ensinantes na pandemia. *Revista Brasileira de Saúde Materno Infantil*, *21*, 393-401.
- Manu, A., Ewerling, F., Barros, A. J., & Victora, C. G. (2019). Association between availability of children's book and the literacy-numeracy skills of children aged 36 to 59 months: secondary analysis of the UNICEF Multiple-Indicator Cluster Surveys covering 35 countries. *Journal of global health*, *9*(1), 010403.
- Niklas, F., & Schneider, W. (2013). Home literacy environment and the beginning of reading and spelling. *Contemporary educational psychology*, *38*(1), 40-50.
- Niklas, F., Cöhrssen, C., Lehl, S., & Napoli, A. R. (2021). Editorial: Children's Competencies Development in the Home Learning Environment. *Frontiers in Psychology*, *12*, 706360.
- Panaoura, R. (2020). Parental involvement in children's mathematics learning before and during the period of the COVID-19. *Social Education Research*, *2*(1), 65-74.

# ANALYSIS, MODELING AND CONTROL OF POWER ELECTRONIC SYSTEMS AND THEIR SIMULATION AS AN EDUCATIONAL SUPPORT

**Juraj Šimko, Michal Praženica, & Roman Koňarik**  
*Department of mechatronics and electronics, University of Žilina (Slovakia)*

## Abstract

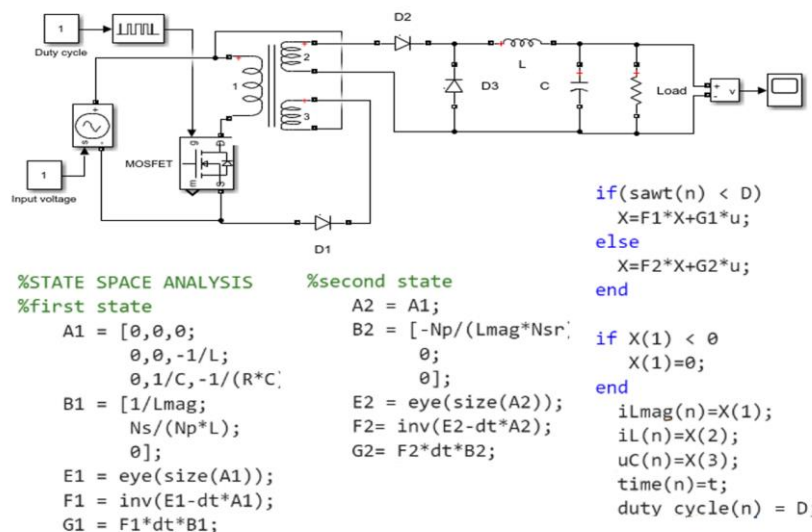
Power semiconductor devices are frequently used in contemporary world. They are used in all areas of everyday life and industrial applications. Thanks to this fact, it is necessary for current and new professionals to be trained and educated in the given theory. Part of this theory, in which our students are educated is the state space analysis of power systems, which represents their mathematical descriptions. Therefore, we created multiple simulation models of many power electronic systems. These models are used by students to verify the correctness of the performed state space analysis of the systems and to compare their results with classical circuit wiring diagram. The aim of such a simulation models is to introduce students to the variety of possibilities to analyze power electronic systems, understanding of their functionality, and also their open loop or closed loop control. There are also other benefits, like deeper understanding of mathematical skills. This paper describes multiple simulation models (topologies) of power systems, their analysis and control.

**Keywords:** *Power electronics, simulation models, state space analysis, control systems.*

## 1. Introduction

The power electronic is one of the youngest field of electrotechnical department. It is relatively new area in electrical engineering. Therefore, it is very important to be professionally educated in this topic. For our students it is necessary to understand how individual power semiconductor topologies work. This knowledge includes both theoretical description and its mathematical interpretation and of course simulation verification. The main point of this issue is to teach students to implement their knowledge not only in a schematic simulation area but also to improve their mathematical and programming skills and lead them to gain new experiences.

*Figure 1. Simulink simulation compare to state space analysis in MATLAB script for isolated DC/DC Forward converter.*



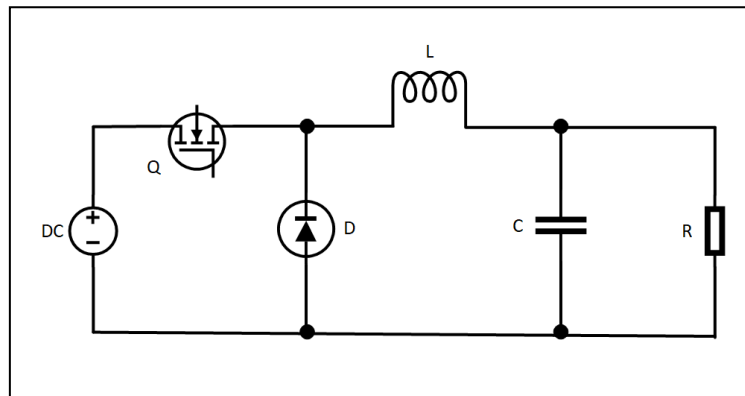
## 2. Programming skills improving education

In our case firstly it is necessary to mention how this programming skills are improving education. Here it is necessary to remember that individual simulation applications are preceded by a certain number of steps that require some degree of knowledge. In order to create a certain simulation model, it is necessary for students to use laws that are applied in electrical engineering for description of the electronic system to obtain a mathematical model. Then it must be modified using mathematical procedures to a shape that can be used in a given simulation model. As we can see, in this process, students will improve in both programming, mathematical and electrotechnical skills and knowledge.

## 3. The procedure for creating given simulation models of various power semiconductor devices

In this section we will take brief look to procedure by which our students are obtaining simulation models and thus improving their skills. We will show it on one of the most basic topologies used in the field of power electronics, specifically on the Buck converter.

Figure 2. Wiring diagram of the Buck converter (Barrenetxea, Baraia, Larrazabal, & Zubimendi, 2018).



### 3.1. Obtaining a mathematical description of the given electronic system

Firstly, it is necessary to analyze this system using basic electrotechnical laws such as Kirchoff's laws. By applying this laws, we get its description and by using a little modification we get it in the form of differential equations. Devices such as DC/DC converters operate in two operational states and therefore we get equations for each state (Jarabicová, & Kaščák, 2019).

State equations for the first mode of operation:

$$\begin{aligned}\frac{di_L}{dt} &= -\frac{1}{L}u_C + \frac{1}{L}u_{IN} \\ \frac{du_C}{dt} &= \frac{1}{C}i_L - \frac{1}{RC}u_C\end{aligned}$$

State equations for the second mode of operation:

$$\begin{aligned}\frac{di_L}{dt} &= -\frac{1}{L}u_C \\ \frac{du_C}{dt} &= \frac{1}{C}i_L - \frac{1}{RC}u_C \quad (\text{same as in the first mode})\end{aligned}$$

### 3.2. Conversion of differential equations to the matrix form and obtaining a state space model of the system

The second step is to obtain a mathematical description of the system in the matrix shape which is important for the simulation verification of the obtained results (Jarabicová, & Kaščák, 2019).

State space model for the first state:

$$\frac{d}{dt} \begin{pmatrix} i_L \\ u_C \end{pmatrix} = \begin{pmatrix} 0 & -\frac{1}{L} \\ \frac{1}{C} & -\frac{1}{RC} \end{pmatrix} \begin{pmatrix} i_L \\ u_C \end{pmatrix} + \begin{pmatrix} \frac{1}{L} & 0 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} u_{IN} \\ 0 \end{pmatrix}$$

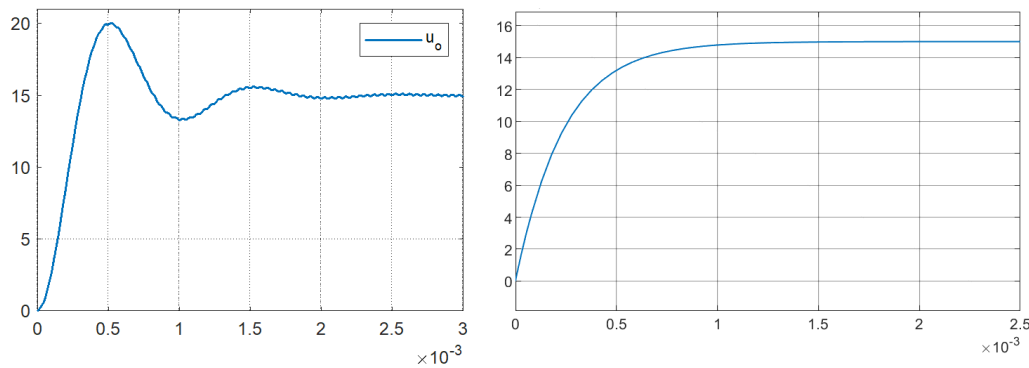
State space model for the second state:

$$\frac{d}{dt} \begin{pmatrix} i_L \\ u_C \end{pmatrix} = \begin{pmatrix} 0 & -\frac{1}{L} \\ \frac{1}{C} & -\frac{1}{RC} \end{pmatrix} \begin{pmatrix} i_L \\ u_C \end{pmatrix} + \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} \begin{pmatrix} u_{IN} \\ 0 \end{pmatrix}$$

### 3.3. Simulation verification in a chosen program

Last step of this analysis is to verify if our obtained results correspond to expectations. For this application we have chosen program named MATLAB. It is a program which allows the analysis of the system using such a mathematical model but also using a simple circuit diagram and therefore students can verify the correctness of their obtained mathematical descriptions (Jarabicová, & Kaščák, 2019).

Figure 3. The output voltage course for (a) MATLAB script simulation and (b) Simulink model simulation.



## 4. Conclusion

As we could see, the study and the field of power electronics also contributes to the improving of education of students. It teaches them to perceive the connections between different technical areas. In this case, it is area whether mathematical, theoretical, electrotechnical or programming. Our students have the opportunity to deeply improve this knowledge, because we do such applications with them on different types of electronic topologies. In many cases, there are also much more complicated analyses of systems, since for individual circuits it is possible to consider different parasitic properties of circuit elements. We apply it on topologies such as rectifiers, DC/DC converters, inverters and power semiconductor converters in general.

### Acknowledgements

This work was supported by the project: KEGA 018ŽU-4/2021 - Modern education methods in analysis, modeling and control of Power Semiconductor Systems.

### References

- Barrenetxea, M., Baraia, I., Larrazabal, I., & Zubimendi, I. (2018). *Power Electronic Converter Design Handbook*. Mondragon.
- Erickson, R. W., & Maksimović, D. (2004). *Fundamentals of Power Electronics*. New York: Kluwer Academic Publisher.
- Jarabicová, M., & Kaščák, S. (2019). *Parametric Simulation of the Interleaved Boost Converter for the Electric Transport Vehicle*. TRANSCOM: Elsevier B.V.
- Valco, M., Sedo, J., & Paskala, M. (2013). *Simulation Analysis of DC/AC Inverter Under Nonlinear Load*. International Conference Technical Computing Prague 2013.
- Frivaldský, M., Prídala, M., & Drgoňa, P. (2017). Implementation of mathematical model of thermal behavior of electronic components for lifetime estimation based on multi-level simulation. *Archives of Electrical Engineering*, 2, 339-350.

## **MOTIVATION OF SECOND- AND SIXTH-GRADE STUDENTS REGARDING INDIVIDUAL AND COLLABORATIVE WRITING**

**Joane Deneault, Jessy Marin, & Natalie Lavoie**

*Department of Education, University of Quebec in Rimouski (Canada)*

### **Abstract**

Writing motivation decreases in elementary school. This is an issue of major importance considering how it relates to writing skills which are necessary for education as a whole. Teachers must introduce students to the pleasure of learning, and working collaboratively is proposed as one way to sustain students' interest in writing. However, very little is known about the contribution of collaborative writing to writing motivation. This is because few studies have opted for recognized motivation indicators or a control design that would reveal the added value of a collaborative approach at different times in elementary school. The aim of this study is to compare the writing motivation of second- and sixth-grade students depending on whether they write individually or in dyads (repeated measures). After each writing session (individually and in dyads), the students answered a likert-scale questionnaire to assess their motivation on four indicators: self-competence, self-efficacy, interest and value. Preliminary results (t-tests) showed that second-graders are equally motivated to write in both contexts but that boys' motivation reached girls' only in the dyad context. Results for six-graders are expected. They will be presented and discussed to highlight the contribution of collaborative writing to writing motivation, which may vary depending on students' sex and grade level.

**Keywords:** *Writing motivation, collaborative writing, elementary.*

---

### **1. Introduction**

Writing motivation decreases in elementary school (Ekholm et al., 2018; MELS, 2012). This is an issue of major importance considering how it relates to writing skills (Camacho et al., 2021), which are necessary for education as a whole. Teachers must introduce students to the pleasure of learning (MEQ, 2020), and working collaboratively is proposed as one way to sustain students' interest in writing (MEES, 2017).

Collaborative writing activities give rise to spoken exchanges regarding the text being produced. Collaborative writing is defined as a socio-cognitive process whereby several writers negotiate, coordinate their actions and share responsibility for the writing of a text (Lowry et al., 2004; Rubiae et al., 2016). Studies examining collaborative writing have shown that it leads to some improvement in the quality of the texts produced (Ferguson-Patrick, 2007; Graham et al., 2012; Lavoie et al., 2011) and appears to be beneficial to weaker pupils (Yarrow & Topping, 2001). However, very little is known about its contribution to writing motivation. Elementary school students reported to appreciate writing with a peer (De Bernardi & Antolini, 2007; Paquette, 2009), but few studies opted for recognized motivation indicators like self-efficacy for writing or task interest and value (Boscolo, 2009; Troia et al., 2012) and few used a control research design that would reveal the added value of a collaborative approach. One study did compare fifth- and sixth-graders' motivation in individual and peer-assisted writing conditions, but no significant differences were found on motivation or self-efficacy (De Smedt, Graham, & Van Keer, 2018). At this point, it is hard to figure out how collaborative writing is beneficial to pupils' motivation in elementary school since no studies investigated its relevance with different grade-level students and with multiple indicators of motivation. The aim of this study was to compare the writing motivation of second- and sixth-grade students depending on whether they write individually or in dyads.



## 2. Method

### 2.1. Participants

Fifty-four (54) french-speaking second-grade and sixty-three (63) sixth-grade students participated in this study. Once the necessary authorizations had been received, the pupils took the *Repérage Orthographique Collectif* (ROC) test, involving a spelling discrimination task and a dictation (Allal et al., 2006). Based on the results on this test, heterogeneous dyads of pupils were created using the pairing procedure proposed by Fuchs et al. (1997).

### 2.2. Procedure and instrument

The pupils planned, wrote and edited/corrected a story, first individually and then (two weeks later) in dyads. In writing these texts, they referred to pictures containing some elements of the story (e.g. main character, secondary characters, place, triggering event). During the writing activity in dyads, the pupils were given only one sheet of paper to write on to encourage discussion and prevent them from each working on the story separately. After each writing session (individually and in dyads), the students answered an adapted likert-scale questionnaire (Deneault & Lavoie, 2020) to assess their motivation on four indicators: self-competence (4 items), self-efficacy (5 items), task interest (4 items) and task value (3 items) (Boscolo, 2009). The 5-point scale was designed for children (a gradation from a smiley face to a sad face to express *totally agree* to *totally disagree*). Internal consistency for each scale was moderate to high (Cronbach alphas ranged from 0,66 to 0,91).

### 2.3. Data analysis

Since only the second-grade students' data were available at the moment of publishing this paper, paired T-tests were done on these data to examine the differences between individual and collaborative writing condition for each motivation indicator (self-competence, self-efficacy, interest and value). However, a 2 (grades) X 2 (writing conditions) MANOVA, with repeated measures on writing conditions, will be used on the mean scores of the four motivation indicators (dependent variables) when all the data will be available.

## 3. Results

T-tests analyses showed that there were no differences between individual and collaborative writing on self-efficacy, self-competence and task interest for second-grade students. The mean score for the task value was higher for individual writing than for collaborative writing ( $p < .05$ ). Results for six-graders are expected soon.

Complementary analyses (t-tests) were done to explore the difference between boys and girls in the two writing conditions. Results showed that in the individual condition, the girls had higher scores for self-efficacy, self-competence and interest than boys, but that boys were as motivated as girls for these motivation indicators in the collaborative condition.

## 4. Discussion

These preliminary results showed that a collaborative context did not stimulate motivation more than an individual context for second-graders and that they attributed more value to the individual writing context. Although not surprising (since writing evaluation in school setting are mainly individual), these results expanded those of De Smedt, Graham, and Van Keer (2018) by showing that the collaborative context is not more motivating for young pupils from second-grade level than for older ones and that this tendency is confirmed with new motivation indicators such as self-competence belief, task interest and task value.

Our study also shows that boys' motivation reached girls' only in the collaborative context. Since girls are generally more motivated to write than boys (Camacho, et al., 2021), this result is of great importance. Past studies showed that the interactions between the boys in collaborative writing settings were similar to those for the girls (Marin et Lavoie, 2019). Together these findings suggest that, when it comes to writing, working in pairs in class could motivate boys to write and help them to feel confident about writing.

## References

- Allal, I., Cheminal-Lancelot, R., Devaux, M.-F., Divry, J., Lequette, C., Maitrot, C.... Zorman, M. (2006). *Repérage Orthographique Collectif (ROC): à l'usage des enseignants de fin de cycle 3 et de 6e/5e de collège*. [http://www.cognisciences.com/IMG/Roc\\_09\\_2009\\_code.pdf](http://www.cognisciences.com/IMG/Roc_09_2009_code.pdf)
- Boscolo, P. (2009). Engaging and motivating children to write. In R. Beard, D. Myhill, J. Riley and M. Nystrand (Dir.), *The SAGE handbook of writing development* (pp. 300-312). SAGE publications Inc.
- Camacho, A., Alves, R. A., & Boscolo, P. (2021). Writing motivation in school: A systematic review of empirical research in the twenty-first century. *Educational psychology review*, 33, 213-247.
- De Bernardi, B. & Antolini, E. (2007). Fostering students' willingness and interest in argumentative writing: an intervention study. In G. Rijlaarsdam (Dir.), *Studies in writing. Writing and motivation* (pp. 183-202). Elsevier.
- Deneault, J., & Lavoie, N. (2020). Motivation et compétence à écrire au primaire : comparaison entre le clavier et le crayon. *Revue des sciences de l'éducation*, 46 (1), 64-92. <https://doi.org/10.7202/1070727ar>
- De Smedt, F., Graham, S. & Van Keer, H. (2018). The bright and dark side of writing motivation: Effects of explicit instruction and peer assistance. *The Journal of Educational Research*, 112(2), 152-167. DOI:10.1080/00220671.2018.1461598
- Ekhholm, E., Zumbrunn, S., & Debusk-Lane, M. (2018). Clarifying an elusive construct: A systematic review of writing attitudes. *Educational Psychological Review*, 30, 827-856.
- Fuchs, D., Fuchs, L. S., Mathes, P. G., & Simmons, D. C. (1997). Peer-Assisted Learning Strategies: Making Classrooms more Responsive to Diversity. *American Educational Research Journal*, 34(1), 174-206.
- Ferguson-Patrick, K. (2007). Writers develops skills through collaboration: an action research approach. *Educational Action Research*, 15(2), 1-20.
- Graham, S. Kihara, S., McKeown, D., & Harris, K. R. (2012). A meta-analysis of writing instruction for students in the elementary grades. *Journal of Educational Psychology*, 104, 879-896.
- Lavoie, N., Levesque, J.-Y., & Marin, J. (2011). Les interactions lors d'activités d'écriture collaborative au premier cycle du primaire: la contribution de l'étayage de l'enseignant. *Revue de l'Association Francophone Internationale de la Recherche Scientifique en Éducation*, 6, 2-20.
- Marin, J., & Lavoie, N. (2019). *Interactions and text production: benefits for boys and girls*. Communication presented at the International conference on Education and New Development. Porto, Portugal.
- Ministère de l'Éducation et de l'Enseignement supérieur (MEES). (2017). *Référentiel d'intervention en écriture*. Gouvernement du Québec. [http://www.education.gouv.qc.ca/fileadmin/site\\_web/documents/education/adaptation-scolaire-services-comp/Referentiel-Ecriture.pdf](http://www.education.gouv.qc.ca/fileadmin/site_web/documents/education/adaptation-scolaire-services-comp/Referentiel-Ecriture.pdf)
- Ministère de l'Éducation (MEQ) (2020). *Référentiel de compétences professionnelles. Profession enseignante*. Gouvernement du Québec. [https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/education/publications-adm/devenir-enseignant/referentiel\\_competences\\_professionnelles\\_profession\\_enseignante.pdf](https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/education/publications-adm/devenir-enseignant/referentiel_competences_professionnelles_profession_enseignante.pdf)
- Ministère de l'Éducation, du Loisir et du Sport (MELS) (2012). *Évaluation du plan d'action pour l'amélioration du français*. Gouvernement du Québec. [http://www.education.gouv.qc.ca/fileadmin/site\\_web/documents/dpse/formation\\_jeunes/Evaluation\\_nPAAF\\_2eRapportFinal\\_ResultatsEpreuves\\_1.pdf](http://www.education.gouv.qc.ca/fileadmin/site_web/documents/dpse/formation_jeunes/Evaluation_nPAAF_2eRapportFinal_ResultatsEpreuves_1.pdf)
- Paquette, K. (2009). Integrating the 6+1 writing traits model with cross-age tutoring: An investigation of elementary students' writing development. *Literacy Research and Instruction*, 48(1), 28-38
- Troia, G. A., Shankland, R. K., & Wolbers, K. A. (2012). Motivation research in writing: theoretical and empirical considerations. *Reading et writing quarterly*, 28(1), 5-28.

## CONTRIBUTION OF INFORMATION DESIGN FOR THE AUTONOMY OF THE POPULATION IN A HEALTH CONTEXT

Mónica Santos<sup>1</sup>, & Suzana Dias<sup>2</sup>

<sup>1</sup>ID+/ Research Institute for Design, Media and Culture/Polo FBAUP (Portugal)

<sup>2</sup>ID+/ Research Institute for Design, Media and Culture/Polo IPCA (Portugal)

### Abstract

This poster presents part of the study developed by the author in the context of the doctoral study, where the importance of Information Design for the autonomy of the population in health context was analyzed. Currently, despite the existence of governmental measures aiming at a preventive health model, it is often verified that the population still uses health services in a consumer perspective or in a reactive way, not taking into account their own health as a life goal to achieve. This behavior triggers a set of negative consequences, not only in personal terms, but also in terms of the inability of the services to respond effectively. After an in-depth bibliographic review of specialist authors in the field of health and in the field of information design and taking as object of study the clinical analysis report model currently used in Portuguese National Health Service, it was concluded that the current educational health messages are not adjusted to the user literacy, not taking into account either the cognitive needs (at the cultural and social level), nor to their emotional needs. This presentation leads to the recognition of the fundamental role of Information Design tools in this specific context, due to their integrating character. Through the construction of messages with a strong sense of ownership and commitment, an increase in the individual's awareness and autonomy regarding the decisions to be taken within the scope of his/her health is promoted. We conclude, however, that in order to enhance these results, a review of the design paradigm is necessary, in which the user cannot be understood as a mere recipient of contents built based on assumptions, but rather integrated in a process of co-creation during the construction of educational health messages, right from an early stage.

**Keywords:** *Information design, health message, co-creation design, visual literacy, clinical analysis report.*

---

### 1. Introduction

The author's doctoral study (Santos, 2020) investigated the significance of Information Design in promoting individual autonomy in healthcare. This poster presents a portion of the research findings. Despite governmental efforts, the Portuguese population's consumerist or reactive approach to healthcare leads to negative consequences, such as patient overload and an ineffective response from healthcare services to the population's needs. Here is discussed that the Information Design tools are crucial for increasing individual awareness and autonomy, but active user participation in the design process is vital. The study included a literature review and validation of the clinical report used in the Portuguese National Health Service, confirming that current health messages do not meet users' diverse needs.

### 2. Design

Information design aims to create clear, organized, and visually appealing documents that can be easily understood and used for effective action. This can be challenging in the health field where complex relationships and low health literacy can make it difficult for the audience to access the message (Espanha, 2009). When messages are designed with preconceived assumptions from the person creating them, and without considering the informational needs of the audience, the information can result in inadequate communication and visually uninteresting presentations that are not suitable for the intended target audience. This can cause information to be rejected for being difficult to understand, irrelevant, boring, irritating, or unconvincing. The negative impact of this difficulty can lead to frustration for users who may not know how to act on the information they have received, leading to a dependence on doctors

or health professionals for decision-making on health management. Assumptions of Information Design are fundamental to health communication messages, as they often involve changing behaviors and presenting strategies to incorporate new actions into daily life. By applying the principles and process of information design, the audience can be engaged with the message, perceive it, agree with it, think about it, remember it, and have the intention to act on its content (THCU, 2002).

### 3. Objectives

The objective of this study was to raise awareness about the importance of Information Design in developing health messages tailored to user needs. The engagement fostered through a better understanding of the information enhances users' empowerment to implement behavioral changes for better self-health management. Additionally, we aim to highlight the importance of co-design methodologies to emphasize the need for a paradigm shift in traditional health communication design, which views users merely as passive content recipients, and engage themselves as active agents as the co-creators of communication solutions.

### 4. Methods

The methodology adopted consisted of a literature review, case studies and practical work that included the methods of observation, interview and co-creation, in which workshops were held to identify the difficulties in accessing and understanding information. An investigation was carried out through design so that it was possible to gather information about users and the context. In summary, the aim of this methodology was to adopt a bottom-up procedure in which people and the community were at the center of the process.

### 5. Discussion / literature review

Several studies, conducting a comparison of different versions of the layout of the clinical analysis document, before and after user collaboration, highlight the importance of user-centered information design (Nystrom, 2018; Meroni & Sangiorgi, 2011; Zikmund-Fisher et al., 2014). This collaboration is crucial because patients who are involved in making decisions about their health are more likely to achieve better health outcomes (Hibbard, 2003 cited by McCarron et al., 2019). The most effective methods are those that involve direct intentional experiences that represent reality or as closely as possible, and the more sensory the forms of interaction with the informational object, the greater the probability of learning from it. As argued by Edgar Dale in 1946, the amount of information retained and remembered depends on the way it is received (according to Anderson (n.d., as cited in Dale, 1969). Similarly, we also 'store' more information through what we "do" rather than what we "hear" and "read".

#### 5.1. Data survey and analysis

In a first approach of our survey, visual analysis of the sample of reports was carried out. We aimed, at first identify visual factors that could affect users with low literacy and second, to establish guidelines for the design of health communication supports. For this study, 30 reports were analyzed regarding design elements as: support, structure, and organization. The relevant issues found, including the absence of graphics and images, the use of technical language, and the presence of unrecognized symbols, act as barriers to the understanding of the information.

#### 5.2. Co-creation method (workshop)

After analyzing clinical analysis reports, two workshops, each lasting three hours, were developed. The workshops consisted of five phases where participants were asked to perform tasks such as reading and locating information, brainwriting/sketching, organizing information spatially, and evaluating final results. This document simulated the presentation of clinical results of a fictional patient, where the values were intentionally outside the reference parameters, and patients were asked to suggest preventive measures to avoid the onset of the disease.

**5.2.1. Results.** The concept tests, containing 3 intentionally altered values for this experiment, yielded the following results: of the twelve participants, only one was able to identify the three altered values; seven participants correctly identified the Total Cholesterol result; three participants misinterpreted results that were normal; two participants mentioned confusing the symbols ">" and "<", revealing to be a barrier to correctly read the results; when asked: "what should you do to prevent your Cholesterol value

from rising" five participants did not know what to suggest. It was also observed that participants had difficulty keeping their gaze on the same line because there was no orientation in the text lines, and mentioned being confused by the existence of two units of measurement for all outcomes.

Based on the findings, a prototype was developed to address reading difficulties and incorporate user responses into graphical elements. Specifically, the results were presented with guiding lines for horizontal reading, highlighting results outside the reference parameters with a gray background. Icons representing right and wrong, chosen by participants, were added at the end of each line. Information on health promotion was included, irrelevant units of measurement were removed to reduce result interpretation ambiguity, and text regarding the sample's nature (e.g., blood, serum) was adjusted to prevent confusion with analysis names. A legend was included to aid symbol comprehension. The prototype underwent testing with users and health professionals, involving tasks similar to those performed with the original report. As a way to increase the difficulty and accuracy in verifying the participants' literacy, seven values outside the reference intervals were placed in this new report.

As a result, all participants correctly identified all the values, except one participant who had doubts about one result, indicating a comprehensive understanding of the document. Some identified issues and improvement suggestions include: confusion caused by added health promotion information, potential anxiety caused by the presence of symbology according to health professionals, removal of irrelevant sample nature information, and inclusion of explanatory notes for interpreting "normal results".

## 6. Conclusions

To enhance outcomes and develop effective health-related educational content, it is essential to reevaluate the traditional design paradigm. Instead of viewing users as passive recipients of assumed content, they should be recognized as active participants in the co-creation process of health messages. Lastly, we emphasize that participatory methodologies that involve collaboration between users and designers result in integrated, retained, and memorable information, crucial factors in the educational environment.

### Acknowledgments

This work is funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the project UIDB/04057/2020.

### References

- Anderson, H. M. (n.d.). *Dale's cone of experience* [Adapted from Audiovisual methods in teaching by E. Dale (1969)]. Queen's University Teaching and Learning. Retrieved from [https://www.queensu.ca/teachingandlearning/modules/active/documents/Dales\\_Cone\\_of\\_Experience\\_summary.pdf](https://www.queensu.ca/teachingandlearning/modules/active/documents/Dales_Cone_of_Experience_summary.pdf)
- Espanha, R. (2009). *Saúde e comunicação numa sociedade em rede - o caso português*. Portugal: Editora Monitor.
- McCarron, T. L., Arora, N., Courneya, P., St-Pierre, I., & Elmoheen, A. (2019). Understanding patient engagement in health system decision-making: A co-designed scoping review. *Systematic Reviews*, 8(1), 97. <https://doi.org/10.1186/s13643-019-0994-8>
- Meroni, A., & Sangiorgi, D. (2011). *Design for services*. Farnham: Gower Publishing.
- Nystrom, D. T., Wallston, K. A., Elasy, T. A., & Ikizler, T. A. (2018). *Methods for patient-centered interface design of test result display in online portals*. *EGEMS (Washington, DC)*, 6(1), 15. <https://doi.org/10.5334/egems.255>
- Santos, M. (2020). *A contribuição do design no aumento da literacia em saúde: Projeto de co-criação com o Instituto Nacional Dr. Ricardo Jorge* [Doctoral dissertation, Faculdade de Belas Artes – Universidade do Porto].
- The Health Communication Unit [THCU]. (2002). Toronto: Center for Health Promotion – University of Toronto. Retrieved from <http://www.thcu.ca>
- Zikmund-Fisher, B. J., Exe, N. L., & Witteman, H. O. (2014). Numeracy and literacy independently predict patients' ability to identify out-of-range test results. *Journal of Medical Internet Research*, 16(8), e187. <https://doi.org/10.2196/jmir.3503>

**HIEROGLYPH AND THE FOUNDATION OF CHILDREN'S TEACHING -  
COSMIC LANGUAGE  
-- COSMIC LANGUAGE = WORLD GENERAL TYPE UNIVERSAL  
LANGUAGE, HIEROGLYPH ENCODING LANGUAGE  
FOR SPELL CHARACTERS**

**Ma Wen Bin<sup>1</sup>, Ma Jin Sheng<sup>2\*</sup>, Ma Ran<sup>3</sup>, & Dong Yu Ping<sup>4</sup>**

<sup>1</sup>Senior high school: Class 4, Grade 3, High School Affiliated to Beijing University of Aeronautics and Astronautics, (Experimental School of Beihang University; Beijing, 100191) (China)

<sup>2</sup>Department of Industrial Design, Beijing University of Aeronautics and Astronautics; Beijing, 100191 (China)

<sup>3</sup>Shengli Oilfield; Dong Ying, 257001 (China)

<sup>4</sup>Golden Horse Studio; Beijing, 100083 (China)

**Abstract**

Cosmic Language is a new type of language and writing, suitable for children and people around the world to learn and master. It has the characteristics of hieroglyph, it also has the encoding characteristics of spell characters. It uses symbols, numbers, letters, Chinese characters, and other ethnic languages with certain characteristics as the units of character creation, similar to letters. Form hieroglyph structures similar to Chinese characters, such as "口,吕,品,田,朋" and string structures etc., and use the four corner codes method of Chinese characters for coding. This open universal language has specific text encoding rules that are suitable for computer classification and retrieval. It is also suitable for people of all races to quickly understand and master, as well as communicate with extraterrestrial creatures.

**Keywords:** Cosmic language, children, hieroglyph, spell characters, coding features.

**1. Cognitive discussion**

We need to analyze how children understand and feel the world.

Starting from the pattern hieroglyph, children can quickly accept and understand. The basic hieroglyph here is the Chinese "一,二,三", that is, 123, or the Roman characters "I, II, III". How to teach children to learn text? The text that can help children quickly remember should be related to their living environment. The toy "cartoon car". Okay, design this pattern: as Figure 1.

Figure 1. Cosmic language:

a) Bicycle (noun), b) Ride on a bicycle (verb)

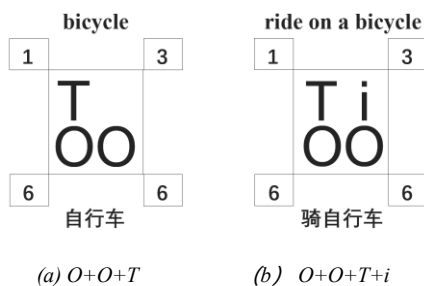
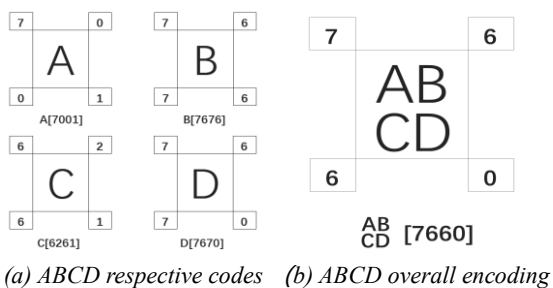


Figure 2. Cosmic Language - Alphabet Pictographic<sup>[1][2]</sup>

Coding Language: "田" Form Four character encoding.



\*Instructor, corresponding author - buaad@buaa.edu.cn, peaceful2022@126.com

Welcome scholars, teachers, and friends from all over the world to contact us, learn from each other, and strive for the progress of human language and culture around the world.

## 2. Hieroglyph: The most basic form of language

Characters in the world are divided into phonogram and ideographic characters. for example: English and Chinese.

Table 1. Examples of hieroglyph Chinese Characters: (part).

		1	2	3	4	5	6	7	8	9	10
一	one	人	口	手	牙	足	舌	耳	目	心	羽
		people	mouths	hands	teeth	foot	tongue	eyes	ears	heart	plume
二	two	山	水	冰	河	流	雨	田	雷	土	川
		mountain	water	ice	river	flow	rain	fields	thunder	soil	river

## 3. English and other spell character

English is a spell characters (script), but all 26 letters have their pictographic meanings.

## 4. A new language form - Cosmic language

The new language system, Cosmic Language, is a kind of language with both the shape and meaning of hieroglyph and the coding form of alphabetic (spell) characters.

Cosmic language ---- Combination coding method: Four corner number combination coding

Using the Chinese character four corner number encoding method. Use 0123456789 ten numbers to represent 10 classifications. The numbering order of the four corner numbers of a character is top left, top right, bottom left, and bottom right. The four characters of ABCD can be used separately, as shown in Figure 2 (a). The composed of ABCD is [7660], as Figure 2 (b).

### 4.1. Universal Language (1): Basic Word Units

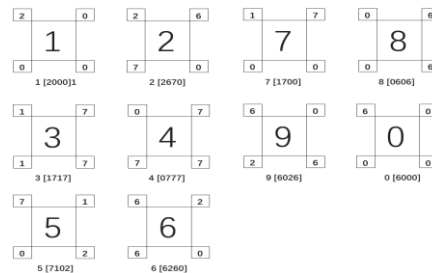
Encode using commonly used language letters and symbols from various countries.

**4.1.1 Cosmic Language.** An example of encoding Chinese characters with four corner numbers. As shown in Figure 3. Example of Chinese character four corner number encoding diagram

Figure 3. Chinese Cosmic Language Encoding.



Figure 4. Arabic Numeric Encoding.



**4.1.2. Cosmic Language.** Example of Arabic four corner digit encoding. As shown in Figure 4.

### 4.2. Cosmic Language (2): Basic Word Formation Methods

The basic way of combining characters is to use Chinese such as "口", "吕", "品", "田", and "朋".

**4.2.1. ① Single character structure.** The single character grouping method is to directly use the original character form, including spell characters (letters) .

For example, as A、B、1、2、°C、φ、口、中、品、田、朋、우、위、n、v、す、ض、ف etc.

**4.2.2. ② Two-character combination method.** '吕' structure: Figure 5 (a), (b), (c), (d). '朋' structure: Figure 5 (e), (f), and "巨" 5 (f). The four corner numbers as shown in Figure 6.

Figure 5. Pictographic Encoding Language for spell Characters.

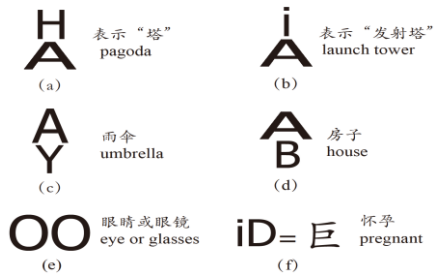
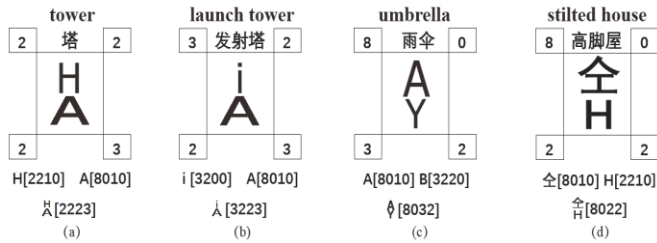


Figure 6. Four corner code.



4.2.3. ③ Three character "品" character structure word combination method. The structure of the character "品" has six arrangement forms. As shown in Figure 7, 8.

Figure 7. Cosmic Language: Car.

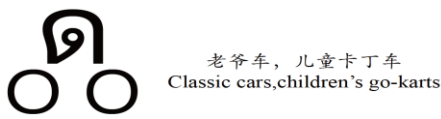
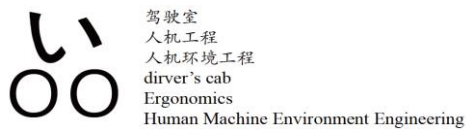


Figure 8. Cosmic Language: Ergonomics.

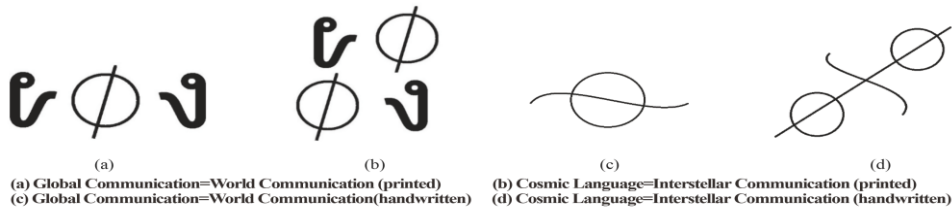


4.2.4. ④ Four character "田" character structure combination method. Example of code retrieval for three character and four character text patterns: as shown in Figure 1 (b) .

4.2.5. ⑤ Character string "朋朋" structure grouping method. Ixxi : communication, negotiation, ixxi communication, negotiation, and non-contact communication between people.

4.3. Cosmic Language (3): Examples of Printed and Handwritten Forms. As Figure9.

Figure 9. Cosmic Language - (a), (b) , printed, (c) 、 (b), handwritten .



4.4. Cosmic Language (4): New Language Pronunciation and Intonation

The people different regions can dub based on their own national language pronunciation.

4.5. Cosmic Language (5): Grammar and number of characters

The grammar mainly adopts the Chinese and English. The number of characters: many.

5. Conclusion

The newly invented cosmic language is easy to learn. International standards will be established.

**Purpose:** Exchange of World People & Communicating with aliens.

References

Chen Yq, (1983). *Triangle number dictionary* (First edition, Unified Book Number 17090-33). Shenyang, Liaoning People's Publishing House.  
 Revised by the Dictionary Research Center of the Commercial Press. (10th Edition, 2021, ISBN 978-7-100-4799). *Four Corner Number New Dictionary*. Beijing, Commercial Press.



# IMPLEMENTING COLLABORATIVE AND DIFFERENTIATED INSTRUCTION IN MIDDLE SCHOOL

France Dubé, Maryse Gareau, & Sophie Lanoix  
*Département d'éducation et formation spécialisées, UQAM (Canada)*

## Abstract

The objective of this action-research-training project was to contribute to the professional development of teachers by fostering collaboration and the planning of teaching/learning situations middle school, and to foster the engagement and success of students with learning difficulties. Supported by a collaborative reflective process, middle school teachers implemented differentiated and collaborative lessons which respected learning paces while promoting interactions among students. Fifteen consultation and co-planning meetings were held over two school years. Twelve teachers, an academic advisor, a special education teacher, two researchers and a research assistant participated in these meetings. Video clips of theoretical elements, supported by research knowledge and collective reflective exchanges, helped to support the implementation of teaching/learning situations. The verbatim of the interviews were analyzed thematically and revealed positive impacts on the professional development of the participants. Middle school teachers learned new teaching devices, implemented differentiated instruction, and enhanced collaboration among their students in the classroom. Analyses also show that these differentiated and collaborative approaches contribute to the success of students with learning difficulties in middle school while promoting their academic engagement and motivation.

**Keywords:** *Differentiated instruction, collaboration, middle school, special education, special needs.*

---

## 1. Introduction

The goal of this action-research-training project was to promote the success of secondary school students, with particular attention to those in junior high school. The collaborative planning of teaching-learning situations looked at group lessons involving interactions and collaborative approaches, combined with elements of pedagogical differentiation. The orientations of the Quebec Education Program and the Special Education Policy emphasize that the Work-Oriented Training Pathway must use pedagogical practices that are planned based on their relevance and effectiveness in meeting the diversified needs of students. These differentiated and collaborative approaches could contribute to the success of secondary school students and maintain their academic engagement and motivation.

## 2. Conceptual framework

Pedagogical differentiation can be defined as "an approach characterized by the choice and intentional implementation of practices that take into account the specificities of the students and the dynamics of the group, aiming to contribute to their academic success" (freely translated from Moldoveanu, Grenier & Steichen, 2016, p. 762). Perrenoud (1997) proposes greater fluidity in the organization and planning of school progression to favour interactive regulation by offering students differentiated learning situations rather than stabilizing groups/levels (Meirieu, 1989). Promoting the success of all students requires taking into account the heterogeneity that characterizes any group of students. Thus, pedagogical differentiation appears essential to meet the challenges that some students face in their school career (MELS, 2006).

Although cooperative learning has a similar meaning to collaborative learning, collaboration is a more spontaneous activity in which participants interact freely, and which is primarily aimed at bringing together and empowering participants who perceive themselves as equals whereas collaboration can be defined as a way of working together by making decisions in a shared way to achieve a common goal (Portelance, Pharand & Borges, 2011, in CTREQ, 2018).

### 3. Research questions

The research questions for this project were: (1) What are the conditions for implementing differentiated and collaborative teaching-learning situations in junior high school? (2) What forms and objects of differentiation have been implemented in the classroom? (3) What impacts have the participating teachers observed on their students?

### 4. Method

Teachers and school counsellors from three secondary schools in a school service centre located in Quebec, on the outskirts of Montréal, participated in the project. In all, nine teachers, one academic advisor, one special educator, one academic advisor-turned-researcher, one researcher and one research assistant participated in the meetings for this action research. All teachers and professionals taught students with learning difficulties enrolled in a Work-Oriented Training Pathway.

A total of 15 consultation and planning meetings were held over the course of the two-year project. These meetings were held in person or via an online Teams platform, which was also used to store all documents developed and shared by the participants and the research team. Except for the first and last ones, the meetings proceeded as follows: (1) feedback offered to teachers that piloted teaching-learning situations in their classroom; (2) co-planning of differentiated and collaborative teaching-learning situations (3) selection of the theme/topic for the next meeting. At the beginning and at the end of the school year, a semi-directed group interview was used to collect the participants' experience with differentiated instruction as well as the enablers and obstacles encountered in implementing it.

### 5. Results

Guided by a collaborative reflective approach (Gareau & Dubois, 2022), the participants and researchers worked on identifying the needs, abilities and interests of each student in order to plan and implement an educational differentiation where each student can evolve according to his or her own learning style and pace, within the group and in interaction with each other, using collaborative pedagogical approaches (Sejnost & Thiese, 2010). The action research loops contributed to a continuous, but sometimes iterative, cycle (Guay & Prud'homme, 2018), involving the sharing or development of tools, the co-development of differentiated and collaborative teaching-learning situations that were then implemented in the participating teachers' classrooms. Several participants reported that they learned a great deal from the sharing of their professional experiences. The collaboration was, of course, enhanced for the students, but also between the teachers who came from three different schools (Gareau & Dubé, 2021). Indeed, the meetings via the TEAMS platform allowed for the establishment of a collaborative network that exceeded the expectations of both the researchers and the participants. Collaboration among students was facilitated by planning and implementing it from the beginning of the school year. Some teachers incorporated collaborative activities into their weekly planning, where students were encouraged to interact, discuss and, most importantly, develop skills to collaborate with each other, while respecting and listening to each other. The teachers emphasized that this learning will be invaluable to them in their internships and, eventually, in the job they will be called upon to do in the near future.

### 6. Discussion

What distinguishes this project from the coaching usually offered to teachers is the systemic vision of the coaching offered and its frequency. In addition, it further puts the academic advisor into action within the co-development group. This allows for a better coaching in a collective reflective practice shared by the different actors and better supports the development of tools. It also ensures a richer collection of data, with a view to developing a more complete and more precise portrait of the abilities and needs, while promoting the professional development (of the competencies) of the teachers who were involved in the project.

It proves important to increase opportunities that foster collaboration and cooperation among students (Prud'homme et al., 2016). Although some teachers may be reluctant because of the behaviour management this may entail (Bergeron et al., 2021), the participating teachers have seen positive impacts on classroom climate. In the current study, instructional flexibility was the most common form of differentiation offered in the classroom, as opposed to a study that interviewed high school teachers who mostly modified tasks or implemented accommodations for students with learning disabilities (Bergeron et al., 2021). Indeed, the teachers who participated in our project offered many choices to their students to complete a task or project in class. As for the objects of differentiation, structures and processes were

most frequently identified in the interviews. In planning differentiated and collaborative teaching-learning situations, students were challenged to work in dyads, teams, and subgroups. The processes were also varied by offering several tools, various pedagogical approaches, and ways of completing the task that allowed for student choice.

There are several reasons for these interesting outcomes. The small number of participants allowed everyone to find a place to express themselves while allowing others to question and feedback on what was said and shared. This encouraged the emergence of findings, theories, and awareness that might not have emerged otherwise and that contributed to their professional development (Gareau, 2018).

## 7. Conclusion

Collaboration among teachers to plan teaching-learning situations that in turn fostered collaboration among students was tested in this action-research-training project. This resulted in increased engagement and success for the students, who had learning difficulties and were enrolled in a Work-Oriented Training Pathway. Further studies will be needed to explore the potential of collaborative and differentiated teaching-learning situations in junior high school to better engage students and ultimately foster their educational success. Differentiating the tools presented to students, particularly through the use of digital technology to interact with the text in order to better understand it, to write a variety of texts following an iterative writing process, or to carry out learning in collaboration with peers are avenues to be explored in future research (Dubé et al., 2019).

### Acknowledgements

The authors would like to thank the teachers, academic advisors and the special educator who participated in this project. This study was made possible thanks to the financial support of the Ministère de l'Éducation et de l'Enseignement Supérieur, as part of a special education partnership project.

### References

- Bergeron, G., Houde, G. B., Prud'homme, L., & Abat-Roy, V. (2021). Le sens accordé à la différenciation pédagogique par des enseignants du secondaire : Quels constats pour le projet inclusif? *Éducation et socialisation. Les Cahiers du CERFEE*, 59, Article 59. <https://doi.org/10.4000/edso.13814>
- CTREQ. (2018). *La collaboration entre enseignants et intervenants en milieu scolaire*. Québec: Ministère de l'Éducation et de l'Enseignement supérieur.
- Dubé, F., Ouellet, C., & Dufour, F. (2019). *Pratiques d'enseignement favorisant le développement de la compétence à lire et à écrire au secondaire en contexte d'inclusion scolaire*. [https://frq.gouv.qc.ca/app/uploads/2021/05/f.dube\\_rapport\\_synthese\\_pratiques-enseignement.pdf](https://frq.gouv.qc.ca/app/uploads/2021/05/f.dube_rapport_synthese_pratiques-enseignement.pdf)
- Gareau, M. (2018). *Pratique réflexive et autorégulation : favoriser le développement professionnel des étudiants à la fin de la formation en enseignement en adaptation scolaire et sociale de la formation initiale vers l'insertion professionnelle*, unpublished thesis, Université du Québec à Montréal.
- Gareau, M., & Dubé, F. (2021). Et si des situations d'enseignement-apprentissage différenciées et collaboratives pouvaient faire la différence? *Formation et profession*, 29 (2), 1-4. <https://doi.org/10.18162/fp.2021.a229>
- Gareau, M., & Dubois, M. (2022). Proposition d'une démarche réflexive collaborative favorisant le développement professionnel. In I. Vachon, S. Guillemette, & G. Vincent (Eds.), *La conseillancé pédagogique, une profession au service des écoles québécoises*. Les éditions JFD.
- Guay, M.-H., & Prud'homme, L. (2018). La recherche-action. In T. Karsenti & L. Savoie-Zajc (Eds.), *La recherche en éducation : Étapes et approches. 4e édition revue et mise à jour* (pp. 235–268). Presses de l'Université de Montréal. <https://doi.org/10.2307/j.ctv69sv3w.12>
- Meirieu, P. (1989). *Itinéraires des pédagogies de groupe. Apprendre en groupe? I et II*. Chroniques sociales, 3e éd.
- MELS (2006). *Programme de formation de l'école québécoise. Enseignement secondaire, premier cycle*. Gouvernement du Québec.
- Prud'homme, L., Paré, M., Leblanc, M., Bergeron, G., Dessermont Sermier, R., Noël, I. (2016). La différenciation pédagogique dans une perspective inclusive: quand les connaissances issues de la recherche rencontrent le projet d'éducation pour tous. In Prud'homme, L., Duchesne, H., Bonvin, P., et Vienneau (Eds.). *L'inclusion scolaire : ses fondements, ses acteurs et ses pratiques* (pp. 123–138). De Boeck Supérieur.
- Sejnost, R. L. et Thiese, S. M. (2010). Chapter 1: The Challenge of Adolescent Literacy. In Sejnost, R. L. & Thiese, S. M. (Eds.). *Building content literacy: Strategies for the adolescent learner*. (pp. 1–19). Corwin Press.

## COURSES IN ACADEMIC TEACHING - AN EXAMPLE FROM SLOVAKIA

**Tímea Šeben Zat'ková**

*Department of Education, University of Ss. Cyril and Methodius in Trnava (Slovakia)*

### Abstract

The aim of the study is to compare models of Courses in Academic Teaching (AT) conducted at several Slovak universities. There is also briefly described the pedagogical education in Slovakia as part of the internal form of further education for university lecturers at particular Higher Education Institutions (HEI). The text illustrates the experience with the implementation of courses in higher education at Slovak universities and summarizes results from questionnaire survey on the importance of the pedagogical preparation and educational needs of the course participants - university lecturers. In education, it is important to draw on the tradition and good practice proven by years of experience. Of course, it is not possible to unilaterally strengthen conservatism in approaches to education, but mainly to develop a tradition with regard to societal needs and developmental tendencies in education science. It is important to focus on prospects for development and modernization in orientation to increase quality and efficiency of higher education process. The source of inspiration for quality improvement is from variety of good practices, surveys and opinions of participants and graduates from various models of education. The study also intends to emphasize the requirement that teachers' work at any level of education (even in higher education) cannot be the result of high erudition in the scientific field and only intuition-based knowledge of education and its' principles.

**Keywords:** *Courses in academic teaching, university lecturers, opinions on pedagogical education, questionnaire survey.*

### 1. Introduction

Since the first universities originated, higher education has changed significantly with many new forms, methods and tools of teaching. University lecturers are confronted daily with innovations and social changes and their teaching methods need to reflect this. But are lecturers sufficiently prepared for their pedagogical activities in the contemporary education? What is typical for lecturers is the fact that they don't specifically prepare for their profession before they start practising (Petríková, Ondriová, 2015). Lecturers are constantly assessed in their scientific-expert activities, but the assessment of their teaching activities is usually limited to mere evaluation of the numbers of students. Faculties in Slovakia focus on requirements expressing the lecturers' qualifications, but the competencies related to teaching methods for example the ability to organise and communicate are not assessed (Kravčáková, Jelenová, 2010). There is not always a correlation between the quality of a teacher's subject knowledge and the quality of their teaching. Only a few Slovak universities provide their teachers with opportunities to improve their teaching skills. Pedagogical content knowledge (PCK) that teachers need to effectively teach a particular subject or course is essential. PCK combines content knowledge with pedagogical knowledge, or knowledge of how to teach that subject matter (Schulman, 1986; Rollnick, Mavhunga, 2017). Since 1989, there has been no legislative groundwork implemented to improve the pedagogical education of lecturers in the Slovakia, but their research-scientific and publication activities are subject to regular quality assessment under the accreditation process, and lecturers must comply with qualification requirements in line with Act No. 131/2012 on Higher Education Institutions and Act No. 269/2018 Coll. on Quality Assurance of Higher Education. In the former Czechoslovakia, the emergence of higher education pedagogy of AT began in the 1950s and it was developed in the 1970s and 1980s. In the 1980s the obligatory model of pedagogical education was introduced as "System of Enhancing Pedagogical Qualification of Higher Education Teachers". This system copied the systems of the Soviet countries codified by Decree No. 8/1983 as obligatory for all lecturers. It included two stages: 1. Basics of AT for young lecturers up to 5 years of experience; 2. a specialised course in AT for all lecturers up to 10 years' experience at HEI. After the 1989 (the end of the Communist Era), this system of education of lecturers collapsed. In the 1990s, pedagogical seminars occurred sporadically at universities as an interest-based and voluntary activity. Later, at the beginning of the 21st century again appeared efforts to introduce courses in AT at some HEIs (Vašutová, 2010; Novák, 2019).

## 2. Design and objectives

The aim is to describe and compare models of courses in AT conducted at Slovak universities and to describe how the PCK of lecturers is acquired at particular HEI. *RQ1*: What models of courses in AT exist in Slovakia? *RQ2*: What are the educational needs of lecturers in higher education? The research design for this study was a mixed-methods design. In accordance with this design, this study is composed of two phases; the first phase, qualitative data collection and analysis, was conducted to identify and describe the models of courses in AT. The second phase was quantitative data collection and analysis. The data is based on a survey with open and closed questions and document analysis.

## 3. Methods

The primary sources of the content analysis were 8 randomly selected web pages from all 33 HEIs in Slovakia. The content analysis approach aimed at freely accessible web pages of selected universities. A questionnaire survey for obtaining feedback from the respondents (the participants of the courses and workshops in AT) was used as a secondary research method. Surveys were obtained in 2021-2023. The data was analysed by statistical calculation or phenomenological analysis by the author. The study was based on a written survey containing a total of 22 open and closed questions, and was emailed to 46 graduates of the course at the SUA of whom 29 completed it. The same questionnaire was sent to participants of the workshop in AT at UCM (27 answered).

## 4. Results and discussion

HEIs in Slovakia organise their own pedagogical education (as a pedagogical minimum) according to their needs and on a voluntary basis. Courses in AT are based on internal directives, or as a part of habilitation and inauguration criteria, or as occasional courses organised and financed within grant projects. Selected models of courses in AT are summarized in table 1. On the official web pages, were not found any information about courses at 3 of the analysed HEI (Constantine the Philosopher University, Nitra; Matej Bel University, Banská Bystrica; Slovak University of Technology in Bratislava).

Table 1. Analysis of selected models of courses in AT.

University	Content of the course	Accreditation and organizational form
University of Žilina (UNIZA)	<b>Two level model:</b> 1. Course for PhD. students (23 lessons); 2. Course for the lecturers of engineering or economic orientation (116 lessons/2 years: 1 <sup>st</sup> year: Engineering pedagogy, ICT, Publication support; 2 <sup>nd</sup> year: Language education).	Internal Directive No. 200/2021: "Principles of the selection procedure for filling the posts of university teachers, researchers, professors and associate professors", and Directive 228/2022: "Professional Development of University Lecturers of UNIZA"
Technical University of Košice(TUKE)	<b>Two level model:</b> 1. Pedagogical Minimum for PhD. students; 2. Course in AT for lecturers (204 lessons/2 years).	The course is optional. Accredited by IGIP <sup>1</sup> (title obtained - ING-PAED IGIP)
Technical University in Zvolen (TU)	<b>One level model:</b> 2 years course (204 lessons/5 blocks) - the curriculum corresponds to the IGIP criteria.	Actual information not found - the last information from 2016 refers to a 2-year course from September 2016 to January 2018.
Slovak University of Agriculture in Nitra (SUA)	<b>Optional seminars:</b> - optional topics for lecturers (1 hour duration), who can choose from the list of offered 15 topics, the exact time and place is specified according to the interest.	Occasional seminars (webinars)/ workshops – optional - model is introduced since the year 2021; <b>Previously – One level model:</b> 3 semesters/2years, accredited by IGIP 2016-2020; re-accredited 2021-2025.
University of Economics in Bratislava (UE)	<b>Three-level model:</b> 1. course for PhD. students (2 days/introduction to the AT); 2. course for novice assistant professors (2 semesters/76lessons); 3. workshops for experienced teachers interested in selected issues ("Edubreak").	- Education is carried out in accordance with internal directive of the rector of UE (No. 3/2014) "Pedagogical Education for Teachers of the University of Economics in Bratislava) - accredited by a British organisation SEDA <sup>2</sup>
University of Ss. Cyril and Methodius in Trnava (UCM)	<b>Two level model:</b> 1. Course for PhD. students - part of the study plans as independent course - "Academic Teaching - Theory and Practice" (1 semester/26 lessons); 2. Occasional workshops under grants support (in 2012, 2014/2015 and 2022/2023).	- organization, scope and content depends on success of the grants (e.g. grants: ESF ITMS 26110230104 Support for the development of human resources in research and development; NFP312010BFQ3 Support of the internal quality assurance system of higher education at UCM)

<sup>1</sup>Internationale Gesellschaft für Ingenieurpädagogik (eng. The International Society for Engineering Education) <https://igip.org/>

<sup>2</sup>SEDA is the professional association for staff and educational developers in the UK, promoting innovation and good practice in higher education. <https://www.seda.ac.uk/>

Results from the questionnaires revealed motivational factors of lecturers to further their education in AT: *a requirement of the head of my department; a condition for professional growth; my own interest; partly self-interest and uncertainty whether this will be a condition for the staff selection procedure.* Courses in AT are seen as very beneficial or partially beneficial, no response indicated that they were useless. The preferred educational needs of the participants are mainly in the field of psychology, followed by pedagogy and foreign languages. Fewer responses indicated an interest in ICT and the professional field of participant' specialization. Participants prefer courses in the form of *active learning, model situations, and presentations of practical tips for teaching.* Particular areas of participants' weaknesses are: *applying a variety of teaching methods; creating didactic tests; nothing; communication with students; work with ICT; developing study materials for students; student results evaluation; ways of motivating students; time management.* Selected suggestions are: PSUA2: *"The course in AT should be compulsory for all. I recommend it to lecturers as well as doctoral students"*. PUCM13: *"I would like to be advised how to be creative when lecturing, how to captivate students with my lecture, how to motivate students and teach them to think about the topic and to have their own opinion on the issue"*. PUCM23: *"It would be better to define in advance for whom the course in AT is intended"*.

## 5. Conclusions

The analysed models of courses are situated mainly at traditionally non-teaching HEIs, engaged in engineering and economic education. These universities have a tradition and higher interest in the development of pedagogical skills in comparison to universities focusing on humanities, social sciences and teacher training study programs. Existing courses vary from occasional workshops and one level models up to multilevel models. Organization of the courses in AT opens up many questions related not only to the scope and content but also to their financing, accreditation, etc. Courses in AT at different HEIs have similar objectives, and they are to develop lecturers' PCK. The respondents confirm the positive feedback on the courses through their statements. Lecturers' motivational factors to attend the courses differ, but the majority are motivated by their intrinsic motivation. The suggestion that arose from the text is to establish the national system for funding the further education of lecturers with multilevel modular systems of their pedagogical education.

## Acknowledgment

Funded by the grant *KEGA004UCM-4/2022 "Promoting Health and Well Being through inclusive education in Higher Education"*.

## References

- Kravčáková, G., & Jelenová, I. (2010). Kľúčové kompetentnosti vysokoškolského učiteľa. In *Verejná správa a spoločnosť*. vol. XI(1), p. 40-56.
- Novák, J. (2019). Hlavné výzvy pre rozvoj pedagogického vzdelávania vysokoškolských učiteľov na ekonomickej univerzite v Bratislave. In T. Šeben Zaťková (Ed.). *Pedagogicko-psychologické vzdelávanie na vysokej škole v retrospektíve a jeho perspektívy*. Nadlac: Ivan Krasko.
- Petriková, D., & Ondriová, D. (2015). Potreba vysokoškolskej pedagogiky vo výučbe vysokoškolákov ako predpoklad kvalitnej prípravy pre učiteľské povolanie. In T. Šeben Zaťková (Ed.). *Vysokoškolská pedagogika a vysokoškolské vzdelávanie*. Nitra: Slovenská poľnohospodárska univerzita.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.
- Rollnick, M., & Mavhunga, E. (2017). Pedagogical Content Knowledge. In K.S. Taber and B. Akpan (Eds), *Science Education. New Directions in Mathematics and Science Education*. SensePublishers, Rotterdam. [https://doi.org/10.1007/978-94-6300-749-8\\_37](https://doi.org/10.1007/978-94-6300-749-8_37)
- Vašutová, J. (2010). Vysokoškolská pedagogika v profesionalizaci vzdelávateľů učitelů. In M. Siroťová and E. Frýdková (Eds.). *Vysokoškolský učitel: vzdelávateľ učitelov*. Trnava: FF UCM.

## INNOVATIVE TEACHING OF PHILOSOPHY THROUGH DRAMA: SOCRATES

**Anna Lazou<sup>1</sup>, & Giannis Spyridis<sup>2</sup>**

*<sup>1</sup>Department of Philosophy Laboratory of Philosophy & Art National & Kapodistrian  
University of Athens, Assistant Professor (Greece)*

*<sup>2</sup>Department of Philosophy Laboratory of Philosophy & Art National & Kapodistrian  
University of Athens, PhD Philosophy (Greece)*

### Abstract

Is it possible for a philosophical text to be something more than words? As philosophers we're trying to understand what constitutes life and in which ways, we can improve ourselves. Socrates with his proposal for an 'examined life' provides us with a perennial means of how we and our mental skills can benefit from philosophical inquiries. Art and drama on the other hand unfolds the human soul and strengthens it through physical action, emotional expression and social explorations. Assuming that Socratic philosophy is a starting point for an alternative method of philosophical education then the platonic allegories can be used by employing specific dramatic techniques as teaching tools addressing most of the problems concerning human life, culture and critical moral issues. In philosophical drama young students in class are invited (following the track of the Platonic Dialogues) to discuss and interpret situations and emotions using guidelines based on the Socratic Method of teaching philosophy with many educational and therapeutic applications.

***Keywords:** Socratic method, teaching philosophy, philosophical drama, platonic dialogues, critical thinking.*

---

### 1. Introduction

Teaching children & young students as 'young philosophers' marks the beginning of a new educational approach with the aim among others at closing the comprehensive gap between ancient and modern philosophy. Platonic drama and in particular the 'artistic' Socrates provide children and young people with the necessary background to reintroduce ancient philosophy in a playful way that can enhance their ability in complex matters such as critical thinking, expression of an emotion and interaction with others. The Socratic method combines different elements of approaching truth since dialectic and negation of knowing anything can be used in classroom between children and young students under the supervision of their teacher. The main purpose of this educational procedure is to exemplify philosophical thinking by exploring the personality and teachings of Socrates and adapting his famous curiosity in modern problems and situations. In addition, platonic drama intermingling philosophy with theater and dramatic practices addresses different educational issues related to both theoretical and practical matters (Lazou, Spyridis, 2019). Philosophy in collaboration with theater could insert movements upon theories (etc. platonic dialogues) and the result could be an interesting philosophical play referring to Socrates and his teachings. Thus, 'young philosophers' are invited to reconstruct a Socratic moment either derived from the platonic dialogues or using their own imagination to bring philosophy to life. Imagine a classroom transformed into an Athenian Street (agora) and the students as citizens of the 5<sup>th</sup> century BC!

### 2. Design

Previously obtained experience in the field by our research team had been staging Andrew Irvine's play, *Socrates on Trial* (2008) for university students and the open public. This experiment was repeated several more times in Athens and Municipalities of Greece (2015-2017) including those members of the audience who were actually participating to the deployment of actions on stage, by asking their own questions– interrogating the actors who played Socrates and Meletus– at a specific moment of the

performance, also voting as supposedly members of the Heliaia (Ἠλιαία) court and becoming at the same time ‘actors’ and revivers of the historical events concerning Socrates’ trial (Ibid, 2019).

Our aim among else in that experiment had been to support that a theatrical project like the one realized by playing Andrew Irvine’s *Socrates on Trial*, could enrich philosophical didactics within the University by adding an innovative and wider, as well as socio-political perspective, outside the typical classroom and different than the established learning processes.

### 3. Method

Teachers of philosophy should embrace alternative methods of teaching while concentrating on the importance of renewing the value of educational procedures. Our educational example about applying artistic Socrates in class does not refer only to drama, but also on several occasions, for example using dancing or other arts. This means that platonic philosophy may be approached and understood as something more than doctrines, words or ideas and reaching therapeutic ways which respond to an old question: Can philosophy be teachable through art? (Lazou, 2017)

Philosophical drama and in particular the platonic drama on the other hand has many applications which can be also found in other sciences. The innovation of the Socratic Method consists in the inquiry of what is believed as false and how we can achieve truth. During this process of examination everything we know can be altered in the same way that a theatrical play can appeal to our thought and change our beliefs. The proximity between philosophy and drama lies in the fact that both seek for freedom and critical thinking. The method discussed has been inspired by actual examples from all educational grades out of the authors’ experience in class and aims to further expand previously published research.

### 4. Objectives

The proposed method has further theoretical dimensions and educational applications concerning the role of philosophy in the contemporary world which are:

- a) The abridgement of theoretical teaching with experiential forms of education and art.
- b) Better understanding of the crucial bond between art and philosophy.
- c) Revealing unexplored psychological (such as the problem of personal identity, human relations, therapeutic needs of modern man etc.) and social aspects and situations (e.g., problem of justice, social role of the wise man, philosophy in education etc.) of drama practices in education.
- d) Application of the Socratic dialectic in the theatrical presentation of philosophical ideas as a specific therapeutic form of philosophical counseling – such as the so-called philosophical “Praxis” – since the 1970’s (Lazou, Spyridis, 2019).
- e) Providing innovative methodologies of teaching philosophy (e.g., Game-based-Learning of Philosophy and other technologically enhanced forms of learning) with substantial experiential material (Anagnostou, Enea, Ktena, Lazou, 2022).
- f) Enriching emotional intelligence by applying platonic drama in class for elementary school pupils or younger students.

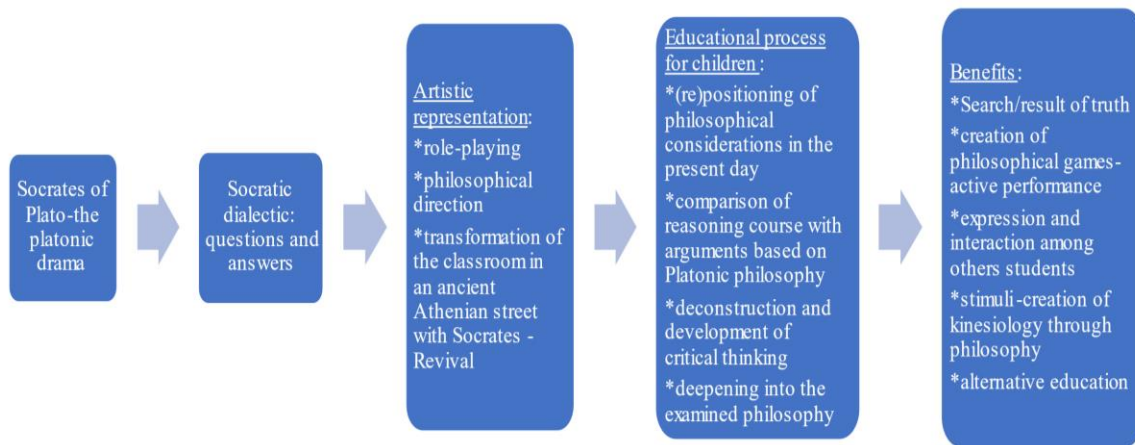
### 5. Conclusion

Consequently, the benefits of such an educational procedure are many, because of the multiple applications philosophy possesses. Teaching philosophy in a classroom should be adaptable and stimulate participation of young students in such a way as teaching practice does not look like an exact lesson but it appears to be a playful creative exchange of interesting ideas. Moreover, the artistic representation of Socrates through the platonic drama explores the differences between understanding ideas and thinking philosophically because ‘young philosophers’ not just follow the footsteps of Socrates, but they are trying to make philosophy on the spot.



Table 1.

## Teaching philosophy: The platonic drama



### References

- Anagnostou M., Enea Mele D., Ktena A., Lazou A. (2022). Philosophical Games in Primary Education: An Interdisciplinary Approach. In M. Carmo (Ed.), *Education and New Developments 2022*, June 2022, 567-571. DOI:10.36315/2022v1end126. Available from: <https://www.academia.edu/video/jYg3OI> & [https://www.researchgate.net/publication/362184324\\_PHILOSOPHICAL\\_GAMES\\_IN\\_PRIMARY\\_EDUCATION\\_AN\\_INTERDISCIPLINARY\\_APPROACH](https://www.researchgate.net/publication/362184324_PHILOSOPHICAL_GAMES_IN_PRIMARY_EDUCATION_AN_INTERDISCIPLINARY_APPROACH)
- Lazou, A. (2017). Instead of an epilogue: Teaching philosophy through art. In A. Lazou & G. Patios (Eds.), *Art Philosophy Therapy* 117-119. Athens: Arnaoutis Books. Available from: [https://www.researchgate.net/profile/Anna-Lazou/publication/314187662\\_ART\\_PHILOSOPHY\\_THERAPY/links/58b937c245851591c5d81115/ART-PHILOSOPHY-THERAPY.pdf](https://www.researchgate.net/profile/Anna-Lazou/publication/314187662_ART_PHILOSOPHY_THERAPY/links/58b937c245851591c5d81115/ART-PHILOSOPHY-THERAPY.pdf)
- Lazou A., Spyridis G. (2019). "Philosophical and Therapeutic Aspects of the Platonic 'Drama': Andrew Irvine's *Socrates on Trial*". Center for Open Access in Science <https://www.centerprode.com/ojas.html> *Open Journal for Anthropological Studies*, 3(2), 23-38. <https://doi.org/10.32591/coas.ojas.0302.010231>. Available from: [https://www.researchgate.net/publication/336246670\\_Philosophical\\_and\\_Therapeutic\\_Aspects\\_of\\_the\\_Platonic\\_Drama\\_Andrew\\_Irvine's\\_Socrates\\_on\\_Trial](https://www.researchgate.net/publication/336246670_Philosophical_and_Therapeutic_Aspects_of_the_Platonic_Drama_Andrew_Irvine's_Socrates_on_Trial)
- Lazou, A. (2019). Socratic 'Acting': Experiencing Dialectic. In A. Lazou (Ed.), *Socrates & Dialectic: On the Diachronicity of Thinking Philosophically* (195-208). Athens: Angelakis Publications.
- Spyridis, I. (2019). Οι κληρονόμοι του Στρεψιάδη (Strepsiades' Inheritants). In A. Lazou (Ed.), *Socrates & Dialectic: On the Diachronicity of Thinking Philosophically* (123-145). Available from: [https://www.academia.edu/44071305/Σωκράτης\\_and\\_Διαλεκτική\\_Η\\_διαχρονικότητα\\_του\\_φιλοσοφείν\\_Socrates\\_and\\_Dialectic\\_On\\_the\\_Diachronicity\\_of\\_Thinking\\_Philosophically](https://www.academia.edu/44071305/Σωκράτης_and_Διαλεκτική_Η_διαχρονικότητα_του_φιλοσοφείν_Socrates_and_Dialectic_On_the_Diachronicity_of_Thinking_Philosophically)

The background features a vertical gradient from light pink at the top to light orange at the bottom. It is overlaid with a complex network of white lines connecting various circular nodes. Some nodes are solid white, while others are semi-transparent or have a glow. Scattered throughout the network are several white icons: a globe, a cloud, a Wi-Fi signal, and a four-pointed starburst. The overall aesthetic is clean, modern, and tech-oriented.

# **VIRTUAL PRESENTATIONS**



# **THE EFFECT OF INTEGRATING GA'S INTO THE CURRICULUM ON THE DESIGN OF A NEW 3-YEAR MECHANICAL ENGINEERING DEGREE AT DUT**

**Mark Walker, Bruce Graham, & Shoreek Sheoratan**

*Dept. of Mechanical Engineering, Durban University of Technology, Durban (South Africa)*

## **Abstract**

The introduction of the South Africa Higher Education Qualification Sub Framework (HEQSF) in 2014 necessitated the replacement or alignment of all existing Higher Education qualifications. The Department of Mechanical Engineering at the Durban University of Technology (DUT) chose to replace the old National Diploma in Mechanical Engineering with a Bachelor of Engineering Technology degree (BEngTech, or "BET"), which was first offered in 2018.

The BET was structured such that it met the requirements of various stakeholders and statutory bodies, including the Engineering Council of South (ECSA). ECSA is designated by the Engineering Profession Act of 2000 as the statutory body responsible for quality assurance and accreditation of engineering programmes. In this role ECSA developed a small bouquet of qualification standards, including the new BET degree, which was selected by DUT. Included in these standards are prescriptions such as credit values, NQF levels, knowledge areas and 11 Graduate Attributes (GAs), all of which must be embedded in the programme. The ECSA qualification standards for the HEQSF aligned programmes are accredited according to an outcomes-based framework, as opposed to the content-based accreditation of the old programmes. The outcomes-based accreditation is focused on the GAs which must be developed and accessed.

ECSA stipulates that a student should not graduate unless they have passed an assessment of each GA. While the development of each GA occurs in several modules (taught exclusively by the department), it was decided that the assessment of them should only take place in exit-level modules. In addition, it was also decided that a student would fail a module that included the assessment of a GA if they failed the GA assessment. This would prevent graduation.

This paper briefly describes the process that was used to design the new BET and focuses on how the development and assessment of the GAs was embedded in the modules, as well as the quality assurance issues around that. Some preliminary analysis will also be presented to indicate the effect of the GAs on the success and graduation rates. The authors of this research adhere to a pragmatic paradigm where quantitative methods will be used, guided by the Grounded Theory Method.

**Keywords:** *Engineering, engineering education, graduate attributes, success rates, analysis.*

---

## **1. Introduction**

This paper describes the effects of integrating Graduate Attributes (GAs) into the curriculum of the Bachelor of Engineering Technology (BET) in Mechanical Engineering, at the Durban University of Technology. This paper will also describe a preliminary investigation, conducted to determine if the assessments used to measure competence in the GAs, would have an effect on student success, and hence throughput.

The study described above forms part of a larger project exploring the success of mechanical engineering students in this programme. The purpose of this larger project is to identify key factors leading to, or impeding, student success. It will also analyse the curriculum design, and implementation thereof, in order to test its conduciveness for student success. Several studies, all relating to student success will be undertaken, namely

- To determine if the entrance requirements are appropriate
- To identify factors leading to student success
- To identify factors leading to poor throughput rates
- To identify 'bottleneck' modules and propose interventions
- To investigate the effect of 'back-to-back' offerings of modules on student progression
- Investigate the effect of integrating GAs into the curriculum

## 2. Background

The Higher Education Act of 1997 laid the groundwork for South Africa's new higher education institutions, mandating the creation of a unified, coordinated higher education system. The goal of reforming higher education and its institutions was to fulfil the requirements of a society that is becoming increasingly technology oriented. (Mtshali and Sooryamoorthy 2019) It was also implied that via a process of amalgamation, the number of universities and technikons (which were similar to polytechs in the UK) would be reduced. In 2003 technikons were renamed Universities of Technology (UoTs) (Mtshali and Sooryamoorthy 2019) and the Durban University of Technology (DUT) was formed by the merger of ML Sultan Technikon and Technikon Natal.

The Higher Education Qualifications Sub-Framework Act No. 67 of 2007 (HEQSF Act) (South African Qualifications Authority 2013) established a single qualification framework for higher education institutions, as envisioned in the Department of Education's 1997 strategy. This was to hasten the creation of a single nationwide coordinated higher education system, with course harmonisation across programmes and student movement between higher education institutions. (Kapp 2019). All existing programmes needed to be aligned to the HEQSF, and any new programmes developed were similarly required to comply with the HEQSF.

The Faculty of Engineering and the Built Environment (FEBE) at DUT had previously offered three-year National Diplomas (NDip), followed by a one-year bachelor's degree in technology (BTech). Postgraduate qualifications, in the form of a Master of Engineering Technology, and a Doctor of Engineering Technology were also offered. The NDip and the BTech were not HEQSF compliant (and could not be aligned) and had to be replaced by entirely new programmes, whilst the postgraduate programmes could be aligned easily.

In developing these new programmes, the requirements of a number of stakeholders and statutory bodies needed to be met, particularly those of the Engineering Council of South Africa (ECSA), along with the (new) Department of Higher Education and Training (DHET), the Council of Higher Education (CHE), and the South African Qualification Authority (SAQA). The CHE is an independent statutory quality council for higher education in South Africa. Quality assurance is led and managed by them. Trends and developments are researched and monitored. The CHE initiates a critical conversation about current concerns in higher education and provides strategic and policy assistance to the DHET Minister. DHET is responsible for providing national strategic leadership in support of the Post-School Education and Training system for improved quality of life of South Africans. ECSAs' core functions are the registration of professionals, accreditation of programmes and the development of standards for educational qualifications.

The three main categories of professional registration administered by ECSA are Professional Engineers, Professional Engineering Technologists, and Professional Engineering Technicians. The category of registration is primarily dependant on the academic qualifications of the applicants. In order to align with the HEQSF, ECSA developed a suite of qualification standards, providing the academic requirements for registration in the various categories (Engineering Council of South Africa 2020). These standards all incorporate 11 *Graduate Attributes*, which must be embedded into the curricula, developed, and assessed (and in order to graduate a student must be considered competent in all 11 GAs). The 11 GAs are described in the first reference.

After consultation with its stakeholders, the engineering departments within FEBE chose to offer the three-year Bachelor of Engineering Technology (BET) followed by a Bachelor of Engineering Technology Honours (BEngTechHons).

Before the BET could be offered, a number of approval process were required. Firstly, a skeletal curriculum structure is presented to ECSA, and if it meets the requirements of the relevant standard, their endorsement is given. Subsequently university Senate approval is sought for an application to DHET for PQM (Programme and Qualification Mix) clearance. Once this is obtained a full curriculum, inclusive of module programme structure, prerequisite, module descriptors, entrance requirements etc, is submitted to CHE for approval. Finally, SAQA adds the qualification to its database of approved qualifications. It is only after this last stage is complete that a new qualification may be offered formally.

## 3. Integrating the GAS

A number of decisions were taken at the faculty level to ensure that the GAs would be developed, assessed and documented in a consistent manner. The assessment of GAs should only be conducted in 3<sup>rd</sup> year, exit level modules, offered by the department. Due to the importance placed on GAs, in relation to programme accreditation by ECSA, it was decided that only modules offered directly by the department, as opposed to serviced modules would be used to assess GAs.

In addition to the ECSA GAs, DUT has its own GAs. In order to avoid duplication, the university GAs were mapped against the ECSA GAs, and thus only assessment of the ECSA GAs is necessary.

Further it was decided, that passing the embedded GA assessment would be one of the requirements to pass the module. In other words, if a student failed the GA assessment, which may have been unrelated to the module content, they would not be able to pass the module. The rationale for this was to eliminate that the contradiction of a student passing a module, but not being able to graduate, as all GAs had not been achieved.

The GAs were to be assessed by using a competency scale, where students would need to demonstrate competence in all of the assessment criteria, as detailed in the assessment marking rubric. In the event of a student failing the assignment, or not demonstrating competence, they would be permitted to correct inadequacies in the work and resubmit. If the resubmission again fell below the required standard, the student would fail GA, and hence also the module

Once a GA had been assessed, the outcome was to be recorded as either 0 or 1 on the Universities Management Information System (MIS), where 0 denotes *not competent* and 1 *competent*. In addition to providing proof of competence on the student's academic record, the MIS is also set such that a subminimum of 1 is one of the requirements to pass the module. This effectively prevents the contradiction mentioned earlier.

By their nature, the GAs may not be directly related to the content of the module in which they are embedded. For example, *Graduate Attribute 9: Independent Learning*, is embedded in the module Fluid Mechanics 3. Its associated assessment criteria, shown below, have no direct link to the content taught in *Fluid Mechanics 3*. In order to assess this GA, the students are given a self-study assignment relating to pipe networks, a section of the module, which is not covered in lectures. They are then required to produce a report separated into two distinct sections, namely *Learning Strategy* and *Pipe Networks*. The *Learning Strategy* section is used to assess the GA and consists of the following:

- Introduction Strategy/plans
- Detailed comments on where/how information was sourced and well as the appropriateness of said sources
- Reflections on the success of the strategy employed, or comments on how the strategy was changed if the original strategy was unsuccessful
- References

Conversely in *Environmental Engineering* where, *Graduate Attribute 7: Impact of Engineering Activity* is assessed, the, the case study used for the assessment is directly related to the module content.

In subjects such as *Fluid Mechanics 3*, where the GA assessment is not related to the content taught in the module, there was concern regarding the possibility of students passing all the content related assessments but still failing the module due to a failed GA assessment.

As previously stated, all students in their third year of study must pass the GA assessments embedded in the modules. There was concern that the implementation of GA assessments could have negative success and hence throughput implications Specifically, the programme contains no electives, so if a student fails even one module, they would be delayed from graduating for at least a year. If a significant number of students were failing modules due to failing the GA assessments, this could be problematic.

In the event of a student not demonstrating competence in a GA assessment, it was decided that they would be given a second opportunity. It was hoped that this would mitigate the potential negative consequences to throughput. As of 2022, two cohorts had already finished their final year of study, and as such, it is an opportunistic time to investigate whether the GA assessments were affecting success and throughput.

#### 4. Investigation method

Quantitative methods guided by the Grounded Theory Method (GT) were utilised in this, and the larger investigation mentioned in the introduction. GT is a collection of tools and processes that allow researchers to find concepts and construct theories from data using a systematic approach. In the theory-generating process, GT is predominantly inductive, which implies that researchers travel from the particular to the general to explain occurrences (Corbin and Strauss 2014) . In developing theory, deduction and abduction play a part. The GT approach to these concerns is distinguished by its willingness to consider numerous answers, all of which are developed "from the ground up" from the information (Foley and Timonen 2015).

The Universities MIS system is used to record student outcomes, such as individual assessment grades, and final grades. As mentioned previously, each students' GA assessment result is recorded with a 0 or 1. As mentioned, any student with a 0 recorded for the GA assessment has failed the module. What is not immediately clear to the casual observer is whether the student has failed the module because of this GA assessment result.

Although a comprehensive analysis could not be carried out, the authors looked at the success rate (and failure rate) of the modules as a whole, as well as the success rate (and failure rate) of the GA assessment, in order to ascertain if a significant proportion of students are failing the modules due to the GA assessments.

Simplistically, if a student passed all assessments, in a module, except the GA assessment, it could be deduced that the GA was the sole cause of failure. Conversely, if the GA assessment results are removed from the final mark, and final mark remains a fail, we can conclude that the GA assessment is not the sole cause of failure.

For the years in question, class lists containing all assessment results were downloaded from the MIS for each module containing a GA assessment. Two modules, namely Strength of Materials 3, and Capstone Design Project were found to have incomplete information captured on the class lists. *Capstone Design Project* had no explicit information regarding the GA assessment for 2020, and *Strength of Material 3* had no information for either year - the lecturers involved were unsure, at the time, on how to record the GA outcome on the MIS. This has since been rectified.

Fortunately, in these two modules, the embedded GAs were in alignment with the module content to such an extent that it is not likely that a student would fail the GA assessment, yet pass the module. For example, Graduate Attribute 1: *Problem Solving* is assessed in Strength of Materials 3. In this GA, students are required to show competence in the application of engineering principles, to systematically diagnose and solve broadly-defined engineering problems. The content-based assessments typically consist of the types of problem solving illustrated above, so it is likely that the student would have passed the GA assessments as well.

Where a student failed a module, the final mark was recalculated, with the mark obtained for the GA assessment removed. If the final mark, after the recalculation, was a pass, the student would have been deemed to have failed the module due to the GA assessment.

Table 1. Failures due to gas in 2020 and 2021.

Module	Number of Students	Failed GA	% Failed GA	Failed module due to GA	Failed module	% Failed module
Capstone Design Project*	56	2	3.6%	0	2	3.6%
Environmental Engineering	146	5	3.4%	0	6	4.1%
Fluid Mechanics 3	104	3	2.9%	0	4	3.8%
Mechanics of Machines 3	136	8	5.9%	0	27	19.9%
Principals of Management	149	4	2.7%	0	10	6.7%
Thermodynamics 3	101	1	1.0%	1	4	4.0%

\*Data only available for 2021

## 5. Results

Given that the BET was only implemented in 2018, the earliest possibility for students to be in their third year would be 2020. For this reason, the years 2020 and 2021 were the only possibilities for this preliminary investigation. This study will be repeated, as more data becomes available.

Table 1 above shows aggregated results for both years, and each of the assessed modules, including the number of students enrolled in the module, the number of students who failed the module, the number of students who failed the GA, and the number of students who failed the module primarily due to failing the GA assessment.

## 6. Discussion

In the two-year period investigated, a total of 23 students failed GA assessments. Of these, 22 would have failed the module even if they had passed the GA assessment. In these 22 cases, it is obvious then, that the introduction of a GA assessment did not contribute toward the student failing the module.

*Thermodynamics 3* is the only module where a student passed all assessments yet failed the GA assessment.

*Graduate Attribute 4: Investigations, experiments and data analysis* is embedded in *Thermodynamics 3*. This is a GA that is not directly related to the module content and is assessed via a laboratory/practical investigation and report. Considering that in the two-year period, 101 students were registered for this module, this one failure is an outlier and cannot be considered significant.

We can conclude that the GAs assessments have not had a significant negative effect on success and throughput in the years investigated. This investigation should be expanded to include further cohorts as the years progress.

## References

- Corbin, J. and Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications.
- Engineering Council of South Africa. Environment, E. A. T. B. (2020). *Qualification Standard for Bachelor of Engineering Technology (BEng Tech) ; NQF Level 7*. South Africa:
- Foley, G. and Timonen, V. (2015). Using grounded theory method to capture and analyze health care experiences. *Health services research*, 50 (4): 1195-1210.
- Kapp, K. (2019). The Implication of the HEQSF Act for Human and Financial Resources. Magister Educationis, University of Pretoria.
- Mtshali, M. N. G. and Sooryamoorthy, R. (2019). A research-inducing environment at a University of Technology in South Africa: Challenges and future prospects. *Futures*, 111: 194-204.
- South African Qualifications Authority. (2013). *Publication of the General and Further Education and Training Qualifications Sub-framework and Higher Education Qualifications Sub-Framework of the National Qualifications Framework* Pretoria: Government printer. Available: [www.gpwonline.co.za](http://www.gpwonline.co.za) (Accessed February 2022).



## MUSIC TEACHING AND LEARNING COMMUNITY SERVICE PROGRAM – TEACHING MUSIC TO ELDERS

**Pui Kei Lau**

*Moon Chun Memorial College, University of Macau (Macau)*

### Abstract

This paper explores the teaching of piano to retired elders in the community by non-music major undergraduate students. It evaluates the effectiveness of the program on students' personal development and their awareness of community service through reflections and self-evaluations from both students and elders. From recruitment, training and implementation, a group of students from different background participated in the volunteer service pilot program providing piano lessons to elders. Using music as a common language, they established a town-and-gown connectivity through the black and white keys.

**Keywords:** *Music teaching and learning community service, teaching music to elders, student affairs, pedagogy.*

---

### 1. Background

Music education is the field of study that explores the role of music in various educational settings. It includes both the teaching and learning of music theory, history, culture, performance, and composition, as well as the development of musical skills, creativity, and appreciation. Music education also aims to foster personal, social, emotional, and cognitive benefits of music for individuals and groups of diverse backgrounds, ages, and abilities.

Service-learning is a teaching and learning methodology which fosters civic responsibility and applies classroom learning through meaningful service to the community. The strongest service-learning experiences occur when the service is meaningfully immersed into ongoing learning and becomes a natural part of the curriculum that extends into the community ("Service-Learning Definition and Philosophy", 2023).

#### 1.1. Design

The University of Macau (UM) adopts a holistic education system based on the residential college (RC) system. Using RCs as a platform for integrating whole-person education through the systematic planning of experiential learning program, UM strives to nurture students in seven areas: Responsible Citizenship, Global Competitiveness, Knowledge Integration, Teamwork and Collaboration, Service and Leadership, Cultural Engagement, and Healthy Lifestyle ("Residential College System", 2023).

According to research conducted in the United States, participation in music ensembles can yield several benefits for students, such as the formation of meaningful social connections, a sense of community, stress reduction, enhanced self-esteem, improved musicianship, and greater group cohesion (Gouzouasis & Henderson, 2012; Stamer, 2004). However, in Macau, not all individuals have had access to musical instruction during their formative years. As a result, a Music Teaching and Learning program was devised, with the goal of encouraging college students to give back to the community by serving as piano instructors.

Started in 2021, the program started training non-music major students as student teachers to teach their peers, with each student teacher undergoing training to teach a particular music concept in a group setting, followed by individual piano lessons. After four weeks of learning fundamentals in a group setting, each teacher pairs up with a student to provide one-to-one coaching, doing simple solo and duet pieces for another six weeks.

As the program matured, it began serving local elders (aged 60-75 years old) in a 10-week piano program in 2023. The program aims to engage students in meaningful service activities that benefit the community and promote personal growth.

**1.2. Method**

To record students’ personal development during the 10-week program, students fill out pre- and post-program assessments and engage in weekly peer observations and self-reflections. Additionally, feedback from participating elders is documented through a questionnaire at the end.

**1.3. Need and objectives**

Education is a right since human life begins, but music education is often neglected because it is not viewed as a skill that can provide a living and it bears a relatively high cost. In Macau, music education focuses a lot on teaching children of different age groups and children with special needs, but there is no one working on teaching music to elders. This is the reason the author initiated a music teaching and learning program for elders.

Music, as an international language connects people, there is a need to pay more attention to the research and practice in music education for elders. Through this program, it is hoped that the educational purposes of self-development, and giving and serving can be cultivated in students while drawing more attention to music education for elders.

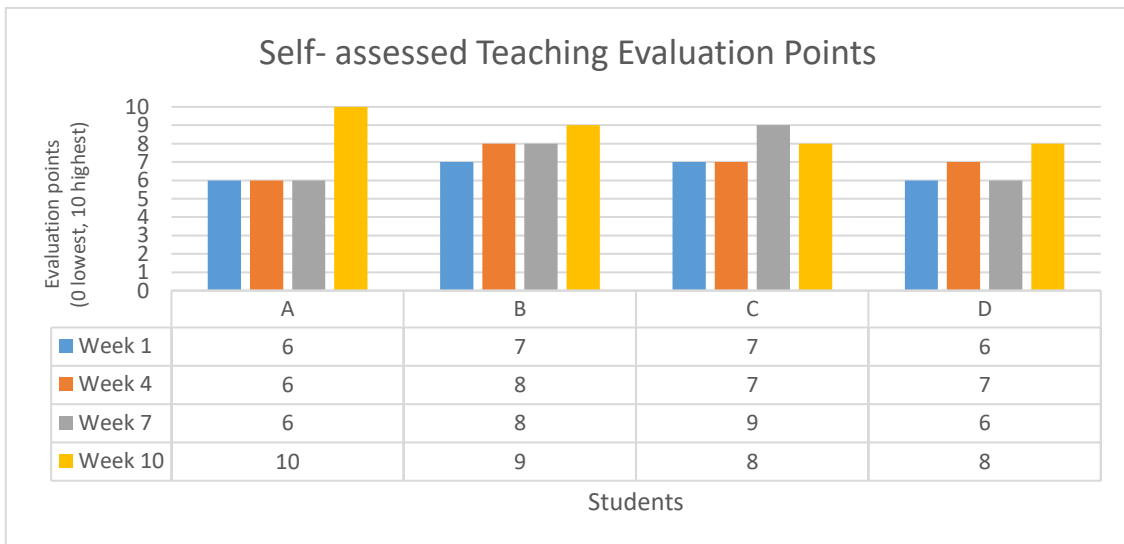
**2. Music teaching and learning community service program**

The Music Teaching and Learning Program connects university students with older adults through live and interactive piano lessons designed to engage seniors and introduce them to fundamental piano playing techniques. The program is designed to last for ten weeks, during which four university students (aged 18-20 years old) are selected through interviews and training to participate as piano teachers. They each teach one of four retired elders, with documented reflections each week evaluating their teaching performance through peer evaluations and self-reflections. At the end of the 10-week program, the elders also complete a questionnaire about their thoughts on the program and the teachers.

**2.1. Discussion**

Before beginning the program, all students fill out a pre-program survey. Piano proficiency of the selected students before the program vary from 6-14 years. Among them, three have no experience of any form of teaching before. The data collected from weekly self-reflections and pre- and post-program surveys are compared and presented below.

*Figure 1. Self-assessed teaching evaluation points.*

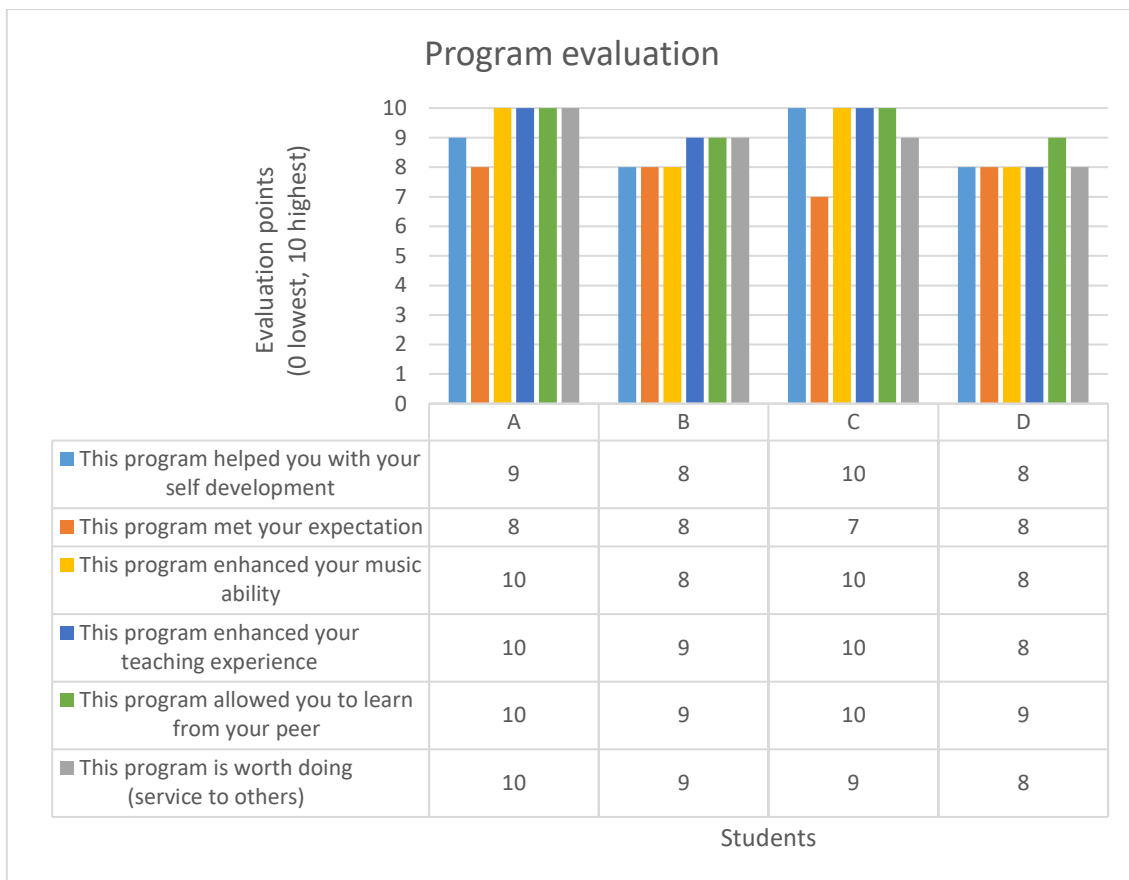


When comparing the self-assessment points given by students about their weekly teaching, not much difference is shown in the first six weeks. However, according to the weekly lesson survey, students expressed some common difficulties when teaching piano to elders, including communication and presentation skills, eye-hand coordination issues, and teaching effectiveness. All of them expressed a need to change their speaking speed and pattern when teaching elders. With the lack of practice by the elders after class, low attendance rates, and coordination issues, all student teachers expressed frustration between weeks 3-6 as they saw no improvement between lessons and did not feel that their teaching was effective (as shown in their self-assessment in Figure 1).

Recognizing that students had not yet found a way to improve the situation, the supervisor called the group for a brainstorming session after the week 6 lesson. During this session, students focused on researching and customizing various teaching methods and games suitable for elders to improve their understanding of the material. The group came up with four different ideas and agreed to try each one on their respective elder students in class. After teaching the week 7 peer-observed lesson, the group compared notes and found the most effective method for working with elders, and began adjusting their teaching plans for the upcoming weeks accordingly. As Student C's idea was the most effective, she gave herself the highest self-assessed points in week 7, while others gave themselves relatively the same points.

Reading the reflections from week 7, all students agreed that they had found a strategic way forward and that their remaining teaching sessions were rewarding and satisfying, as shown in week 10 in Figure 1. As the goals of the Music Teaching and Learning program are to engage students in meaningful service activities that benefit the community and promote personal growth, Figure 2 shows the effectiveness of self-development (self-development, learning expectations, music ability, and teaching experience), peer learning, and the enhancement of social responsibility through service to others.

Figure 2. Self-development assessment.



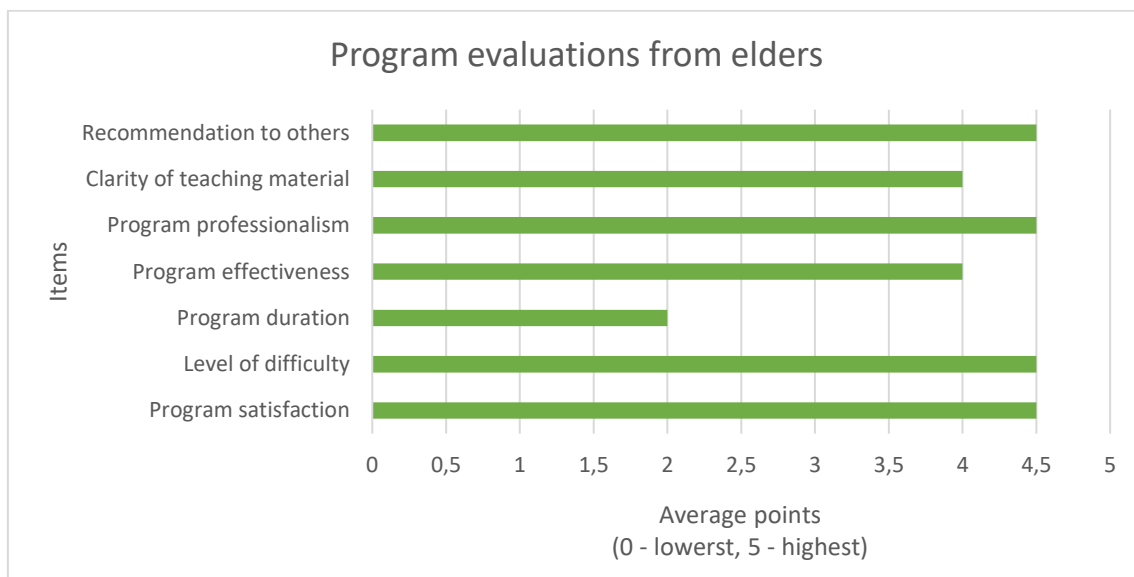
According to Figure 2, all students expressed positive feedback for the program’s impact on self-development, peer learning and enhancement of social responsibility. Among them, learning from peer received the most positive feedback, with a total of 38 points. Enhancement of teaching experience received 37 points, while both enhancement of social responsibility and music ability received 36 points. Self-development received 35 points, and learning expectation received the lowest score of 31 points among the six categories. As learning expectation receives the lowest point among the six categories, the data collected is compared in table 1.

Table 1. Pre- and pro- program comparison table.

Students	Learning expectations (pre)	Learning outcomes (post)
A	Enhance piano skills, to provide love and care to elders through art and music.	Increased affection to music, dealing with different teaching situations, improved communication skills.
B	Learn about piano pedagogy, integrate into future teaching, get teaching experience.	Enhanced musical knowledge, gained practical music teaching experience, apply to future teaching, improved music theory knowledge.
C	Learn about different teaching methods, want to learn and apply music teaching skills.	Acquired knowledge in working with elders and piano teaching skills.
D	Get teaching experience especially with elders, personal growth and satisfaction, spread music to more people.	Cultivated teaching responsibility, improved teaching methods.

When comparing learning expectations and learning outcomes in the pre- and post- program surveys, it actually matches with little deviation. Therefore, I deduced that the reason why learning expectation received the lowest score in the feedback survey is that the students had a different expectation to the learning behavior of elders. They did not expect that the elders, like teenagers themselves, would also skip classes and not complete their assignments.

Figure 3. Program evaluations from elders.



A questionnaire is given to the elders after completing the 10-week Music Teaching and Learning program to seek their opinion. The results, presented in Figure 3, indicated that the elders enjoyed the program immensely and acknowledged the professionalism of the student instructors. In the comments section, they also expressed a desire for the program to continue.

## 2.2. Limitations

The Music Teaching and Learning Program was launched with the support of a local non-profit organization, but there was one restriction: only four pianos were available for the 10-week program. As a result, only four students were recruited to teach four elders. To enable more students and elders to participate in music and community service, the program will be adjusted in the upcoming year to focus on associating music and movement with elders instead of instrumental playing.

Another limitation is that there was only one supervisor available to lead the students in all lesson planning, teaching, and reflection activities, so manpower and time were limited. It is hoped that in the next academic year, student teachers who have gained experience from this trial run can continue to serve by guiding and advising new recruits, allowing the program to grow and have a greater impact.

### 3. Conclusion

Through the Music Teaching and Learning community service program, elders can learn piano without any charge while participating students gain hands-on experience in teaching. The program received positive evaluations from the participants for fostering students' personal growth, collaborative learning and social responsibility. They expressed that the project was worthwhile and beneficial, despite the increased workload. Students also improved their music pedagogy skills, learned diverse teaching strategies from their supervisor and peers, and deepened their understanding of the philosophy of music education. Moreover, they experienced a sense of fulfilment and joy from serving the elderly.

The project enabled students to transform from learners to teachers, and also strengthened their awareness of service to others and intergenerational communication skills. Although the project involved only four students and four elders, it is hoped that it can raise more awareness in Macau society about the lack of music education services for elders at this stage and contribute to enriching the society through music.

### References

- Gouzouasis, P., & Henderson, A. (2012). Secondary student perspectives on musical and educational outcomes from participation in band festivals. *Music Education Research, 14*(4), 479–498. <https://doi.org/10.1080/14613808.2012.714361>
- Residential College System. (2023). Retrieved March 23, 2023, from [https://rc.um.edu.mo/Service-Learning Definition and Philosophy](https://rc.um.edu.mo/Service-Learning%20Definition%20and%20Philosophy). (2023). Retrieved March 23, 2023, from <https://dpi.wi.gov/service-learning/about#:~:text=What%20is%20Service%2DLearning%3F,meaningful%20service%20to%20the%20community>
- Stamer, R. A. (2004). Choral student perceptions of the music contest experience. *Update: Applications of Research in Music Education, 22*(2), 5–12.

## PRE-SERVICE SCIENCE TEACHERS' EMOTIONAL PROFILE DESIGNING IBSE ACTIVITIES: THE GENDER PERSPECTIVE

**Cristina García-Ruiz, Jorge Luque-Jiménez, Teresa Lupión-Cobos,  
& Ángel Blanco-López**

*Department of Science Education, University of Málaga (Spain)*

### Abstract

In recent years, gender has been one of the demographic variables most often used to describe differences between groups. It results in particular interest regarding science education since there is a gender gap related not only to the students' future career expectations but also there is an important emotional difference between two genders in order to face and perceive science education. These gender differences could persist in posterior stages of education, reaching master levels after a science degree. As is the case when they are referring to pre-service teachers, these differences could be important in the way of selection, design, and application of active methodologies such as inquiry-based science education or integrated STE(A)M education, especially in the use of these methodologies to investigate and promote scientific attitudes and values towards science. Hence, this study aims to gain insight into the possible gender differences in the emotions experienced by pre-service science teachers (PSSTs) when designing and presenting an inquiry activity for Secondary Education students. To do so, we applied an *ad hoc* emotion questionnaire adapted from the work of Jiménez-Liso et al. (2019), referring to the emotions achievement and epistemic emotions associated with the stages of the design of the inquiry activities. The questionnaire was issued to 43 Physics and Chemistry PSSTs, and the analysis was performed in terms of the gender they explicit (20 males and 23 females), collecting the frequencies of emotions and their percentage representation per participant and stage. Results show that, in general, female PSSTs show more insecurity, altogether with a greater concentration level, compared to the male PSSTs, revealing that the differentiated emotions expressed by female or male PSSTs when designing IBSE activities might be taking into consideration into pre-service teaching.

**Keywords:** *Pre-service teachers, inquiry-based science education, gender, emotions.*

---

### 1. Introduction

Well into the 21st century, and despite STE(A)M skills ensuring a more innovative and prosperous economy (Bacovic et al., 2022), in Spain, there is still a low percentage of secondary education students (less than 20%) that choose a STE(A)M profession as a future career option. Looking closely into the gender gap related, the case of female students is particularly relevant, with only 4% of representation in STE(A)M-related careers. Unfortunately, the underrepresentation of women in scientific and technological careers seems to be a general tendency (Penner, 2015) since Spain is currently in the average of the OECD countries in the matter (López-Rupérez et al., 2021).

Analysing this gender gap, several authors claimed three main reasons women are underrepresented in STE(A)M careers. Hence, Cheryan et al. (2017) summarise them in a cultural background in favour of masculine stereotypes around STE(A)M areas, scarce contact with scientific and technological contexts and gender differences in terms of self-efficacy.

Self-efficacy, understood as the level of confidence in implementing scientific research, is closely related to the development of the scientific identity, which is the degree of considering oneself a scientist. Regarding the gender differences mentioned above, and as stated by Miles & Naumann (2021), both concepts are critical in science education and are not equally gender-managed, with women reporting a lower perception of both self-concepts than men.

According to Aurah (2017), these perceptions are essential since students with a good perception of self-efficacy exhibit a major level of ambition related to their future careers, also getting higher marks in scientific fields, being one of the main aspects in women's election of STE(A)M careers. Consequently, the gender stereotypes around science could be the key factor making women have more

negative feelings about their scientific self-efficacy. Therefore, the emotional profile is related to the self-efficacy concept, playing an essential role in the relation of women with science, functioning like a decisive factor when selecting STE(A)M professions (Benlloch-Pla et al. 2018; Udo et al., 2004).

### 1.1. Gender emotional profile in pre-service teachers

Such gender differences in emotions and perceptions are present as well in pre-service teachers, and they could affect their teacher identity in the way of selection, design, and application of active methodologies such as inquiry-based science education or integrated STE(A)M education, particularly relevant in promoting scientific attitudes and values towards science (García-Ruiz et al., 2020).

It is assumed that teacher identity is strongly related to the notion of oneself and is immensely affected by the context, being also generally described concerning emotions and previous experiences (Avraamidou, 2014). Thus, according to Snyder et al. (2013), when changing from a professional STE(A)M career to becoming a teacher, it is necessary to build up a new identity, and the emotions experienced in the process should be well-driven in order to get a good level of autonomy and confidence (Waters and Dietzman 2015).

Taking into consideration the existing gender gap in STE(A)M professions, assuming the role that the experienced emotions play in it and knowing it is also shaped by pre-service teaching, our study explores the possible gender emotion differences in pre-service science teachers (PSSTs) when designing and presenting an inquiry-based activity for Secondary Education students. By doing so, we hope to gain insight into the gender gap and contribute to improving future teacher training programs with an exceptional view of the role of women in science teaching.

## 2. Methods

A total of 43 PSSTs participated in this study held at the University of Málaga during the academic years 19/20 (11), 20/21 (15) and 21/22 (17). All of them were enrolled in the master's degree in secondary education (MEd), in the specialty of Physics and Chemistry, a prerequisite for teaching in secondary schools in Spain, and held a bachelor's or a master's degree in either science or engineering.

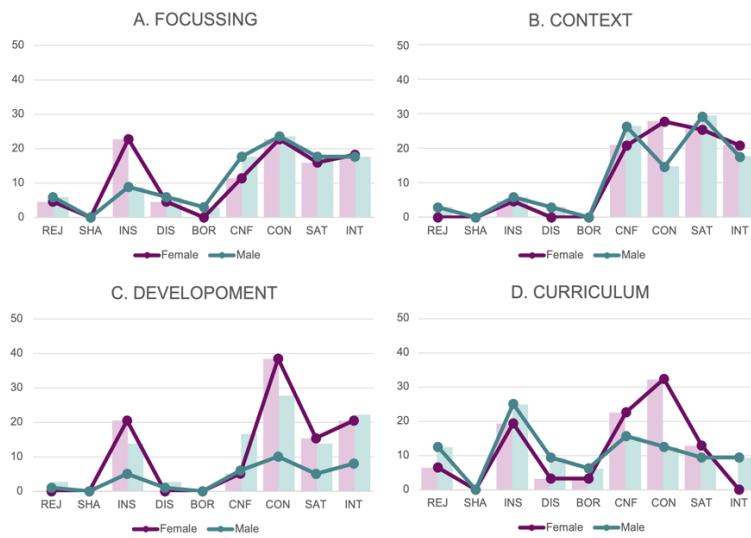
As research instrument, we applied an emotion questionnaire designed *ad hoc* and based on the work of Jiménez-Liso et al. (2019), which referred the emotions associated with the stages of the design of the inquiry activities (A: focusing; B: context, C: development, D: curriculum, E: management, F: assessment, G: presentation, and H: transfer into the practice). The questionnaire included achievement (confidence, satisfaction, shame, and dissatisfaction) and epistemic emotions (interest, concentration, boredom, rejection, and insecurity), and PSSTs could choose more than one emotion per stage. For its analysis, performed in terms of the gender PSSTs explicit (20 males and 23 females), a quantitative descriptive study was carried out with the RStudio program (version 1.3.1093), collecting the frequencies of emotions and their percentage representation per participant and stage.

Data were recorded after completing an IBSE training program, designed to promote PSSTs' understanding and implementation of inquiry-based teaching practice, integrate instruction in pedagogical content knowledge about IBSE, support the design and implementation of IBSE activities and encourage their transfer into practice (García-Ruiz et al., 2022).

## 3. Results

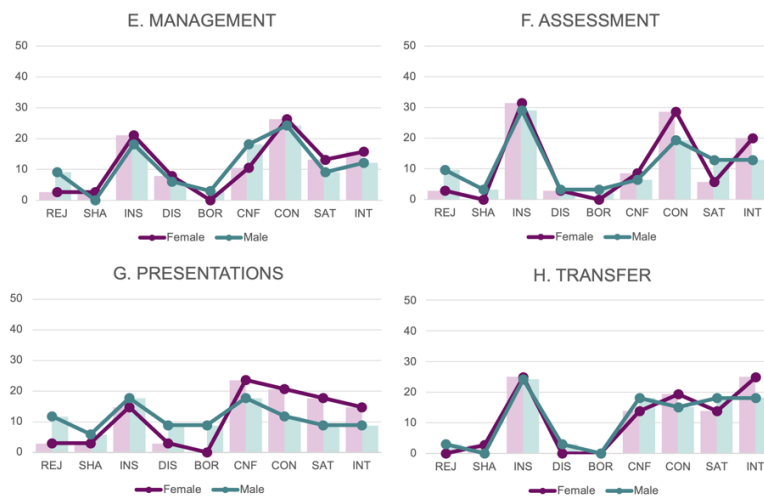
On designing IBSE activities and following the taxonomy of Pekrun and Linnenbrink-García (2014), that considers as positive emotions those associated with success and challenges (interest [INT], satisfaction [SAT], concentration [CON] and confidence [CNF]) and as negative those related to failure and abandonment (boredom [BOR], dissatisfaction [DIS], insecurity [INS], shame [SHA] and rejection [REJ]), figure 1 shows the emotional gender differences for stages A to D. Despite female and male PSSTs profiles looks quite alike, we would like to highlight several differences. While in stage A (focussing), there is a major selection of insecurity by female PSSTs, a tendency that is also observed in stage C (development), concentration is the other emotion more expressed by females in stages B (context), C (development) and D (curriculum).

Figure 1. Gender emotional profile for stages A-D.



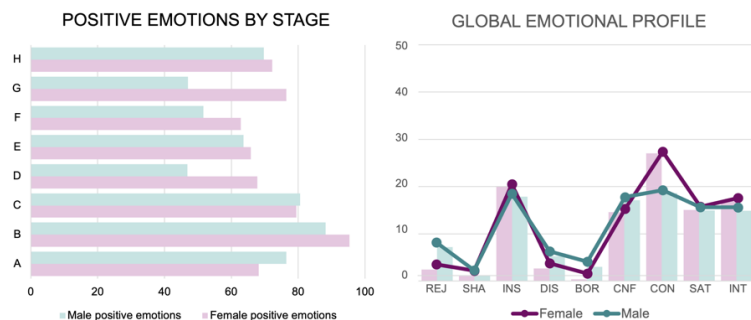
Regarding stages E-H, represented in figure 2, both female and male profiles are similar, with minor differences at stages F (assessment) and G (presentations), with female PSSTs greater expressing positive emotions than male PSSTs.

Figure 2. Gender emotional profile for stages E-H.



Considering the general profiles, figure 3 shows a more outstanding balance of positive emotions expressed by female PSSTs, particularly in stages B, D, and G. In terms of the type of emotion manifest, concentration is the one with major female representation.

Figure 3. General gender emotional profile.





#### 4. Discussion

Results show that female PSSTs show more insecurity when designing IBSE activities, altogether with a greater concentration level, compared to the male PSSTs. This result is particularly interesting when analysing each of the stages independently, with female PSSTs expressing more than double the level of insecurity in the stage of focussing, revealing that this first step might result in some difficulty for them. These results might be in accordance with those documented by Miles & Naumann (2021), who reported lower levels of self-efficacy and science identity in female university students. Hence, in the particular case of female PSSTs who experience a career change when moving into teaching from a professional STE(A)M background, as described by Snyder et al. (2013), they required the construction of a new self-conception through a process filled with both positive and negative emotions which arose as significant when becoming a science teacher (Waters and Dietzman 2015).

#### 5. Conclusions

One of the factors to diminish the gender gap associated with the STE(A)M careers depends directly on teacher training. Since PSSTs experience tensions that may become problematic, related to their teacher identity development and, ultimately, to the emotions they encounter when becoming a science teacher, it urges research into their emotional teaching profile. Consequently, the differentiated emotions expressed by female or male PSSTs when designing IBSE activities might be relevant when scheduling training programs aimed to provide emotional teacher support.

#### Acknowledgments

This study is part of the R&D Project PID2019-105765GA-I00 “Citizens with critical thinking: A challenge for teachers in science education”, funded by the Spanish National R&D Plan, through its 2019 research call, and the Project B1-2020-23 “Development and monitoring of the teaching identity of physics and chemistry pre-service and in-service secondary education teachers through a specific inquiry training program in the MED”, funded by the University of Málaga. Dr García-Ruiz was supported by the RYC program 2020, funded by the State Research Agency and the European Social Fund (reference: RYC2020-029033-I/AEI/10.13039/501100011033). J. Luque-Jiménez thanks to the reference project RYC2020-029033-I for the research contract received, co-financed by European funds.

#### References

- Aurah, C. M. (2017). Investigating the relationship between science self-efficacy beliefs, gender, and academic achievement, among high school students in Kenya. *Journal of Education and Practice*, 8(8), 146–153.
- Avraamidou, L. (2014). Studying science teacher identity: current insights and future research directions. *Studies in Science Education*, 50(2), 145-179. <http://dx.doi.org/10.1080/03057267.2014.937171>
- Benlloch-Pla, M., Solaz-Portolés, J. J., & Sanjosé-López, V. (2018). Ansiedad ante las ciencias y pruebas de evaluación científicas: efectos del nivel académico y género [Science and science assessment tes anxiety: gender and academic level effects]. *Revista Científica*, 1(34), 20–33. <https://doi.org/10.14483/23448350.13542>
- Bacovic, M., Andrijasevic, Z., & Pejovic, B. (2022). STEM education and growth in Europe. *Journal of the Knowledge Economy*, 13, 2348-2371. <https://doi.org/10.1007/s13132-021-00817-7>
- Cheryan, S., Ziegler, S.A., Montoya, A.K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin*, 143(1), 1-35. <http://dx.doi.org/10.1037/bul0000052>
- García-Ruiz, C., Lupión-Cobos, T., & Blanco-López, Á. (2020). Emociones y percepciones sobre indagación de profesorado en formación inicial [Pre-service teachers’ emoticons and perceptions about inquiry]. *Investigación en la Escuela*, 102, 54-70. <http://doi.org/10.12795/IE.2020.i102.04>
- García-Ruiz, C., Lupión-Cobos, T., & Blanco-López, Á. (2022). Effects o fan inquiry-based science education training program on pre-service teachers. A mixed-methods case study. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(12). <https://doi.org/10.29333/ejmste/12578>
- Jiménez-Liso, M. R., Martínez-Chico, M., Avraamidou, L., & López-Gay, R. (2019). Scientific practices in teacher education: the interplay of sense, sensors, and emotions. *Research in Science and Technological Education*, 1–24. <https://doi.org/10.1080/02635143.2019.1647158>

- López-Rupérez, F., Expósito-Casas, E., & García-García, I. (2021). Educación científica y brecha de género en España en alumnos de 15 años. Análisis secundarios de PISA 2015 [Science education and gender gap in Spain for 15 year old students. Secondary analyses from PISA 2015]. *Revista Complutense de Educación*, 32(1), 1-14. <http://dx.doi.org/10.5209/rced.66090>
- Miles, J., & Naumann, S. (2021). Science self-efficacy in the relationship between gender & science identity. *International Journal of Science Education*, 43(17), 2769-2790. <https://doi.org/10.1080/09500693.2021.1986647>
- Pekrun, R., & Linnenbrink-García, L. (Eds.) (2014). *International Handbook of Emotions in Education*. Routledge. <https://doi.org/10.4324/9780203148211.ch3>
- Penner, A. M. (2015). Gender inequality in science. *Science*, 347(6219), 234-235. <https://doi.org/10.1126/Science.aaa3781>
- Snyder, C., Oliveira, A. W., & Paska, L. M. (2013). STEM career changers' transformation into science teachers. *Journal of Science Teacher Education*, 24, 617-644. <https://doi.org/10.1007/s10972-012-9325-9>
- Udo, M. K., Ramsey, G. P. & Mallow, J.V. (2004). Science anxiety and gender in students taking general education science courses. *Journal of Science Education and Technology*, 13, 435-446. <https://doi.org/10.1007/s10956-004-1465-z>
- Waters, J. J., & Diezmann, C. M. (2015). Challenges confronting career-changing beginning teachers: a qualitative study of professional scientists becoming science teachers. *Journal of Science Teacher Education*, 26(2), 163-192. <https://doi.org/10.1007/s10972-014-9413-0>

# **SIGNIFICANCE AND ATTITUDE OF TEACHING APPLIED MECHANICS CALCULATIONS IN CIVIL TECHNOLOGY: STUDENTS ANALOGY**

**Khojane Geoffrey Mokhothu**

*Central University of Technology, Free State (South Africa)*

## **Abstract**

The principles of mathematics and science play a significant role in the Civil Technology curriculum. The study aimed to investigate the attitudes of the prior and topical students/teachers towards Civil Technology applied mechanics calculations. The objective of the study is to explore the significance of Civil Technology applied mechanics calculations to the teachers, also to evaluate the attitudes of the prior and topical students/teachers towards Civil Technology applied mechanics calculations. The purposive sampling applied to review data of the sample of 8 teachers (prior students) from five education district in the Free State province, also to select 24 students (topical). All 32 participants were from BEd and PGCE programme at the University of Technology. The research used mixed method consists of quantitative and qualitative to gather data, questionnaire and face to face interview were used as the instruments. The researcher analysed data, interpreted the results, and discuss the finding. The results revealed that participants do not have negative attitude towards Civil Technology applied mechanics calculations, moreover, they are ready to teach calculations. The results also indicated that few teachers need a refresher training on challenging area of the calculations. The participants suggested that the Department of Basic Education (DBE) should include applied mechanics back in the curriculum and partner with the Institutions of Higher Learning to provide them with special formal training on Civil Technology calculations. The results implicate that participants have positive attitude to teach Civil Technology applied mechanics calculations as they conduct a meaningful integration of practical and theory in the subject.

**Keywords:** *Civil Technology, mathematics and science principles, attitude and curriculum, applied mechanics calculations.*

---

## **1. Introduction**

Mathematics and Science principles ground the skills application in Civil Technology and the building environment in general. Hence, applied mechanics is regarded as a pillar to integrate science, mathematics, and Civil Technology or Technology subjects in general (DoE 2014: 9; Van der Walt, 2012: 46). Therefore, the study seeks to investigate and explore the significance of Civil Technology applied mechanics calculations to the teachers and to evaluate the attitudes of prior and topical students/teachers towards Civil Technology applied mechanics calculations.

## **2. The conceptualisation of the study**

### **2.1. Applied mechanics in Civil Technology**

Applied mechanics is the application of fundamental scientific and mathematical principles theory to practical meaning through calculations such as angle of forces, centroid, moments in general (beams), elasticity module (stress and strain), and frames, all of which concepts are considered the cornerstone of Civil Technology or all engineering programmes (Van der Walt, 2012: 46).

### **2.2. Civil Technology**

Civil Technology, conferring to the Curriculum and Assessment Policy Statement (CAPS), concentrates on principles and concepts in the built environment as well as the technological process (DoE, 2014: 9). It further concentrates on practical skills in addition to the application of mathematical and scientific principles (DoE, 2014: 9; DoE, 2014: 11; Maeko, 2016; Mokhothu, 2020; Mtshali, 2020).

## **3. The aim of the study**

The aim of the study was to investigate the attitudes of the prior and topical students/teachers towards Civil Technology applied mechanics calculations.

#### 4. The objective

The objective of the study was to explore the significance of Civil Technology applied mechanics calculations to the teachers, also to evaluate the attitudes of the prior and topical students/teachers towards Civil Technology applied mechanics calculations.

#### 5. Assumption

Students seem to have positive attitudes towards applied mechanics in Civil Technology. Also, students deem applied mechanics a correct chapter to integrate mathematics and scientific principles in Civil Technology theory and practical work.

#### 6. Methodology

##### 6.1. The context of the study

The researcher revisited Mokhothu's (2015) finding about the attitude of the teachers about Civil Technology applied mechanics calculations. Further revisited official policy documents and empirical literature about the history of Civil Technology as a subject. Additionally, from the reading, the researcher developed an assignment to inquire about the views of topical students in all the departments of the relevant field of study in order to compile and develop analogies of perspectives from both prior and topical students.

##### 6.2. Participants

All participants were Civil Technology students (both prior and topical), males and females, from one of the University of Technology in South Africa. The total number of participants was N=32, which consisted of n=8 teachers (prior students) from five education districts in the Free State Province and n=24 students (topical) enrolled at the University of Technology. All 32 participants were from the BEd (FET) specialisation Technology, BEd (SP & FET) Technology and the PGCE programme at the University of Technology. All PGCE participants were NQF level 6 and 7 graduates from Civil Engineering, Construction Management, and Quantity Survey, or the building environment in general.

##### 6.3. Procedure

Purposive sampling was applied to review data, both quantitative (questionnaire) and qualitative (interviews) of 8 teachers (prior students), in Mokhothu's (2015) MEd dissertation. The assignment was given to 24 students (topical) to analyse the history of Civil Technology from three Department of Basic Education (DBE) documents: the Learning Programme Guidelines (LPG), the Curriculum Assessment Policy Statement (CAPS 1), and the Curriculum Assessment Policy Statement (CAPS 2). They were also asked to find the gaps and make recommendations. The analysis was presented and discussed in class, and common conclusions were grasped.

#### 7. Results presentation, interpretation, and discussion

Table 1. applied mechanics and mathematics and science principles prior students.

	Total Number (N)	Frequency (n)	Percentage (%)
<b>More towards strongly agree</b>			
<b>Q1</b> Civil Technology curriculum establish general background of civil engineering	<b>8</b>	<b>8</b>	<b>100%</b>
<b>Q2</b> Integration of mathematics and science principles applications shows the important of Civil Technology curriculum	<b>8</b>	<b>8</b>	<b>100%</b>
<b>Q5</b> I recommend full training course in applied mechanics	<b>8</b>	<b>8</b>	<b>100%</b>
<b>More toward strongly disagree</b>			
<b>Q3</b> Mathematics and scientific principles make Civil Technology less interesting subject	<b>8</b>	<b>8</b>	<b>100%</b>
<b>Q4</b> I lack confidence in teaching applied mechanics in Civil Technology curriculum	<b>8</b>	<b>8</b>	<b>100%</b>

**Interviews: Main question to both prior and topical students:** Did you find mathematics and scientific principles applied in Civil Technology beneficial to the integrated curriculum?

**Main Theme:** Role of Mathematics and Physical Science in Civil Technology.

Table 2. Mathematics and Science in Civil Technology responses.

<b>Responses of prior student</b>
All 8 participants responded positively; they pronounced that mathematics and science principles play a major beneficial role as they translate theory into practical through an integrated curriculum. They further claimed that to understand the strength of material and its behaviour, it requires students to have a clear background in physical science, and to manipulate calculations, it also requires a clear background in mathematics. Therefore, applied mechanics integrates all these three subjects.
<b>Responses of topical students</b>
In summarising all the responses from 24 topical students, they also arrived at the same conclusion as they mentioned mathematics and physical science as being an opener to analysis and logical thinking, or critical thinking, to become a problem solver. They further highlighted a few examples, such as how to design a bridge, a foundation, and a roof, which require a student to have both scientific and mathematical knowledge. One also asked how you design a cantilever beam without a calculation; that would require a student to learn applied mechanics. In addition, for the student to understand the reinforcement of concrete, it requires applied mechanics. If we keep on ignoring applied mechanics, we will only produce artisans without critical thinking and engineers without a strong foundation in Civil engineering calculations.

In table 1, Q1, Q2 and Q5 students in majority strongly agree with frequency of n=8 and percentage of 100%. While in Q3 and Q4 majority of students strongly disagree. The finding in table 1 proves the assumptions of the study correct. In general, all the results revealed that participants do not have negative attitude towards Civil Technology applied mechanics calculations, moreover, they are ready to teach calculations. The results also indicated that few teachers need a refresher training on challenging area of the calculations. The participants suggested that the Department of Basic Education (DBE) should include applied mechanics back in the curriculum and partner with the Institutions of Higher Learning to provide them with special formal training on Civil Technology calculations. Therefore, results concur with Nugent *et al*, (2010) when pronouncing that the increasing workforce demands necessitate the development of even more sophisticated skills in science, mathematics, engineering, and technology for the next generation of workers (Nugent, Kunz, Rilett, & Jones, 2010:4)

## 8. Conclusion

The results implicate that participants have a positive attitude towards teaching Civil Technology applied mechanics calculations as they conduct a meaningful integration of practical and theoretical knowledge in the subject. Therefore, students uphold the continuation of teaching applied mechanics in the Civil Technology curriculum.

## References

- Department of Education. [DoE] (2008). *Learning Programme Guidelines Civil Technology*. Pretoria: Department of Education.
- Department of Basic Education. [DoE] (2014). *Curriculum and Assessment Policy Statement*. Pretoria: Department of Education.
- Department of Education. [DoE] (2014, July 18). *Government Gazette – Republic of South Africa* (Vol. 589 No. 37840). Pretoria: Department of Education. <http://www.saflii.org/za/gaz/ZAGovGaz/2014/677.pdf>
- Maeko, S. (2016). *Investigating the instructional practices of the practical component of Civil Technology for lecturer training in selected South African Institutions of Higher Learning* [Doctoral dissertation: Tshwane University of Technology, Pretoria, South Africa].
- Mokhothu, K. G. (2015). *The Integration of Technical Subjects in Civil Technology Curriculum with Special Reference to FET Technical Schools* [Master's thesis: Central University of Technology Free State]. <https://core.ac.uk/download/pdf/222967554.pdf>
- Mokhothu, K. G. (2020). Investigating the impact of learn by doing in Civil Technology class: Students Action. In C. Mafalda (Ed.), *Proceedings of 8th International Conference on Education and New Developments (END)* (pp. 164-167). ISBN: 978-989-54816-2-1
- Mtshali, T. I. (2020). Critical thinking skills for Civil Technology practical assessment task (PATs). *World Transactions on Engineering and Technology Education*, 18(2), 237-241.
- Nugent, G., Kunz, G., Rilett, L., & Jones, E. (2010). Extending engineering education to K-12. *The Technology Teacher*, 69(7), 14-19.
- Van der Walt, P. N. (2012). *Civil Technology for Grade 11* (2<sup>nd</sup> ed.). Bloemfontein: Van der Walt Civil books-publisher.

## ASSESSMENT OF THE SUB-COMPETENCES OF ENTREPRENEURIAL COMPETENCE IN THE BASIC SCHOOL

**Külli Hiimäe-Metsar<sup>1</sup>, Krista Uibu<sup>1</sup>, & Mervi Raudsaar<sup>2</sup>**

<sup>1</sup>*Institute of Education, University of Tartu (Estonia)*

<sup>2</sup>*School of Economics and Business Administration, University of Tartu (Estonia)*

### Abstract

Age-appropriate entrepreneurial competence increases the well-being of the individual and society because diverse abilities and competences must be applied in entrepreneurship. Entrepreneurship is defined through the entrepreneurial process, which begins with the recognition and action of an entrepreneurial opportunity and ends with the implementation of a new idea. In the development of entrepreneurship competence, the assessment of the development of cognitive and social skills is difficult and novel in the field due to the abundance of entrepreneurship sub-competences and their different starting points. The purpose of the study is to create and validate a test to assess the knowledge and attitudes of basic school students about entrepreneurship. 19 Estonian basic schools of different locations and sizes participated in the test. The test was taken by 616 students who were divided into 3rd grade (N=326) and 6th grade (N=290) students. The test contains special types of tasks, e.g., multiple-choice tasks, each answer of which provides information about the learner's knowledge or attitude about at least one entrepreneurial sub-competency. There were three tasks in the test to measure each sub-competency. The tasks (N=34) were divided into multiple-choice situational tasks and self-directed tasks. The entrepreneurial sub-competences were: (1) self-efficacy, (2) motivation and risk-taking, (3) economic and financial literacy, (4) planning and management skills, (5) sustainable thinking, (6) community initiative, (7) environmental awareness and ethical thinking, (8) teamwork, (9) valuing ideas and opportunities, (10) vision and creativity. As a result, the tasks measuring sub-competences were divided into three categories: ideas and opportunities, resources and into action. As the main results of the study, the responses of the 3rd and 6th grade students differed, and it was found that the 3rd grade students achieved the best results on the tasks categorized according to the self-efficacy dimension and the lowest results in tasks measuring economic mindset competences. In contrast, 6th graders achieved the best results in tasks assessing ideas and opportunities and the worst results resources mobilization in tasks. As a result of the study, a test was prepared and validated, which enables the evaluation of sub-competences in entrepreneurship. As a result of the purposeful assessment of the sub-competences of entrepreneurial competence, there is an opportunity to develop entrepreneurial competence in the 3rd and 6th grades.

**Keywords:** *Entrepreneurial competence, assessment, cognitive, social, basic school.*

### 1. Introduction

People with entrepreneurial competence are needed both in business and for the development of the well-being of society (Fayolle and Linan, 2014). In the field of entrepreneurship, a person can use his various abilities and sub-competences, thereby supporting the growth and well-being of personal development (Wiklund, 2019). Entrepreneurship is defined through the entrepreneurial process where sub-competencies of entrepreneurial competence manifest themselves from noticing an entrepreneurial opportunity to implementing a new idea (Shane, 2012, Mets et al., 2022). Different authors agree that cognitive and social skills developed in basic school age (Bandura, 1986, Ryan & Deci, 2000) promote the development of entrepreneurial competence sub-competences (Bacigalupo et al., 2016, Saptono et al., 2021). Among the sub-competences of entrepreneurial competence, economic and financial literacy is based on economics, which Albert Marshall defines as "the study of man in the ordinary activities of life". Therefore, the approach to entrepreneurial competence is based on an economic mindset, where most of us want to change the world, but to change the world, it is important to first understand it.

Previous empirical studies partially highlight the sub-competences of entrepreneurial competences that develop in a child's cognitive and social development, which, based on social cognitive theory, focus on self-determination, self-efficacy and social skills (Bandura, 1960), Profit theory economic and entrepreneurial process thinking (Knight, 1921, Shane&Venkataraman, 2000 ) and creative problem solving (Osborn&Parens, 1953) and creativity theory (Amabile, 1983) dimensions (Montroy et al, 2016, Ndou et al., 2018, Silveyra et al., 2021). For example, studies of entrepreneurship competence show that sub-competences based on the entrepreneurial process are assessed in general terms or only in terms of some sub-competences, for example, the development of teamwork and cooperation skills during participation in projects. However, when assessing entrepreneurial competence, it is necessary to distinguish sub-competences from which to base the development of entrepreneurial competence in basic school (Saptono et al, 2021). It has been pointed out as a problem that the assessment of the various sub-competences needed in the entrepreneurial process is difficult (Fayolle&Linan, 2014, Mets et al., 2022), because there is no clarity regarding the sub-competences of entrepreneurial competence that develop according to age and their assessment tools. Tests are used to assess the development of students' sub-competences in the learning process (Vestheim&Lyngsnes, 2016).

## **2. Sub-competences of entrepreneurial competence in basic school**

Entrepreneurial competence is related to the wider cultural, social, political, and economic situation of society (Keane et al, 2016). Entrepreneurial competence in basic school is defined as a learning process in which different sub-competences of entrepreneurial competence are supported (Montroy et al, 2016). For example, the ability to find opportunities and ideas that create value for others. The value created in the entrepreneurial process can be financial, cultural, or social, which is supported by the development of entrepreneurial competence and the formation of an entrepreneurial attitude in basic school. Attitude is understood as a comprehensive competence that includes sub-competences of entrepreneurial competence, such as creativity, communal or social will (Tiemensma&Rasmussen, 2019).

Based on the EntreComp model, in order to distinguish the sub-competences of entrepreneurial competence, the groups of sub-competences are divided according to the dimensions specific to the entrepreneurial process: ideas and opportunities (1), resources (2), into action (3) (Bacigalupo et al, 2016). In basic school, the EntreComp model is not suitable as a basis for assessing entrepreneurship competence, because it is difficult for the teacher to implement the model that gathers 15 sub-competencies in practical teaching. The disadvantage of the M-TEC entrepreneurship competence model is that it does not consider the dynamic nature of the business process (Mets et al. 2022, Silveyra et al. 2021). Therefore, a more suitable model for basic school is necessary for the assessment of various sub-competences.

The sub-competences assessed using the validated model are a prerequisite for the development of the student's entrepreneurial competence (Ilonen & Heinonen, 2018). Of the various sub-competences of entrepreneurship in basic school, entrepreneurship education has a positive effect on entrepreneurial self-efficacy and teamwork skills, which develop effectively in the 3<sup>rd</sup> and 6<sup>th</sup> grades (Saptono et al, 2021). Therefore, it is necessary to use age-appropriate tasks to assess the development of the student's entrepreneurship competence sub-competences and to develop an entrepreneurial attitude.

## **3. Assessment of the age-appropriate development of students' entrepreneurship sub-competences in the 3<sup>rd</sup> and 6<sup>th</sup> grades**

In 3<sup>rd</sup> and 6<sup>th</sup> grades, cognitive processes, self-determination, and entrepreneurial self-efficacy develop in the child's development (Bandura, 1977, Ryan&Desi, 2000). It is relatively easy to assess the student's way of thinking (cognitive skills) and social relations, which describe the student's actual knowledge and ability to remember, understand, apply, analyse, and synthesize (Ilonen&Heinonen, 2018). It is important that prior knowledge, attitudes, skills, and their pace of development determine what the student pays attention to when studying, which is why it is necessary to assess the sub-competences of entrepreneurial competence at different school levels to develop the student's entrepreneurial competence (Ilonen&Heinonen, 2018, Saptono et al., 2021).

The development of different sub-competences is possible through the development of cognitive and social skills and based on the attitude formed from prior knowledge. At different age levels, the sub-competences of students' entrepreneurial competence develop differently, for example, self-efficacy, motivation, creativity, planning skills, economic thinking, risk-taking, perception of the surrounding environment (Keane et al, 2016). The student's prior knowledge (common concepts, well-established knowledge) is manifested when solving tasks that distinguish different sub-competences, including discussing problems and situations where the student uses critical thinking when answering

multiple-choice questions (Lamb et al, 2020, MacCord et al, 2018, Vestheim & Lyngsnes, 2016). Previous studies have found that students develop critical and logical thinking in grades I and II, which is why tasks of different complexity are used to assess the sub-competences of entrepreneurial competence (Aronshtam et al, 2021).

Such tasks provide an opportunity to develop the student's initiative, problem-solving skills, innovativeness, creativity, and teamwork skills (Jardim et al, 2021). For example, in 1st grade, 7-8-year-old students, entrepreneurship manifests itself in finding an idea to solve a problematic situation and during the activity (Pepin, 2018), then different sub-competences of the student can be assessed. In basic school, assessment tools for students' entrepreneurial competence have also used aspects of social entrepreneurship development (Pinho et al, 2019), but the student's self-confidence, argumentation, respect, and sense of responsibility competencies have also been assessed (Feire, 1996). To the extent that the purpose of assessing the sub-competences of entrepreneurial competence is to find out the student's knowledge and attitudes about the sub-competences of entrepreneurial competence, they are related to previous and future knowledge and skills (Ilonen & Heinonen, 2018). First, the student's basic knowledge is assessed in terms of sub-competences. The purpose of the study was to evaluate the entrepreneurship sub-competences of 3rd and 6th grade students at different basic schools with a test. A quantitative study and factor analysis of the relationships between entrepreneurial sub-competences was conducted.

#### **4. Research problem, purpose, and research questions**

The assessment of partial competences based on the entrepreneurial process in grades I and II of basic school is in line with the development of cognitive and social skills for the development of entrepreneurial competence. However, there are few empirical reasons for assessing the sub-competences of entrepreneurship competence, therefore there is no starting point and validated measurement tool for assessing the different sub-competences of students' entrepreneurship competence.

The purpose of the article is to develop an assessment tool for evaluating different sub-competences of entrepreneurial competence in the 3rd and 6th grade in basic school.

1. How and with what is entrepreneurship assessed in basic school?
2. What differences appear in the 3rd and 6th grade entrepreneurial competence sub-competencies?

#### **5. Method**

##### **5.1. Sample**

Data from the students who participated in the study were collected as part of a larger research project. The research sample (3rd and 6th grade) consisted of 616 students from 19 Estonian basic schools. As many different schools as possible were included in the sample, considering their regional location and location (rural and urban school), school type (basic school, high school), class size (small and large classes, combined classes), previous entrepreneurship. educational experience (with experience, without experience). All students studied according to the national curriculum of the Estonian basic school. This article analyses the data of students who took the entrepreneurial competence sub-competency test in the 3rd and 6th grades.

The partial competences of students' entrepreneurial competence were assessed in the spring of the 3rd and 6th grades. There was a total of 616 test takers of entrepreneurial competence in both classes, 311 (50.4%) of them were girls and 290 (47%) were boys, 15 (2.6%) students left their gender unspecified. The sample included 13 urban schools and 12 rural schools from 15 different Estonian counties. The average age of the students was 10 years.

##### **5.2. Assessment tool and procedure**

A test was used to assess students' entrepreneurial competence, which measured knowledge and attitudes across different sub-competences of entrepreneurial competence (n=10). The sub-competencies of entrepreneurial competence are based on the theory of the entrepreneurial process and sub-competencies are divided into three stages or areas of the entrepreneurial process: opportunity discovery, resources, and implementation. Different stages of the entrepreneurial process combine several general competencies into entrepreneurial competencies.

In the tasks of the test, factual knowledge is differentiated according to sub-competencies, and based on situations, self-appropriate tasks show the existence of developed sub-competencies (attitudes), which can be quantitatively assessed (Keane et al, 2016). The measured sub-competencies are cooperation skills, economic and financial literacy, creativity, management and planning skills, involvement of resources, risk-taking, initiative, ethical and sustainable thinking, noticing opportunities



and self-efficacy. Since it is difficult to measure a student's skills with a test, in the first part of the test, students were asked to self-assess their skills and/or attitude towards the sub-competencies of entrepreneurial competence.

The test has two parts: a self-assessment of one's own competences, and the other is tasks that measure these competences. First, self-important tasks (n=8) to assess students' skills and attitudes, in which the student had to evaluate his actions or skills on a five-level coded Likert scale. The data of the assessment tool were coded so that they express the student's self-assessment: 1- inappropriate, 2- unsuitable, 3- suitable under certain conditions, 4- suitable and 5- most suitable.

The problem situations presented in the tasks were presented as short scenarios, the answers of which were based on the curriculum of entrepreneurship education and the sub-competencies of the EntreComp model of entrepreneurial competence. The tasks used in the test make it possible to assess the student's cognitive abilities (Aronshtam et al, 2021). In part II of the test, problem, and situation tasks (n=21) were used, in which the student's knowledge and attitude towards sub-competences of entrepreneurial competence were assessed. Each task had five multiple-choice answers, each of which provided information about the student's level of knowledge and attitude. As for the general abilities of the assessment tool, the answers were coded based on the student's knowledge: 0 - not selected, 1 - incorrect, 2 - partially correct, 3 - correct answer. The student could choose one answer and could continue with the test only when the choice was made.

The metrics of the assessment tool were divided into areas (1) noticing opportunities - ideas and opportunities, sub-competences related to vision and creativity, ethical and sustainable thinking; (2) resources - sub-competences related to self-efficacy, motivation, economic and financial literacy, and cooperation skills; into action (3), which brings together social skills, including community initiative, planning and management skills and risk-taking.

To achieve the validity of the assessment tool, a preliminary study was conducted with 2nd and 5th grade students in the spring of 2021, where in addition to student testing, the expert method was also applied. The assessment tool in the main study was tested with a written test on 69 students and a second time with an online test on an additional 49 students after adjusting the assessment tool to achieve an age-appropriate assessment tool. The dataset of the main study was divided into two according to the type of questions: self-directed and multiple-choice tasks. Analysing the individual tasks revealed that the reliability of the data (KMO) in the 3rd grade (N=327) p= 80% and in the 6th grade (N=290) p= 69%. Reliability of multiple-choice tasks (KMO) 3rd grade 60% and 6th grade p=64%.

### 5.3. Data analysis

To explain the differences in the sub-competencies of entrepreneurial competencies of 3rd and 6th grade students, group-centred methods were used in the data analysis, which allow comparing the classes with each other. In order to analyse the data, the sub-competency tasks of the entrepreneurial competence test of the development of understanding of basic skills were grouped into self-directed (1) and multiple-choice tasks (2).

Descriptive factor analysis finds out the variability of the solutions of the tasks used in the evaluation of the sub-competencies of entrepreneurship competence based on a reliable factor distribution by students and classes. Data analysis was performed in IBM SPSS Statistics using the principal component analysis method. Sampling adequacy was measured using the KMO test. As a result of the analysis, a three-factor model emerged, in which the sample reliability coefficient  $p = 0.61$  (Sig <0.001) is sufficient. After the communality analysis, features with a descriptive power (extract) below 0.3 or 30% were removed from the descriptive factor model, as in this case the feature has a small share with other features.

When analysing the multiple-choice responses, the model was rotated using the Varimax method to even out the factor distribution on the basis of a stronger relationship. When analysing self-relevant tasks, the model was rotated using the Oblimini method, since self-important questions are correlated with each other.

## 6. Results

The study gave results to the questions, which sub-competencies of entrepreneurial competence have developed and what are the differences between the 3rd and 6th grade. The reliability of the data used in the factor analysis of the self-assessment tasks tested in the third grades is 80%, which confirms the suitability of the model as a measuring tool for the sub-competencies of entrepreneurial competence. As a result of the descriptive factor analysis, various sub-competences were revealed, the metrics of which provided strong components in the factor model. Strongest in (1) finding opportunities was finding

ideas and opportunities (82%), (2) engaging resources, economic and financial literacy (82%), and (3) initiative in application (72%).

As a result of the analysis of the self-assessment tasks tested in the sixth grade, a three-factor model was also developed, in which the strongest components are (1) creativity in noticing opportunities (82%), (2) involving resources, economic and financial literacy (68%), planning and management skills (66%), resource mobilization (64%) and (3) taking action, risk-taking (69%) and teamwork (77%).

The results of the third-grade multiple-choice analysis show (1) opportunity recognition (85%) and ethical and sustainable thinking (84%), (2) economic and financial literacy (39%) in the area of resource mobilization. the strongest components in recognizing opportunities and (3) taking initiative (67%) and taking risks (60%).

As a result of the analysis of the sixth-grade multiple-choice test, the strongest component in recognizing opportunities was ethical and sustainable thinking (72%) and recognizing ideas and opportunities (71%), (2) resources, economic and financial literacy (70%), resource mobilization (60%) and (3) initiative in implementation (64%).

The results of the study are so reliable that the sub-competencies of entrepreneurship competence as a phenomenon and its connections are studied, and it is not recommended to make assessments about all Estonian students.

## 7. Conclusions and summary

Based on the research, we can see that the students' self-assessment of entrepreneurship sub-competences differs from the actual entrepreneurship competence. There are no previous studies on the tasks based on which the entrepreneurship of I and II grade students is evaluated. Thus, this empirical study is an important starting point for further research. Previously, the types of entrepreneurial tasks were analysed, and the sub-competences developed with tasks in basic school were identified (authors, 2021). This study then provides a theoretical framework and a validated measurement tool for elementary student development in basic school.

## References

- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review*, 84(2), 191–215.
- Chicco D., Warrens M.J., Jurman G. (2021). The Matthews Correlation Coefficient (MCC) is More Informative Than Cohen's Kappa and Brier Score in Binary Classification Assessment," in IEEE Access, vol. 9, pp. 78368-78381, 2021.
- Keane, T., Keane, W.F. & Blicblau, A.S. (2016). Beyond traditional literacy: Learning and transformative practices using ICT. *Educ Inf Technol*, 21, 769–781.
- Lamb, L., Firestone, J., Schmitter-Edgecombe, M. & Hand, B. (2018). A computational model of student cognitive processes while solving a critical thinking problem in science, *The Journal of Educational Research*.
- McCord, M., Lorin, W., & Michaelsen, L. (2018). 5 S framework: Great assignments made easy. *Business Education Innovation Journal*, 10(2), 77–87.
- Mets, T., Raudsaar, M., Vahejõe, K., Kaseorg, M., Vettik-Leemet, P. (2022). Putting Entrepreneurial Process Competence into the Focus in Entrepreneurship Education: Experience from Estonian Universities. *Administrative Sciences*. 12(2):67.
- Pepin, M. (2018). Learning to be enterprising in school through an inquiry-based pedagogy. *Industry and Higher Education*, 32(6), 418–429.
- Pinho, M., Fernandes, D., Serrão, C. & Mascarenhas, D. (2019). Youth Start Social Entrepreneurship Program for Kids: Portuguese UKIDS-Case Study. *Discourse and Communication for Sustainable Education*, 10(2) 33-48.
- Shane, S. & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *The Academy of Management Review*, 25, 217–26.
- Shane, S.A. (2012). Reflections on the 2010 AMR Decade Award: Delivering on the Promise of Entrepreneurship As a Field of Research. *Academy of Management Review*, 37, 10-20.
- Silveyra, G., Herrero, Á., Pérez, A. (2021). Model of Teachable Entrepreneurship Competencies (M-TEC): Scale development. *International Journal of Management Education*. Elsevier.
- Vestheim, O.P. & Lyngsnes, K.M. (2016). A study of Norwegian schools achieving good national test results. *International Journal of Educational Research*: Elsevier
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78.

## CONSIDERING TEACHERS' IDENTITY, WELL-BEING, AND PROFESSIONAL DEVELOPMENT IN CROATIAN CULTURAL CONTEXT

Sanja Tatalović Vorkapić, Dunja Anđić, Renata Čepić, Sanja Skočić Mihić,  
& Aleksandra Smolić Batelić

*Faculty of Teacher Education, University of Rijeka (Croatia)*

### Abstract

Previous studies worldwide have shown not only that teachers' professional development is significantly related to their identity and well-being, but also that it should be empirically studied in each specific cultural context. Given the insufficient similar research studies in Croatia, this review paper aims to discuss the theoretical framework of teachers' identity, well-being, and professional development in the context of the characteristics of the educational system and the position of teachers in Croatia. Therefore, this paper presents a systematic literature review and a research proposal to investigate the relationship between the identity of pre-service and in-service teachers of kindergarten and elementary schools, their well-being and professional development in Croatia. The neo-social analytic approach to understanding human personality implies an integrated model of identity-based on five key principles: evolutionary influence on human nature, dispositional personality traits most commonly examined with the Big- Five personality model, characteristic adaptations in particular situations, integrated life stories and the broader social context in which individuals live. At the same time, considerable attention is given to embedding the above principles in the social ecology of everyday life, characterized by motives, values, goals, situations, roles, statuses, competencies, demands, attitudes, developmental tasks, and challenges. Thus, the main contribution of this article is to review the identity model of the teaching profession and propose a research model to examine the relationship between the elements of this model and professional development and well-being. Well-being includes psychological well-being (environmental mastery, self-acceptance, personal growth, meaning in life, positive relationships with others, and autonomy), life and work satisfaction, optimism, self-efficacy, resilience, grit, and flow. The following research questions are posed for discussion: How can the identity, well-being, and professional development of teachers in Croatia be described?; What is the relationship between the different elements of the focused and socio-demographic variables?; How do the aforementioned different elements of identity affect certain aspects of well-being, i.e., what type of identity leads to high levels of well-being and what type of identity and level of well-being leads to a certain type of professional development? The use of qualitative (narrative biographies of a subsample) and quantitative methods (use of scales) are described. The research and practical implications of the proposed study are associated with new findings that will improve existing educational policies that provide guidelines for achieving high levels of well-being in the teaching profession in terms of identity and professional development.

**Keywords:** *Identity, personality traits, pre-service and in-service teachers, professional development, well-being.*

---

### 1. Introduction

Educational practice in early childhood and preschool education is a complex, multi-layered, dynamic, and unpredictable action. Korthagen (2004) repeatedly raises the question of the possible frameworks for finding a good teacher, and in the context of this long-term analysis he has pointed out that it is not possible to give a definite answer to this question, but only an umbrella model for a set of possible answers. This umbrella can be based on these two questions: What are the basic qualities of a good teacher and how can we help people become one. In this regard, his reflections are based on the well-known thesis of Hamachek (1999, p. 209): "Consciously, we teach what we know; unconsciously, we teach what we are", which was later confirmed in a number of different studies in this field (Tatalović Vorkapić, 2012, 2015, 2017a,b,c). Although this researcher and many others have confirmed the importance of teachers' professional development and implicit pedagogy, to date there is neither a clear

theoretical model nor holistic research on these three key variables: Teacher Identity, Well-Being, and Professional Development, which is one of the main reasons for writing this review article.

## 2. Theoretical model of identity and professional identity of teachers

One of the integral processes of the entire human experience and functioning is the process of forming one's identity. Indeed, we are constantly involved in this lifelong and dynamic process that changes its manifestations throughout life. Previous research on personal identity has resulted in three theoretical models (Tatalović Vorkapić, 2014). Although socio-analytical and neo-socio-analytical models of personality identity (Roberts, 2006) have made significant contributions to its understanding, the third, recent New Big Five model (McAdams & Pals, 2006) provides an integrative framework for a holistic understanding of the person. This model consists of five main principles that form the basis for this theoretical framework of human personality: biological determinism; dispositional characteristics; situational factors; life narratives; and culture. Personality traits play an important role in human identity, especially when we focus our research on the professional identity of pre- and in-service teachers. Previous research has pointed to the importance of displaying and expressing certain personality traits, most of which are operationalized and measured within the Big Five model (Tatalović Vorkapić, 2012, 2015, 2017a). High levels of extraversion, openness to new experiences, agreeableness, and conscientiousness and low levels of neuroticism have been found to be extremely important and established as such in educational professions (Anđić, Tatalović Vorkapić, and Vargek, 2019; Anđić and Tatalović Vorkapić, 2020; Tatalović Vorkapić, 2012, 2015, 2017a,b,c, 2020; Tatalović Vorkapić and Jelić Puhalo, 2016; Tatalović Vorkapić and Lončarić, 2013; Tatalović Vorkapić and Pelozo, 2017; Tatalović Vorkapić et al., 2014, 2016, 2018, 2020), with higher scores among early childhood educators than primary school teachers on most of personality dimensions.

## 3. Theoretical model of well-being an teachers' well-being

In contrast to subjective well-being, eudaimonia is realized based on the feelings that arise when someone moves towards self-realization in terms of developing their unique potentials and progressing towards important goals in life (Ryan & Deci, 2006). There are two models of eudaemonic well-being: the model of psychological well-being and the theory of basic psychological needs as a theory of self-determination. The psychological well-being model is explained in more detail because of due its empirical verification and reliable measurability (Ryff & Singer, 2006). This model emphasizes that an individual's psychological well-being is realized based on his own development and self-realization, which includes six components: self-acceptance, purpose in life, environmental mastery, positive relations with others, personal growth and autonomy. Insight into the teachers' well-being is extremely important for several reasons. One of the most important determinants of children's well-being is the well-being of their teachers, as confirmed by McCallum and Price (2010): "*Well teachers, well students*". Previous domestic research has shown that some other characteristics of pre-service and in-service teachers are also extremely important, such as optimism, satisfaction with work and subjective well-being (Tatalović Vorkapić & Čepić, 2020), highlighting the importance of these features in teachers.

## 4. General, inclusive an ecological aspects of teachers' professional development

*"We understand professional development "as a lifelong learning and development process in the personal, social, and narrow professional fields, whereby it is important how the teacher views his/her competencies and how he/she assesses the opportunities for professional action in the direction of critical, independent, and responsible decision-making and action"* (Čepić & Kalin, 2017, p.7). Opfer and Pedder (2010) identified six characteristics of effective professional development: Applicability to the educational context (i.e., classroom and school), clearly communicated goals and purposes, expert support, respect for participants' prior knowledge and experience, incorporation of effective teaching and learning strategies, and support for questioning and problem solving. Teachers' professional identity is a dynamic and multi-layered process that can be understood not only as the result of influences on teachers in initial and continuing education, but also as an ongoing interaction between teachers' personal worlds and the collective discourses of the community in which they live (Olsen 2008). During the formation of his/her professional identity, each teacher passes through certain stages that have their own features, roles and responsibilities. In recent literature, professional identity is integrated into a broader social discourse driven by values, personal characteristics, ideology, relationships, status, education, and qualifications (Androusoy & Tsafos, 2018). In order to objectively examine and understand their professional identities, narratives, storytelling, autobiographical writing, educational biography have increasingly appeared in

research in the last twenty years as a method and research subject in teachers' education (Connelly & Clandinin, 1990, 2006). In describing identity, it has already been noted that narratives ('telling' and 'retelling' of a person's life) are considered as part of identity, but also as a method. As reflection they help teachers create new meanings and enable them to organize and articulate their knowledge and beliefs about education and make connections between their personal and professional lives (Čepić & Šćulac, 2019). In addition to the general characteristics of professional identity, it is necessary to mention the characteristics of inclusiveness and ecology in the professional activities of teachers.

Teachers have positive attitudes toward inclusive education and at the same time, they are considered insufficiently qualified to teach in inclusive education (Skočić Mihić, 2011). Teachers who have been trained and have experience working with these children (Forlin, 2001) and who have participated in initial or ongoing training on inclusive teaching (Sharma & Sokal, 2015) feel more competent. Initial training contributes to the acquisition of teacher competencies in inclusive teaching (Acedo, 2008), and the impact on pre-service and in-service teachers' positive attitudes toward inclusion and competencies to create, implement, and evaluate individualized education programs for students with disabilities (Van Laarhoven et al., 2007). Under the influence of the information before and after attending the inclusive training course, teachers' attitudes became more positive, their concerns decreased, and their sense of competence for teaching inclusive classes increased.

Ecological identity is actually a concept of self-perception based on the recognition of one's connectedness and dependence on the natural world. The social and cultural context is significantly related to the development of ecological identity and proecological behaviors, as well as empathy (as part of ecological identity (Clayton, 2003), which is linked to teachers' personality traits and is especially important when it comes to love and care for the environment and living beings (construct of nature connectedness) (Anđić & Šuperina, 2021). Kretz (2014) highlights the development of an ecological selfhood as a central component of his own pedagogical approach. Kızılay and Önal (2019) found a medium-significant effect of prospective teachers' (who teach science) ecological identity on their pro-ecological behaviors and emphasized the importance of their initial education. There is a significant lack of studies on influence of nature connectedness, i.e. its relationship with/on teachers' personality traits and professional development, as well as with their pedagogical practices and teaching processes in education in Croatia.

## 5. Conclusion – From theory to research proposal

Although the concept of identity is worth exploring in its own right, it is extremely important to examine it in the context of the pre- and in-service teachers' identity. Until now studies focused only on examining the relationship between some parts of teachers' well-being and identity, to there is a lack of a holistic approach to a more comprehensive understanding of the development and interplay of elements in the pre- and in-service teachers' identity, the relationship between professional and environmental identity within personal identity, their relationship and dynamics in the context of professional development, and the overall impact of all processes on their psychological well-being. Although the personality model presented considers all the key elements for understanding identity development, the positioning of professional and other identities (e.g., ecological and inclusive) defined within specific social roles of an individual and the required competencies of teachers do not have a clear place in the model, nor is their interaction both with each other and with other elements of the model clear, which will be addressed in this study. Moreover, although the model clearly emphasizes the importance of its dynamic and processual features, it is not entirely clear what exactly happens in the development of teachers' identity. Finally, the model does not answer on the question of pre- and in-service teachers' well-being. By taking a holistic approach to the study of teacher identity, well-being, and professional development within the framework of contemporary theoretical models, it will be possible to achieve a better understanding of the above concepts and provide an entirely new theoretical model that will ultimately have significant implications for educational policy in our country, particularly in relation to the planning of teacher professional development programs.

### *Acknowledgements*

This work has been supported in part by the University of Rijeka under the project number (uniri-drustv-18-11): *“Children's well-being in transition periods: the empirical validation of ecological-dynamic model.”*

## References

- Acedo, C. (2008). Inclusive education: Pushing the boundaries. *Prospects*, 38(1), 5-13.
- Anđić, D., Tatalović Vorkapić, S., & Vargek, D. (2019). Proekološki stavovi i osobine ličnosti budućih učitelja. In M. Orel & S. Jurjevčič (Eds.), *EDUvision 2019 – Modern Approaches to Teaching the Future Generations* (pp. 1402-1414). Ljubljana, Slovenia: EDUvision, Stanislav Jurjevčič s.p.
- Anđić, D., & Tatalović Vorkapić, S. (2020). What is the relationship between personality traits and pro-environmental attitudes among future early childhood educators. In L. Gómez Chova & A. López Martínez & I. Candel Torres (Eds.), *INTED2020 Proceedings, 14th International Technology, Education and Development Conference, 2nd-4th March* (pp. 7694-7702). Valencia, Spain: IATED Academy.
- Anđić, D., & Šuperina, L. (2021). How important is future teachers' "connectedness to nature"? Adaptation and validation of the connectedness to nature scale. *Education Sciences*, 11(5), 250. <https://doi.org/10.3390/educi1105025>
- Androusou, A., & Tsafos, V. (2018). Aspects of the professional identity of preschool teachers in Greece: Investigating the role of teacher education and professional experience. *Teacher development*, 22(4), 54-570.
- Clayton, S. (2003). Experiencing Nature as Individuals. In S. Clayton, & S. Opatow (Eds.), *Identity and the Natural Environment: the psychological significance of nature* (pp. 45-65). Cambridge, England: MIT Press.
- Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19(5), 2-14.
- Connelly, F. M., & Clandinin, D. J. (2006). Narrative inquiry. In J. L. Green, G. Camilli, & P. B. Elmore (Eds.), *Handbook of complementary methods in education research* (3rd ed., pp. 477-487). USA: Lawrence Erlbaum Associates
- Čepić, R., & Kalin, J. (Eds.). (2017). *Profesionalni razvoj učitelja: status, ličnost i transverzalne kompetencije*. Rijeka: Učiteljski fakultet Sveučilišta u Rijeci.
- Čepić, R., & Šćulac, V. (2019). The Context and Challenges of the Preschool Teachers' Professional Development: a Qualitative Analysis. In M. Županić Benić, O. Holz, & M. Michielsen (Eds.), *Requirements and Approaches for Contemporary Teacher Training* (pp. 51-62). Wien, Zürich: LIT VERLAG GmbH & Co. KG Wien, Zürich.
- Forlin, C. (2001). Inclusion: identifying potential stressors for regular class teachers. *Educational Research*, 43(3), 235-245.
- Hamachek, D. (1999). Effective teachers: What they do, how they do it, and the importance of self-knowledge. In R. P. Lipka & T. M. Brinthaupt (Eds.), *The role of self in teacher development* (pp. 189-224). Albany, N.Y.: State University of New York Press.
- Kızılay, E., & Önal, N. T. (2019). From the environmental identity to the behavior: The status of pre-service science teachers. *International Journal of Evaluation and Research in Education*, 8(2), 271-279.
- Korthagen, F. A. J. (2004). In search of the essence of a good teacher: Towards a more holistic approach in teacher education. *Teaching & Teacher Education*, 20(1), 77-97.
- Kretz, L. (2014). Ecological identity in education: Subverting the neoliberal self. *Leadership and Research in Education: The Journal of the Ohio Council of Professors of Educational Administration*, 1, 4-21.
- McAdams, D. P., & Pals, J. L. (2006). A New Big Five: Fundamental Principles for an Integrative Science of Personality. *American Psychologist*, 6(3), 204-217.
- McCallum, F. & Price, D. (2010). Well teachers, well students. *Journal of Student Wellbeing*, 4(1), 19-34.
- Olsen, B. (2008). *Teaching What They Learn, Learning What They Live: How Teacher's Personal Histories Shape Their Professional Development*. Boulder, Colorado: Paradigm Publishers.
- Opfer, V. D., & Pedder, D. (2010). Benefits, status and effectiveness of continuous professional development for teachers in England. *The Curriculum Journal*, 21(4), 413-431.
- Roberts, B. W. (2006). Personality development and organizational behavior. In B. M. Staw (Ed.), *Research on organizational behavior*, (pp. 1-41). New York: Elsevier Science/JAI Press.
- Ryan, R. M., & Deci, E. L. (2006). Self-Regulation and the Problem of Human Autonomy: Does Psychology Need Choice, Self-Determination, and Will? *Journal of Personality*, 74(6), 1557-1586.
- Ryff, C. D., & Singer, B. H. (2006). Best news yet on the six-factor model of well-being. *Social Science Research*, 35(4), 1103-1119.
- Sharma, U. & Sokal, L. (2015). Can teachers' self-reported efficacy, concerns, and attitudes toward inclusion scores predict their actual inclusive classroom practices? *Australasian Journal of Special Education*, 40(1), 21-38.

- Skočić Mihić, S. (2011). *Spremnost odgajatelja i faktori podrške za uspješno uključivanje djece s teškoćama u rani i predškolski odgoj i obrazovanje*. [Doktorska disertacija]. Edukacijsko-rehabilitacijski fakultet, Zagreb, Hrvatska.
- Tatalović Vorkapić, S. (2012). The significance of preschool teacher's personality in early childhood education: Analysis of Eysenck's and Big Five Dimensions of personality. *International Journal of Psychology and Behavioral Sciences*, 2(2), 28-37.
- Tatalović Vorkapić, S. (2014). Je li privilegirani status modela osobina ličnosti u psihologiji ličnosti opravdan? – Prikaz modela identiteta. *Suvremena psihologija*, 17(2), 181-198.
- Tatalović Vorkapić, S. (2015). How much personality is important in educational context? In M. Orel (Ed.), *International Conference EDUvision 2015: "Modern Approaches to Teaching Coming Generation"* (pp. 75-83). Ljubljana, Slovenia: EDUvision, Stanislav Jurjevčič s.p.
- Tatalović Vorkapić, S. (2017a). Personality and Education: Contemporary issues in Psychological science about Personality in Teacher Education. In C. Martin & D. Polly (Eds.), *Handbook of Research on Teacher Education and Professional Development Professional Development* (pp. 163-186). USA: IGI- Global.
- Tatalović Vorkapić, S. (2017b). Osobine ličnosti i profesionalne kompetencije hrvatskih i slovenskih učitelja. In R. Čepić & J. Kalin (Ed.), *Profesionalni razvoj učitelja: status, ličnost i transverzalne kompetencije* (pp. 67-86). Rijeka, Croatia: Učiteljski fakultet, Sveučilište u Rijeci.
- Tatalović Vorkapić, S. (2017c). Psychometric properties of student-teacher relationship scale – short form: Croatian validation study from preschool education context. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *ICERI2017 Proceedings, 10<sup>th</sup> International Conference of Education, Research, and Innovation, November 16<sup>th</sup>-18<sup>th</sup>, 2017*. (pp. 155-161). Seville, Spain: IATED Academy.
- Tatalović Vorkapić, S. (2020). Personality traits and psychological needs satisfaction as predictors of early childhood teachers' job satisfaction. In L. Gómez Chova, A. López Martínez & I. Candel Torres (Eds.), *INTED2020 Proceedings, 14th International Technology, Education and Development Conference, 2nd-4th March, 2020*. (pp. 7703-7711). Valencia, Spain: IATED.
- Tatalović Vorkapić, S., & Čepić, R. (2020). Personal and professional well-being among Croatian early childhood educators: Are they related? In S. Padmanaban & C. Subudhi (Eds.), *Psycho-Social Perspectives on Mental Health and Well-Being* (pp. 255-280). Hershey, Pennsylvania: IGI-Global.
- Tatalović Vorkapić, S., Čepić, R. & Šekulja, I. (2016). Are there any differences in personality traits and life satisfaction between preschool and primary school teachers? *Journal of Research in Childhood Education*, 30(3), 361-373.
- Tatalović Vorkapić, S., & Jelić Puhalo, J. (2016). Povezanost osobina ličnosti, nade, optimizma i zadovoljstva životom odgojitelja predškolske djece. *Napredak*, 157(1-2), 205-220.
- Tatalović Vorkapić, S., & Lončarić, D. (2013). Posreduje li profesionalno sagorijevanje učinke osobina ličnosti na zadovoljstvo životom odgajatelja predškolske djece? *Psihologijske teme*, 22(3), 431-455.
- Tatalović Vorkapić, S., Ljevar, L., & Batistič Zorec, M. (2020). Personality traits and subjective theories of future early childhood educators as determinants of their professional identity. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.) *EDULEARN2020 Proceedings, 12th Annual International Conference on Education and New Learning Technologies, 6th-7th July, 2020*. (pp. 2234-2243). Palma de Mallorca, Spain: IATED.
- Tatalović Vorkapić, S., & Peloza, I. (2017). Exploring the personality traits and well-being among pre-school and primary school teachers in Croatia. *Current Issues in Personality Psychology*, 5(1), 21-31.
- Tatalović Vorkapić, S., Skočić Mihić, S. & Čepić, R. (2018). The role of personality and professional development in Croatian elementary school teachers' experience and competencies in the work with gifted children. In L. G. Chova, A. L. Martinez, & I. C. Torres (Eds.), *EduLearn2018 Proceedings, 10<sup>th</sup> Annual International Conference of Education and New Learning Technologies, July 02<sup>nd</sup>-04<sup>th</sup>, 2018*. (pp. 1111-1118). Palma de Mallorca, Spain: IATED Academy.
- Tatalović Vorkapić, S., Vujičić, L. & Čepić, R. (2014). Pre-school Teacher Identity. In P. Breen (Ed.), *Cases on Teacher Identity, Diversity, and Cognition in Higher Education* (pp. 22-60), USA: IGI Global.
- Van Laarhoven, T. R., Munk, D. D., Lynch, K., Bosma, J., & Rouse, J. (2007). A Model for Preparing Special and General Education Preservice Teachers for Inclusive Education. *Journal of Teacher Education*, 58(5), 440-455.

**THE AMPHIBIOUS LIFE OF SOUTH AFRICAN SCHOOLS  
DEPARTMENTAL HEADS:  
A STRADDLE BETWEEN LEADING AND TEACHING**

**Tshepo T. Tapala**

*Faculty of Education, School of Professional Studies in Education,  
Edu-Lead Research Focus Area, North-West University (South Africa)*

**Abstract**

Departmental heads are teachers of subjects and specialists who in turn are leaders of such specialized fields called subjects. They lead departments and carry a workload they must execute in their classes and being part of the school management. These cohort of teachers are part of the middle management of schools. They are the bridges between what is decided in the school management teams and what should happen in the classrooms and are expected to enforce policy implementation in their departments and school-wide too. Basically, they are channels of communication between teachers and the school management teams and vice versa. Their existence is “amphibious” as they straddle between leadership and teaching, responsibilities that are regulated and must be carried out satisfactorily. The departmental head position in South Africa is a recognized, formal one as it is constituted in the Personnel Administrative Measures on what and how they should carry out their responsibilities. The document also indicates the workload of all teacher categories with teaching load ranging from 85%-90% for primary school departmental head and up to 85% for secondary school departmental heads as stipulated by the Education Labour Relations Council Resolution No. 7 of 1998. Therein, the departmental head is appointed as a post level two teacher who is responsible for teaching, extra and co-curricular activities, personnel, general or administrative and communication responsibilities. As leaders, they are expected to have basic knowledge of policy pertaining for their subject specialization area, lead a team of educators, motivate their teachers, manage resources and facilities in their departments, advice the principal on teacher placement and assist in the recruitment of new members of staff particularly those serving in their subject department. The other demand placed on the departmental head are that they are subject teachers. They are not ordinary teachers as they must be specialists in those subjects. This is because they should advice their teams on the best practices of teaching the subject. They must have specialized skills in the assessment and moderation of such subjects. As a result, departmental heads spend most of their time teaching than leading and managing. The latter was supposed to be their primary occupation, but this is to the contrary. Due to the contradictions, the DH is forced to live an “amphibious” life which needs to be managed well and for which they require to be well informed and supported in.

**Keywords:** *Departmental head, middle management, amphibious, school management team, teaching and leading.*

## **1. Introduction**

This conference proceeding is conceptual in nature and a precursor to the up-coming project of the same name to be undertaken in two provinces of the Republic of South Africa in 2023. Once completed, the project will determine how departmental heads perceive their dual roles of being teachers or instructors and leaders.

Who are the departmental heads (DHs)? They are part of the middle leadership of schools that function between the school management teams (SMT) at the top and teachers at the bottom. Middle leaders are just that, leading from the middle, literally as it would be apparent as this paper unfolds (Grootenboer, 2018). DHs are teachers involved in leadership roles in the school and still teach a subject or subjects in a grade or phase. It is not easy to define their roles as they straddle various roles and positions based on size of the school, stipulations by the education department and policy expectations (Grootenboer, 2018). Their roles are amphibious, having a dual life meaning on one hand they are both teachers teaching a subject in a classroom, and on the other are expected to lead, manage and administrate



processes and systems both for the subject/s they lead and for the school. In South Africa, schools may have one to four DHs depending on the size of the school and the subject choice offered at such a school if it is a secondary school as stipulated the Performance Administrative Measures (RSA, 2016). As Leithwood (2016) puts it, DHs are very important in schools as they are the leaders and administrators of their departments. Furthermore, it is important to note that they advise the principal and SMT on placement of teachers and most importantly, they are not just teachers, but also specialists in the subjects they head. Therefore, they are resource teachers and important for policy dissemination across the school.

## **2. The DH as teacher and instructor**

DHs are not just administrators and the link between management and teachers in the lower ranks. In South Africa they are formally appointed due to their experience and/or subject expertise. They teach the subjects they head and guide others on the best methods, techniques and pedagogical approaches best suited to the subjects. The DHs are expert teachers who epitomize the subject they teach and head. They must perform classroom demonstrations to the novice and inexperienced teachers. They are custodians of the subjects but should be abreast with the latest development in such subjects and policy changes that occur constantly. Although they are expected to teach and be exemplary to others in the ways of teaching, they are also expected to be administrators in their departments and school (RSA, 2016).

## **3. The DH as leader and administrator**

The work of the DH is not only limited to teaching, but also dedicated to supervising the teachers in their departments. As if that is not enough, the DH is expected to mentor these teachers. Monitoring of teachers' curriculum implementation is also crucial to their daily activities (Harris, Jones, Ismail & Nguyen, 2019). DHs monitor the attendance of both teachers and learners and make sure that the timetable is followed as drawn and allocated. Furthermore, the DH is responsible for responsible for sourcing resources for their departments, allocate the resources and manage them in such a way that they last longer (Leithwood, 2016). The quality of work done by the learners and teachers is also the responsibility of the DH (Nurulita, Prestiadi & Imron., 2021). They must moderate the work to make sure that the right quantity and acceptable level of quality is given to learners. As if that is not a lot already, DHs must make sure that curriculum policies both from external and internal are implemented or followed as intended. Although curriculum policy implementation in schools may be seen as the purview of school principals, the DH is the responsible person to make sure that these policies are implemented by the teachers in the classrooms. A lot of administrative work for the DH is spent in the management of efficiency in teaching and leadership of promoting excellence in learner academic performance, supervision of staff both personally and academically, and staff development which are a huge demand for the DH while they are expected to teach too.

## **4. Challenges of the dual life of DH**

The DH spends most time communicating and relaying information from the higher management echelons to the teachers below (Leithwood, 2016). In contrast, the DH does not have much time in their hands to do all necessary and required communication. They are always straddled and stretched between teaching and administration which takes much of their time. Their roles are ambiguous and fraught with barriers limiting them to carry out their duties to their optimum best. In addition, the DH is overburdened by trying to satisfy the need to be a teacher, an administrator, a manager of resources and personnel and lead a team of teachers in their subject group. This may hinder their personal growth and at times get stuck without progressing in their professional development. It is with this notion in mind that the upcoming project seeks to determine how departmental heads manage their dual roles as leaders and teachers, to investigate what interventions strategies exist to support departmental heads in executing their leadership and teaching roles and to determine what intervention strategies can be employed to assist departmental heads to manage their dual roles as leaders and teachers. Not are they expected to liaise with internal stakeholders, but DHs are expected to interact with a range of external participants in education like parents, curriculum specialists from the department of education and a host other who needs their attention related to learner performance. Again, these requires the DHs attention, taking more of their time and adding more workload to them. As if this is not burden enough, the DH must contend with the everchanging curriculum and have current knowledge of the latest teaching and learning techniques that they must share with their team of subject teachers.

## 5. Theoretical framework

Schools functioning does not happen in isolation but occurs as part of an intricate and varied system. It is thus appropriate that the complexity theory is employed for this study to explain the challenges encountered by employees especially the DHs in executing the complex responsibilities of leadership and teaching, and how they make success of it. As Mason (2011) puts it, complexity theory is an interdisciplinary theory that can aid in analyzing educational reform. It is concerned with entire systems and the interactions between the various system components. Teachers, students, parents, community leaders, the government, its respective educational departments (national, provincial and district) and policies, and economic systems are some of the aspects that make up schools. Foss and Saebi (2017) supported by Foss and Saebi (2018) Lanzolla and Markides (2021) purport that the complexity theory is appropriate in understanding complex nature of the DHs work. The application of complexity approach in this study stems from its capacity to clearly explain the different aspects of something complex like the dual responsibilities of DHs in terms of its components, hierarchies, interdependencies, non-linear relations, and boundaries, thus aiding a better understanding of how such systems ultimately work (Lanzolla and Markides, 2021) and explain the non-linear dynamic systems. Although this theory is most applicable in the business management world, it is appropriate here too. The complexity of how DHs are expected to deliver quality education with the goal of moving from one level of behaviour to another is increased by the interaction between all the role players with the various contextual backgrounds and levels of competence.

## 6. Methodology

The study will follow the interpretivist paradigm, as interpretivism foregrounds the meaning that individuals assign to their experience (O'Reilly & Kiyimba, 2015). Intersubjective meanings are crucial to achieving understanding and meaning (Merriam, 1998; Merriam & Tisdell, 2016). The paradigm will permit the researchers not only to describe the social context, conventions, norms and standards of the DHs, but also to reflect on critical elements in assessing and understanding the behaviour of the participants under study (Merriam, 1998; Merriam & Tisdell, 2016). As this study aims to explore the complex roles of departmental heads a qualitative approach will be most appropriate to understand the complex phenomenon under study (Merriam, 1998; Merriam & Tisdell, 2016). How participants perform their daily duties will be scrutinised (O'Reilly & Kiyimba, 2015). As revealed by Merriam & Tisdell (2016), qualitative research assists in understanding experiences, feelings, social circumstances or phenomena as they happen in the participants' actual world, and thus easy to observe these in their ordinary or natural setting. A phenomenological mode of inquiry will be employed as it aims as it assists in the understanding of the lived experiences of individuals like DHs, principals and teachers on the responsibilities of DHs (Ogina, 2017; Seobi & Wood, 2016). The researcher took an exploratory and descriptive stance (Merriam & Tisdell, 2016). The research will use purposive sampling to gain more insight into the DHs dual responsibilities of leading and teaching as described by Merriam and Tisdell (2016). The sample will be carefully considered and selected as follows. The research will be conducted in two provinces. Initially, six schools with a total of 30 participants will be sampled. The sample will comprise of six principals, six deputy principals, 12 departmental heads and six teachers to participate in the study. Face-to-face interviews will be used to generate and gather data from 30 participants in six schools (Merriam and Tisdell, 2016). Open-ended questions with follow ups will be posed to elicit the views and opinions of the participants. Thematic analysis to uncover prominent themes will enable the researcher to describe the participants' perceptions of the DH dual responsibilities. Permission to conduct the research and ethical clearance will be done via all the necessary routs. Ethical clearance shall be obtained by applying to the North-West University ethics body and permission to conduct the research in schools will be obtained from concerned provincial departments and school authorities.

## 7. Inclusion and future exploration

Although the sample of this research is initially a small one, it will form the basis of conducting a much more extensive study on the dual responsibilities of DHs both nationally and internationally. It will open doors for collaboration between this researcher and others globally. This may lead to extensive collaboration among researchers and institutions to influence policy on how DHs are trained and deployed in schools, and what their roles should be and how they should be carried out without burdening them.

### *Acknowledgements*

I would like to acknowledge the funding I received from my institution and the research entity I serve for making it possible for this paper to be presented at this conference, and further to carry out the much-anticipated project on the dual responsibilities of DHs in schools.

### *References*

- Foss, N. J., & Saebi, T. (2018). Business models and business model innovation: Between wicked and paradigmatic problems. *Long Range Planning*, 51(1), 9-21.
- Grootenboer, P. (2018). *The practices of school middle leadership*. Singapore: Springer.
- Harris, A., Jones, M., Ismail, N., & Nguyen, D. (2019). Middle leaders and middle leadership in schools: exploring the knowledge base (2003–2017). *School Leadership & Management*, 39(3-4), 255-277, doi: 10.1080/13632434.2019.1578738
- Lanzolla, G., & Markides, C. (2021). A business model view of strategy. *Journal of Management Studies*, 58(2), 540-553.
- Leithwood, K. (2016). Department-head leadership for school improvement. *Leadership and Policy in Schools*, 15(2), 117-140.
- Mason, M. (2011, December 12). Complexity theory and its relationship to educational change [Video]. Youtube. Accessed from: <https://www.youtube.com/watch?v=vk2s7gumXMY>
- Merriam, S. B. (1998). *Qualitative research and case study applications in education* (2nd ed.). San Francisco: Jossey-Bass Publishers.
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). San Francisco, CA, USA: Jossey-Bass.
- Nurulita, N. D., Prestiadi, D., & Imron, A. (2021). Education Supervision as A Teacher Professionalism Improvement. In *Proceedings of the 1st International Conference on Continuing Education and Technology (ICCOET 2021)* (pp. 129-131). Atlantis Press.
- O'Reilly, M., & Kiyimba, N. (2015). *Advanced qualitative research: A guide to using theory*. London: Sage.
- Ogina, T. A. (2017). How heads of departments understand their roles as instructional leaders: A South African study. *International Journal of Educational Sciences*, 18(1), 224-230. doi: 10.1080/09751122.2017.1352573
- RSA. (2016). *Personnel administrative measures (PAM) of 1999*. Government Printers.
- Seobi, B. A., & Wood, L. (2016). Improving the instructional leadership of heads of department in under-resourced schools: A collaborative action-learning approach. *South African Journal of education*, 36(4), 1-14. Retrieved from <http://ref.scielo.org/p2nv58>

# PRIMARY SCHOOL TEACHERS' PERCEPTIONS OF THEIR SELF-DIRECTED LEARNING SKILLS AND USE OF PRACTICES THAT PROMOTE SELF-REGULATED LEARNING

**Bernadette Geduld<sup>1</sup>, & Lindie Ehlers<sup>2</sup>**

<sup>1</sup>*Research Unit Self-directed learning, Faculty of Education, North West University (South Africa)*

<sup>2</sup>*Gateway Christian School, Mpumalanga (South Africa)*

## Abstract

In a review of the causes and consequences of the weak outcomes of South Africa's education, researchers reported high drop-out rates before completion of secondary school and that less than five percent of learners who start primary school obtain a university qualification. The recent outbreak of the COVID-19 pandemic that resulted an unprecedented change in teaching and learning environments heightened the necessity of self-directed teachers who develop learners' self-regulated learning skills to empower them to manage and regulate their own behaviours. Against the background of poor performance and the central role of teachers in the development of self-regulated learning skills in primary schools, the aim of this paper is to explore teachers' perceptions of their own self-directed learning skills and the teaching strategies they utilise to develop self-regulated learning skills in their learners. The study was located within an interpretivist philosophical orientation and a qualitative research design. We made use of purposive sampling and collected data via semi-structured individual interviews from eleven teachers. Content analysis and a thematic approach were used to analyse the data deductively and inductively. Most participants were confident with their own self-directed learning skills and abilities to develop self-regulated learning skills. Participants revealed that they are well supported in the schooling environment with the needed resources to assist in developing self-regulated learning skills. Participants make use of various strategies, which seem to be more teacher initiated than learner initiated in attempting to teach and develop self-regulated learning skills by engaging in various activities.

**Keywords:** *Motivation, higher quintile schools, self-directed learning, self-regulated learning, teaching strategies.*

---

## 1. Introduction

In a review of the causes and consequences of the weak outcomes of South Africa's education, Mlachila and Moeletsi (2019) reported high drop-out rates before completion of secondary school and less than five percent of learners who start primary school obtain a university qualification. Due to learning deficits acquired at the primary school level, caused by the low quality of education, the educational battle of many learners is currently already lost at primary school level. We argue that self-directed teachers who develop self-regulated learning (SRL) skills can alleviate high failure rates experienced in many South African schools.

Saks and Leijen (2014), explain that self-directed learning (SDL) originates from adult education, whereas SRL originates from cognitive psychology. SDL is practiced mainly outside the traditional school environment, whereas SRL is a narrower micro-level construct mainly practiced in the school environment where learning tasks are usually set by the teacher. SDL involves involve a broader macro-level construct where individuals create their own learning environments and plan their own learning trajectories in work and life (Gandomkar & Sandars, 2018). Self-direction in learning is linked to most of the skills of SRL such as self-instruction, self-reinforcement, goal setting, planning, selection of strategies and self-evaluation. Furthermore, achievement, motivation, self-esteem, and self-efficacy are grounded in the process of SRL as well as SDL (Gandomkar & Sandars, 2018).

Self-regulation is an essential requirement for academic success (Parrish, 2018) since learners must have the abilities to focus, plan, reflect and control their cognition and emotions in the learning processes. Learners who do not have these SRL skills find learning problematic, as they will have

difficulty reflecting on situations, coming up with solutions, and handling difficult situations and emotions.

Slavit and Mcduffie, (2013) aver that it is important to also consider the self-directedness of teachers, for of the role they play in introducing, guiding, modelling self-directedness with their dispositions and teaching practices. For example how they build learners self-confidence to take initiative, to work independently, to persist when difficulties are experienced, to accept responsibility for own learning, exercise self-discipline and curiosity to learn or change to improve themselves. Learners learn by example from their teachers as models for SRL and they practice what they see (Dickinson, 2018).

Against the background of poor performance and the important role of teachers in the development of SRL in primary schools, the following two research questions guided this study: (a) What are teachers' perceptions of their own SDL skills? and (b) What teaching strategies do they utilize to develop SRL skills in their learners?

## 2. Theoretical framework

In the theoretical and conceptual framework, this study drew on Zimmerman and Moylan's (2009) model of SRL from a social cognitive perspective., the self-directed model of Garrison (1997) and on literature on SDL as well as teachers' self-directed learning skills to develop SRL.

Zimmerman and Moylan's (2009) SRL model is cyclical and has three phases which illustrate all the SRL skills self-regulated learners apply before, during and after a learning task. The effectiveness and duration of these SRL cycles relies strongly on feedback from outside sources (Zimmerman & Moylan, 2009), where teachers could play a significant role. In the forethought phase, self-regulated learners analyse tasks, set goals, and plan how to complete learning tasks. During this phase their motivation and self-belief is important, since it influences how they set goals and plan to complete tasks. The performance phase deals with all the SRL skills learners apply during task completion. Examples are, applying time management, actively seeking help when they struggle, using different task strategies and self-observation, to name a few. Lastly, in the self-reflection phase, which consists of self-judgement, self-evaluation and self-reaction, learners will judge their own performance to determine whether the goals they have set have been reached and adapt learning strategies to attain success with future tasks (Zimmerman & Moylan, 2009).

SDL is best described by Knowles (1975) as an action where people decide on their own (with or without assistance) to determine their learning needs. In doing so, they establish learning goals as well as the resources they might need while applying effective learning strategies, as well as evaluating the outcome of the learning experience. Self-directedness links to taking control and managing the self and learning activities. The self-directed model of Garrison (1997) consists of three important, closely connected dimensions, which are: self-management (taking responsibility for learning on a cognitive level), motivation (the willingness to take on a task or the reason behind doing what needs to be done), and self-monitoring (reflect on learning, construct meaning). The three dimensions of self-directed learning therefore include motivation, where the teacher gives a task by setting clear goals and giving directions towards what is expected and what will link to the learning process. In this instance, the teacher should provide the required resources and learning material (Garrison, 1997). During the second dimension of self-monitoring, the teacher should guide the learner by giving the choices between how they want to engage and carry out the learning process and deal with questions, answers, and feedback. With the third dimension, which is self-management, the teacher will have to demonstrate to learners how they could manage their learning activity to reach the given outcome or goal. It is therefore vital for teachers to manage and monitor how learners set their goals, how they get the correct resources, and to guide them towards being able to monitor their progress and taking responsibility for the outcome. Teachers should be motivated about guiding students to reach the desired outcome and teaching them to become self-regulated learners; it is therefore important for teachers to be motivated about their own SDL as well (Garrison, 1997). Teachers can apply various strategies to assist the development of SRL, such as observation of the students, explaining, describing and modelling the required cognitive and metacognitive learning strategies, strategies for self-instruction, motivational and emotional control strategies and strategies for resource and time management (Harding *et al.*, 2018; Effeney, Carroll and Bahr, 2013; Zimmerman & Moylan, 2009).

## 3. Research design and methodology

The study was located within an interpretivist philosophical orientation since we wanted to understand the perceptions of teachers on how their own SDL skills enable them to develop SRL skills in learners. A qualitative research design was used during this research. Maree (2016) describes a qualitative

design as a research design that strives to collect very rich and descriptive data about a specific phenomenon with the focus on understanding what is being observed. In this study a basic qualitative research study was used as a strategy of inquiry (Merriam, 2009). The research population consisted of primary school teachers in the Mpumalanga region. We made use of purposive sampling in this study where 11 participants' voluntary took part.

The second author in this study collected data from four primary schools in the Mpumalanga region. Four of the primary school teachers were from a quintile 4-5 school, and seven of the participants were from private schools. All the schools are well equipped with the required resources, such as access to internet, library, and textbooks. Although the schools are well-resourced, teachers in these schools often work with children from different socio-economic and home environments.

We used content analysis and a thematic approach to analyse the data by means of inductive and deductive coding. We applied for ethical clearance from the North West University and gained permission for the research from the Department of Basic Education and school principals. We abided by all ethical aspects of conducting research.

#### 4. Discussion of findings

Verbatim quotes, printed in italics, were used to provide a description of participants' perceptions and experiences. We used codes placed after the verbatim quotations to represent the participants and their schools as follows: T1 S1 indicates the responses of teacher participant one from school one.

The first theme below answers the first research question and are indicative of participants' perceptions of their own SDL skills. The second theme answers the second research question and revealed participants' views of how their SDL skills influence the development of SRL skills in their learners.

##### 4.1. Theme 1: Teachers' perceptions of the self-directed learning skills they possess

To ensure that participants had a clear understanding of SDL skills, they were given examples of SDL skills and were then asked which of the skills they possess and why they think so. It emerged from six (6) participants' responses (T5S2, T8S3, T3S1, T2S5, T10S3, T6S2) that planning, and goal setting are SDL skills they perceive themselves to possess. This is how one participant explained: *To plan, I am a big planner and love to set things out and make lists of what needs to be done and set time limits for myself to reach the goals I have set.* (T5S2).

Participants also perceive themselves to possess the skill of seeking resources by making use of various platforms such as the internet, library, interactive whiteboard, textbooks and so forth to seek help, and by taking responsibility to find the resources they need and keep themselves motivated, as indicated in the following responses: *I seek resources and plan: I research various platform and take responsibility.* (T3S1), and *I do take responsibility for my work and can sustain my own motivation.* (T6S2).

Participants (T2S5, T6S2, T3S1) indicated that with years of teaching experience they have develop many SDL skills to cope with the Departmental requirements for teaching. Participants also reported on some metacognitive strategies they demonstrate, such as reflection, evaluating what they are thinking and planning, being aware of strengths and weaknesses, being aware of learning styles, and planning. This theme revealed that the participants perceive themselves to possess certain SDL skills such as goal setting, planning, seeking resources, taking responsibility, and sustaining their own motivation (Garrison 1997; Knowles, 1975; Saks & Leijen, 2014).

Participants also indicated SDL skills they do not possess. It was noteworthy that a few participants indicated that they do find it challenging to motivate themselves at times and to remain motivated. Some participants indicated that they find it challenging to engage with and adapt to different teaching and learning strategies. The following are examples of their responses: *I struggle to stay motivated, especially when I am struggling.* (T7S2), *I struggle using different teaching and learning strategies when I learn or teach something new. I am not always flexible to try new things and, sustaining my own motivation – I sometimes find it difficult to stay motivated to reach a goal the way I planned to do it from the start.* (T5S2). *To seek resources – I tend to stick with only some and need to broaden the horizon here.* (T6S2). The lack of motivation experienced by participants T7S2; T1S1 and T5S2 can be problematic since motivation creates the platform to commit to certain outcomes and goals related to the SDL and SRL learning process (Zimmerman & Moylan, 2009). Not having confidence in their own abilities might prevent teachers from doing or practising what they have learned.

#### **4.2. Theme 2 Perceptions of own self-directed skills that enable them to develop self-regulated skills in their learners**

All participants seem to be actively involved in their attempt to model and demonstrate SRL skills to their learners. They believe they demonstrate supportive roles in guiding students towards the implementation of the required skills (Garrison, 1997). One participant clarified: *Learners detect and perceive things easily. If I have a great level of self-directedness, learners will see it and it will have a positive impact on them. (T11S4).*

The SRL skills participants perceived themselves to develop include the following: Task analysis such as planning and goal setting, where learners are shown how to break their tasks into smaller parts, plan and set goals. Participants' own goal setting and planning skills help them to develop similar skills in their learners. Participants from the private schools use actual goal cards that are provided to learners, where they set daily goals for each subject. In the public schools, the learners are taught to distinguish between different kinds of goals which might include long-term and short-term goals: *I set goals for myself and always encourage learners to set short and medium goals that are achievable (T11S4).*

Participants used various extrinsic motivation methods such as merit systems, positive feedback, and also differentiation in homework and assignments, to promote interest and prevent boredom. External motivation can cause a challenge when it comes to developing self-regulated learners, since intrinsic motivation is the key element when it comes to SRL (Zimmerman & Moylan, 2009).

Participants reported the development of task interest and intrinsic motivation by means of passionate presentations of interesting and creative lessons. Once again, the teachers are working hard at motivating learners and keeping them interested, yet little is done or said about getting learners to the point of self-motivation/intrinsic motivation. They develop time management skills in their learners by setting proximal goals for task completions and time limits for classwork. The following two response exemplify their perceptions: *I give learners only a certain amount of time to finish a goal. (T8S3), and I specify time for activities I encourage learners to train themselves to finish a page in max 10 minutes. I have a timer that goes off every 10 min. (T5S2).*

Participants indicated that they encourage help seeking skills to the extent where some are even available to assist after hours: *I encourage them to ask questions in class. I am also available on WhatsApp to assist with homework. (T1S1).* What is noteworthy is the fact that there is a differentiation between seeking help and guiding learners towards the answer, but not actually giving them the answer, thus keeping them accountable in the help seeking process.

Participants indicated they model agency and utilize their knowledge of resources and help seeking skills to encourage learners to make the best use of modern technology such as the internet, and seeking the resources they need, but also informing them about platforms where they can find resources and do some research of their own. Participants believe that their own exposure to these resources enable them to teach their learners how to seek help from others and from technology.

Participants said they create structured environments that limit distractions. A lot of the strategies participants engage in seem to be teacher-initiated rather than learner-initiated, with motivation being more externally focused than internally. Learners with little concentration spans are assisted by means of short brain exercises and short breaks, to learn how to manage themselves during times of distraction. Participants fulfil a supportive role, realizing that not all learners function at the same level of self-regulation and that skills take time to develop. Participants engaged in various attempts to assist learners in applying metacognitive monitoring such as referring to pre-known knowledge before new concepts are learned, giving tests, holding class discussions, mastering concepts and so forth. However, what was noticeable is the fact that participants hardly mentioned task strategies such as cognitive learning strategies, i.e., making summaries, flowcharts, reading strategies, etcetera.

Self-evaluation by means of assessments, notes, class discussions, group work, tests, and self-assessments is another important skill, and participants reported. During the metacognitive monitoring phase participants mentioned the following strategies: use of pre-knowledge to make new concepts accessible, practice testing, quizzes and repetition. One participant explained: *Practice testing – I quiz and encourage learners to recall from memory. Repetition – repeat work or drill work over and over. If you are asked the same question regularly within a year, you would probably know the answer for a very long time. (T8S3).* Class discussions are held to reflect on the work that has been learned and to check their understanding of the work: *I do conference talks for reflection about what is done or not done and how to improve. (T6S2).* It does not, however, seem like learners are guided toward critical analyses of their own progress. Although participants are aware of this strategy, it seems like they find it challenging to completely allow learners to become self-regulated in that they tend to still take a lot of responsibility for the learning process. Participants perceive themselves as being able to work alone and with others and they demonstrate this to learners by introducing them to group and individual activities and getting them to become analytical, but also finding the methods that are helping them as individuals

to be successful: *Planning, working alone, working with others; I have taught my students how to plan, set goals and how to cross it off. Some students find it hard to work with others. By allowing them to work cooperatively helps them to develop areas that is hard for them. (T7S2)*. The ability to complete tasks alone or with the help of others are emphasized as a SRL skill (Knowles, 1975; Saks & Leijen, 2014).

## 5. Conclusion

The participants in this study all met the three dimensions of SDL according to Garrison's (1997) model. Based on participants responses, the most prominent SDL skills they engage with are goal setting, planning, finding resources, taking responsibility and working on sustaining their own motivation. These findings are in line with what participants indicated when asked about what and how they implement or develop SRL skills. Based on these responses, it is interesting to note that the exact SDL skills participants identify within themselves are also the skills they demonstrate and focus on when modelling SRL to their learners. Although participants were confident in the SDL skills they do possess, they were also very aware of the skills they do not possess and thus not develop in learners, and in itself this awareness is demonstrative of someone who is a self-regulated and self-directed person. Some of these skills mentioned are a lack of technology skills (therefore not being able to utilize resources effectively), sustaining motivation amidst struggles, and to utilize teaching. It is recommended that teachers are exposed to and trained in how to develop metacognitive monitoring skills and different task strategies, since it is a shortcoming that is identified in the analyses of the teaching strategies they use. The development of SDL and SRL skills should form part of teacher training to equip future teachers with knowledge and skills to foster these essential 21<sup>st</sup> century skills. A strong emphasis should be placed on the practice of constructivist teaching approaches, since this traditional transmission teaching approaches often hinder the development of SRL.

## References

- Dickinson, K. (2018). *7 Habits of the best self-directed learners*. <https://bigthink.com/personal-growth/self-directed-learning>
- Effeney, G., Carroll, A. & Bahr, N. (2013). Self-Regulated Learning: Key strategies and their sources in a sample of adolescent males. *Australian Journal of Educational & Developmental Psychology*, *13*, 58-74.
- Gandomkar, R., & Sandars, J. (2018). Clearing the confusion about self-directed learning and self-regulated learning. *Medical Teacher*, *40*(8), 862-863. doi: 10.1080/0142159X.2018.1425382
- Garrison, D.R. 1997. Self-directed learning: Toward a comprehensive model. *Adult education quarterly*, *48*(1):18-33.
- Harding, S., Nibali, N., English, N., Griffin, P., Graham, L., Alom, B.M., & Zhang, Z. (2018). *Self-regulated learning in the classroom: Realising the potential for Australian's high capacity students*. Assessment Research Centre, Melbourne Graduate School of Education.
- Knowles, M. (1975). *Self-directed learning: A guide for learners and teachers*. Chicago, IL: Association Press/ Follet.
- Maree, K. (2016). *First steps in research*. 11th ed. Pretoria: Van Schaik.
- Merriam, S.B. (2009). *Qualitative research: A guide to design and implementation. Revised and expanded from qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass.
- Mlachila, M.M. & Moeletsi, T. (2019) *Struggling to make the grade: A review of the causes and consequences of the weak outcomes of South Africa's education system*. International Monetary Fund.
- Parrish, N. (2018). *How to teach self-regulation*. Edutopia. <https://www.edutopia.org/article/how-to-teach-self-regulation>
- Saks, K. & Leijen, A. (2014). Distinguishing self-directed and self-regulated learning and measuring them in the e-learning context. *Procedia-Social and Behavioural sciences*. *112*, 190-198. <https://doi.org/10.1016/j.sbspro.2014.01.1155>
- Slavit, D. & Mcduffie, A.R. (2013). Self-directed teacher learning in collaborative contexts. *School science and mathematics*, *113*(2), 94-105.
- Zimmerman, B.J. & Moylan, A.R. (2009). Self-regulation: Where metacognition and motivation intersect. In D.J. Hacker, J. Dunlosky, & A.C. Graesser (eds.). *The Educational psychology series. Handbook of metacognition in education*. (pp. 299-315). New York, NY, US: Routledge/Taylor & Francis Group.



## MIXED REALITY IN SECONDARY EDUCATION

**Verónica Marín, Ignacio González, Belen Quintero, & Eloísa Reche**  
*Department of Education, University of Córdoba (Spain)*

### Abstract

The advancement of emerging technologies in society has been underlined since 2020, during the confinements implemented in all countries to protect the population from COVID-19. This was the turning point in which specific digital tools forcefully positioned themselves within each area of society. Thus, in the area of education, the first step was to strengthen online training, and the second to provide methodologies that would bring laboratories and classrooms closer to the walls of the rooms in which students were carrying out their learning process.

In this sense, technologies such as virtual reality and augmented reality have been positioning themselves as resources that turn the training process around, by bringing workspaces that are difficult to access, or classified as either dangerous or unsafe, closer to students.

However, there are also negative aspects regarding their use, such as the lack of training for their use, or the scarcity of economic resources for acquiring the devices needed. Thus, this communication presents the results obtained regarding the knowledge possessed by secondary education teachers about them.

The objective of the work, as part of the larger project [Design, implementation and evaluation of Mixed Reality materials for learning environments (PID2019-108933GB-I00)], is to discover the knowledge possessed by secondary education teachers about Mixed Reality (virtual + augmented reality). With a sample of 121 teachers, and with a mean age of 41.3 years old (S.D. = 8.67), it was concluded that teachers, although they are aware of the existence of this emerging technology, don't have enough training for its use in secondary education classrooms.

**Keywords:** *Mixed reality, teacher training, pre-service teachers, secondary education.*

---

### 1. Introduction

Virtual Reality (from here on VR), and augmented reality (from here on AR), catalogued as emergent technologies, are now a reality in many education centers, and they have come, to the greatest extent possible, to provide support to the learning processes of students. VR, since its creation, was presented as a resource that was able to create a virtual environment within which one could interact in real time, from the education point of view (Pérez-Fuentes et al., 2011, p. 77), thus facilitating the acquisition of content through experience. The development of VR brought with it the so-called AR, which was an advancement in immersive learning processes, as it provided users with “tangible” information, as it allowed the use of different devices (smartphones and tables) without the need to become “isolated” from the world that surrounds them, as they do not have to use goggles that introduce them to the digital stage.

The development of technology and the combination of both technologies (VR and AR), led to the creation of Mixed Reality (from here on MR), defined as a “blend of physical and digital worlds, unlocking the links between human, computer, and environment interactions” (Choi et al, 2022, p. 2). As we can observe, it takes the first-person experience from VR (Al-Gindy et al., 2020), and the immersion and real-time interactivity from AR, without losing one's environment. In conclusion, MR combines three elements: immersion, simulation, and interaction. This means that the information is presented in a manner that is more realistic and authentic, thereby promoting retention in our brain, as the experience is recorded in our memory.

Authors such as Li and Wang (2021), point out that the use MR will improve the learning experience, as it provides students with a greater level of interactivity and immediate feedback (Rossler, Sankaranarayanan & Hurutado, 2021). Research on the subject has shown that resources such as augmented books used in group activities in the classroom led to the improvement in comprehension of the readers (Danaei et al., 2020). Along this line, *Teach Me<sup>™</sup>* (Teaching in Mixed Reality environments)

presented by Black et al. (2016) shows how future teachers, through a virtual lab environment, learn how to be a teacher with MR, through the use of avatars that simulate students. Through the use of this technology and an immersive environment, the intention is not only for them to learn, but also to be able to manage the consequences that could be found in the classroom. Then, if they fail to teach well or make a mistake, these will not have an influence on the real learning of their students. In this way, pre-service teachers gain confidence on themselves.

MR in the field of education has the ability to stimulate the senses of the students who use it, and allows presenting information in a manner that is more realistic and authentic, thus increasing the interest and will of the students to interact with the content and the environment (Araiza-Alba et al., 2021).

Ultimately, MR is an education environment that helps improve the comprehension of complex cognitive structures; the learning is more effective and natural, and it promotes active participation and reflection. Also, the results of the activities performed are more immediate, visible, and palpable.

## 2. Method

The present study was designed as an ex post facto, descriptive, correlational and quantitative study. An ad hoc questionnaire was designed to collect the data, under the auspices of the R+D+I Design, implementation, and evaluation of Mixed Reality materials for learning environments (PID2019-108933GB-I00), financed by the Ministry of Science and Universities from the Government of Spain. This instrument measures the knowledge of Secondary Education teachers about mixed reality in the field of education. In this sense, the general objective was to determine the perception of Secondary Education teachers on the use of mixed reality within their profession. The following starting hypotheses were posited:

- H1. Women are more prone to using MR in the teaching-learning process in the Secondary Education stage.
- H2. Age is a determining factor on the use of MR for teaching in Secondary Education.

### 2.1. Instrument

As described above, a questionnaire was utilized to collect the data, and was subjected to validity and reliability tests. It was initially composed by 39 items distributed into two sections. The first inquired about the sociodemographic variables of the participant, which in this case were: gender, age, and macro area of teaching. The second was composed by the rest of the items (36), referring to MR itself. A 5-option Likert-type response scale was utilized, in which 1 indicated complete disagreement, and 5 complete agreements (Matas, 2018).

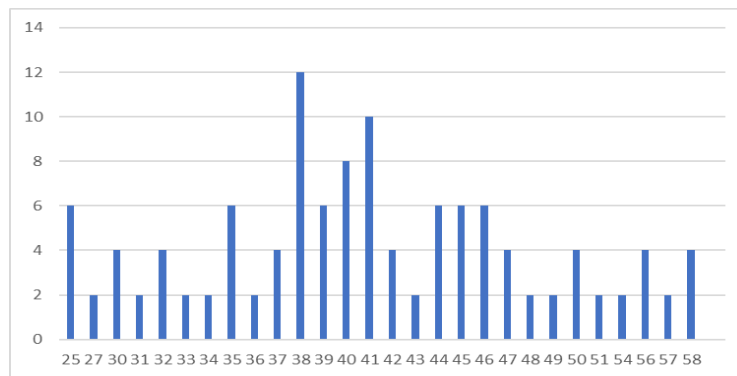
The questionnaire was subjected to a Cronbach's alpha test to determine its initial reliability. The test provided a score of .959. Once an item-by-item discrimination was performed, the results showed that the reliability was still high.

To determine the validity of the questionnaire, an exploratory factor analysis was performed, which determined the existence of two factors –one referring to knowledge and use of MR in the classroom, and another on the view and use of MR in inclusive environments-. Also, two items were eliminated [I know how to integrate MR in learning strategies directed towards the achievement of class objectives, and I am able to collaborate with other teachers to apply the MR methodology], given that all of them obtained scores higher than .30 (Mavrou, 2015); lastly, the remaining 37 items explained 81.769% of the variance. To corroborate if the reliability values were maintained in the two dimensions obtained, Cronbach's alpha was performed again, with high values obtained for both of them, .981 and .978 respectively.

### 2.2. Sample

The study participants were Spanish, Mexican, and Dominican Republic secondary school teachers, during academic year 2021-2022. To obtain this sample, a non-probabilistic, convenience sampling method was utilized (Otzen and Manterola, 2017) for an N = 121. Of these, 37.3% were men and 62.3% women. Considering the distribution of the sample according to age, the mean age was 41.3 years old (S.D. = 8.67) (see figure 1). When focusing on the country of origin, 60% were Spanish, 10% Mexican, and 30% from the Dominican Republic.

Figure 1. Distribution of the sample according to age.



### 2.3. Procedure

The procedure followed for the collection of data was the application of an online questionnaire during the 2021-2022 academic year, through the use of the Google Forms platform.

### 3. Results

The analysis of the knowledge of secondary school teachers about MR in their education stage showed that they were largely unaware about this tool (see table 1), except for considering the reception of information for utilizing MR as a necessity (item 25).

Table 1. Knowledge about MR.

	M.	SD
1. I am familiarized with the variety of applications and programs available for creating virtual spaces in MR	2.52	1.341
2. I know the technological support necessary for the use of MR in an educational environment	2.30	1.300
3. I know how to create virtual spaces for their use in the subject(s) I teach	2.65	1.442
4. I know about immersive devices (goggles/headsets) necessary for the use of MR	2.48	1.303
5. I know about the holographic devices for using MR	2.15	1.171
6. I know how to use immersive devices (goggles/headset) for using MR	2.02	1.137
7. I know how to use the movement controllers for using MR	1.82	1.061
8. I know about MR portals	2.02	1.152
9. I know about MR dioramas	1.67	.982
10. I know about MR holograms	1.90	1.080
11. I know the computer characteristics needed for using MR	1.93	1.098
12. I know the safety, privacy, social, ethical, and moral implications of the use of MR technology	2.05	1.166
13. I know the terminology specific for the MR environment	1.90	1.032
14. I am able to promote learning through the use of MR	2.17	1.337
15. I know how to plan teaching and learning strategies with MR adjusted to a specific length of time	2.12	1.189
16. I know how to efficiently implement MR depending on the context where it is used	1.92	1.164
17. I have experience in the use of MR resources in the teaching and learning process	1.85	1.097
18. I know how to use MR to encourage students to participate in the teaching process	1.97	1.188
19. I know how to use MR to encourage students to participate in their own learning	2.03	1.188
20. I know how to use MR to motivate students towards learning	2.10	1.198
21. I know how to use MR to develop key competencies	1.98	1.167
22. I know how to use MR in cooperative/collaborative learning	2.00	1.145
23. I know how to design tasks associated with real situations through MR	2.03	1.159
24. I know how to use MR to promote transversal learning of contents	2.08	1.206
25. I consider MR training necessary	3.97	1.256
26. I am able to use MR to promote inclusive education	2.15	1.294
27. I know how to use MR to promote intercultural and/or multicultural education	2.02	1.167

28. I know how to design learning proposals with MR for students with high intellectual abilities	1.93	1.200
29. I know how to design learning proposals with MR for students with motor disabilities	1.68	1.029
30. I know how to design learning proposals with MR for students with hearing disabilities	1.67	.947
31. I know how to design learning proposals with MR for students with visual disabilities	1.60	.938
32. I know how to design learning proposals with MR for students with intellectual disabilities	1.63	.970
33. I know how to design learning proposals with MR for students with severe developmental disorders	1.57	.905
34. I know how to design learning proposals with MR for students with ADHD	1.70	1.026
35. I know how to design learning proposals with MR for students with learning difficulties	1.73	1.035
36. I know how to design learning proposals with MR for students who entered the educational system late	1.75	1.079
37. I know how to design learning proposals with MR for students at risk of social exclusion	1.72	.989

To determine the existence or not, of differences in the participating sample, considering the variable gender, and to provide an answer to hypothesis 1 (Women are more prone to using MR in the teaching-learning process in the Secondary Education stage), a Student's t test for independent samples was performed, which provided results in favor of the women (see table 2).

Table 2. Distribution of the sample according to sex.

		M.	S.D.	p.	t.
I know how to create virtual spaces for their use in the subject(s) I teach	Male	2.83	1.355	.031	1.399
	Female	2.47	1.512		
I know about immersive devices (goggles/headsets) necessary for the use of MR	Male	2.37	1.119	.001	-.981
	Female	2.60	1.464		
I know how to use MR to promote transversal learning of contents	Male	2.03	1.089	.038	-.453
	Female	2.13	1.321		
I know how to design learning proposals with MR for students with visual disabilities	Male	1.57	.722	.006	-.388
	Female	1.63	1.119		
I know how to design learning proposals with MR for students with learning difficulties	Male	1.70	.830	.006	-.352
	Female	1.77	1.212		

The ANOVA performed to determine the existence or not of differences, considering the variable age, showed the lack of differences, so that H2 can be rejected (Age is a determining factor on the use of MR for teaching in Secondary Education).

#### 4. Discussion and conclusions

The advancement of emerging technologies have re-defined learning processes that are supported by the beliefs and knowledge of teachers about them. Therefore, a study of these views is an essential pillar for the advancement of education based on ICT in general, given that the positive results of learning mediated by MR lie in its use, as indicated by Araiza-Alba et al. (2021).

The factorial structure of the instrument differed from other works conducted with a similar population and context (Marín et al, 2022), although the dimension that referred to inclusive environments was maintained (Marín and Sampedro, 2023).

In contrast to the works by Aso et al. (2021) and Fuentes et al. (2019) the study participants did not consider themselves to be prepared and trained for the use of MR in secondary education. It is notable that they did not believe that its use would promote the transversal learning of the content (Aso et al., 2021, Fuentes et al., 2019), active learning, or greater motivation (Vasilevski and Birt, 2020).

As for MR, it was verified, as in the work by Marín, Sampedro and Vega (2023), that the variable age did not have an effect on having knowledge on how to use MR or not, in educational and inclusive contexts. However, with respect to gender, and in contrast to the data from Bursztyn et al.

(2017), in aspects such as the creation of virtual spaces, knowing about the immersion devices (goggles/headsets) needed for using MR, or knowing how to create training spaces for the visually disabled or those with learning difficulties, the women were more predisposed towards them.

Thus, it can be concluded that there is a great lack of knowledge and a need for specific training in the use of this technology for the development of immersive training processes.

## References

- Al-Gindy, A., Felix, Ch., Ahmed, A., Matoug, A., & Alkhidir, M. (2020). Virtual Reality: Development of an Integrated Learning Environment for Education. *International Journal of Information and Education Technology*, 10(3),171-175. 10.18178/ijiet.2020.10.3.1358
- Araiza-Alba, P., Keane, T., Chen, W. S., & Swinbu, J. K. (2021). Immersive virtual reality as a tool to learn problem-solving skills. *Computer & Education*, 164, 10421. <https://doi.org/10.1016/j.compedu.2020.104121>
- Aso, B., Navarro-Neri, I., García-Ceballos, S. & Rivero, P. (2021). Quality Requirements for Implementing Augmented Reality in Heritage Spaces: Teachers' Perspective. *Education Science*, 11(8), 405. <https://doi.org/10.3390/educsci11080405>
- Black, J., Noltemeyer, A. L., Davis, D. R., & Schwart, T. (2016). Pre-Service Teachers' Responses to Student Behavior in a Mixed-Reality Environment. *SAGE Open*, 6(1), 1-10. <https://doi.org/10.1177/2158244016633494>
- Bursztyn, N., Shelton, B., Walker, A., & Pederson, J. (2017). Increasing undergraduate interest to learn geoscience with GPS-based augmented reality field trips on students' own smartphone. *GSA Today*, 27(5), 4-11. doi:10.1130/GSATG304A.1
- Choi, S. H., Park, K. B., Roh, D. H., Lee, J. Y., Mohammed, M., Ghasemi, Y., & Jeong, H. (2022). An integrated mixed reality system for safety-aware human-robot collaboration using deep learning and digital twin generation. *Robotics and Computer-Integrated Manufacturing*, 73, 102258. <https://doi.org/10.1016/j.rcim.2021.102258>
- Danaei, D., Jamali, H. R., Mansourian, Y., & Rastegarpour, H. (2020). Comparing reading comprehension between children reading augmented reality and print storybooks. *Computers & Education*, 153, 103900. <https://doi.org/10.1016/j.compedu.2020.103900>
- Li, K., & Wang, S. (2021). Development and application of VR course resources based on embedded system in open education. *Microprocessors and Microsystems*, 83, 103989. <https://doi.org/10.1016/j.micpro.2021.103989>
- Marín, V., & Sampedro, B. E. (2023). Secondary education teacher's views on mixed reality in inclusive environments. *Education and information Technologies*, En prensa.
- Marín, V., Sampedro, B. E., Aznar, I., & Trujillo, J. M. (2022). Perceptions on the use of mixed reality in mobile environments in secondary education. *Education+Training*, 65(2). <https://doi.org/10.1108/ET-06-2022-0248>
- Marín, V., Sampedro, B. E., & Vega, E. (2023). Creencias del profesorado de secundaria en torno al uso de la Realidad Mixta. *Revista Electrónica Interuniversitaria de Formación del Profesorado*,26(1). 85-97. <https://doi.org/10.6018/reifop.543331>
- Matas, A. (2018). Diseño del formato de escalas tipo Likert: un estado de la cuestión. *Revista Electrónica de Investigación Educativa*, 20(1), 38-47. <https://doi.org/10.24320/redie.2018.20.1.1347>
- Mavrou, I. (2015). Análisis factorial exploratorio: cuestiones conceptuales y metodológicas. *Revista Nebrija de Lingüística Aplicada a la Enseñanza de Lenguas*, (19), 71-80. <https://doi.org/10.26378/mlael019283>
- Otzen, T., & Manterola, C. (2017). Técnicas de muestreo sobre una población a estudio. *International Journal of Morphology*, 35(1), 227-232. <http://dx.doi.org/10.4067/S0717-95022017000100037>
- Pérez-Fuentes, M. C., Álvarez-Bermejo, J. A., Molero, M. M., Gázquez, J. J., & López Vicente, M. A. (2011). Violencia Escolar y Rendimiento Académico (VERA): aplicación de realidad aumentada. *EJIHPE: European Journal of Investigation in Health, Education and Psychology*, 1(2), 71-84. Doi:10.1989/ejihpe.v1i2.6
- Rosler, K. L., Sankaranarayanan, G., & Hurutado, M. H. (2021) Developing an immersive virtual reality medication administration scenario using the nominal group technique. *Nurse Education in Practice*, 56, 103191. <https://doi.org/10.1016/j.nepr.2021.103191>
- Vasilevski, N., & Birt, J. (2020). Analysing construction student experiences of mobile mixed reality enhanced learning in virtual and augmented reality environment. *Research in Learning Technology*, 28, 2329. <http://dx.doi.org/10.25304/rlt.v28.2329>

# **RESPONSE TO INTERVENTION (RTI) PROGRAM FOR THE DEVELOPMENT OF EXECUTIVE FUNCTIONS IN FIRST-YEAR ELEMENTARY SCHOOL**

**Graziele Kerges-Alcantara, & Simone Aparecida Capellini**

*Investigation Learning Disabilities Laboratory (LIDA), Department of Speech and Hearing Science, São Paulo State University “Júlio de Mesquita Filho” (UNESP) (Brazil)*

## **Abstract**

*Objectives:* To develop a second-tier Response to Intervention (RTI) program for the development of executive functions in first-year elementary school students and to analyze the clinical significance of the program via a pilot study. *Method:* The work was carried out in two phases: elaboration and application of the RTI program; followed by a clinical significance analysis of the children’s performance in pre and post-test situations. *Participants:* The initial sample comprised 71 children (age from 6 years to 6 years and 11 months, of both sexes) from two public schools (groups GI and GII). These were submitted to a pre-assessment protocol: Attention Screening Test by digit cancellation; Five Digit Test; Digit Span subtest, Track Testing, and Protocol for Early Identification of Reading Problems. Risk for difficulty in executive function was presented by 18/37 of the participants that completed the pre-assessment protocol and these were selected for the intervention program. *Results:* There was a reliable improvement in the components of executive function inhibition, working memory and alternation, for some children and in rhyme identification tasks, phoneme production, and phonological working memory, although the program does not focus on its development. *Conclusion:* The program we elaborated demonstrated applicability and can be used by educational speech therapists, school psychologists and educators as a scientific evidence-based intervention tool to support the development of executive functions in second-tier RTI programs.

**Keywords:** *Executive function, intervention studies, learning.*

## **1. Introduction**

Executive functions (EF) are considered higher-order cognitive resources that command low-er-level processes. They are directly related to the ability to learn, since for the student to be able to acquire reading and writing skills, it is essential that there is planning, attention, behavior regulation and motivation (Diamond & Lee, 2011).

Studies showed that there is a difference between the development of its different components, that is, some would consolidate before others (Dawson & Guare, 2012; Diamond & Lee, 2011; Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000).

This model, proposed by Miyake et al. (2000), which received acceptance in the literature (Diamond & Lee, 2011; Diamond, 2013, Sullivan, Davis, & Koh, 2022), considers three components essential related to executive functions: inhibition, working memory and shifting demonstrating that, from their integration, they allow other skills to emerge, such as planning, decision making, problem solving, among others. Studies have been published both nationally (Seabra, & Dias, 2012; Gonçalves et al., 2017) and internationally (Van der Ven, Kroesbergen, Boom, & Leseman, 2012; Rudasill, Acar, & Xu, 2022), on the use of early interventions for the development of executive functions and problems of learning, as well as the performance of skills involved, however, there are still few studies that focus on the development of executive functions in students at risk for learning difficulties through the Response to Intervention (RTI) (Grosche & Volpe, 2013; Reynolds & Shaywitz, 2009; Rodríguez, Areces, García, Cueli, Gonzalez-Castro, 2021).

The Response to Intervention (RTI) is a multi-level educational and behavioral model where the activities developed seek the identification and early intervention in schoolchildren at risk for learning and behavioral difficulties, as well as diagnostic models of learning and behavior disorders (Andrade, Andrade, & Capellini, 2014; Fuchs & Fuchs, 2006; Fletcher & Vaughn, 2009), widely used in

international and national literature (Andrade, Andrade, & Capellini, 2014; Berkeley et al., 2020; Fuchs & Fuchs, 2006)

The RTI Model is composed of three tier: (1) universal screening of academic and behavioral problems in all schoolchildren through collective content and strategies, scientifically proven to be the most effective, and their progress systematically monitored by teachers; (2) application of specific and progressive interventions in smaller groups, based on the response to progress monitoring assessments (Fletcher & Vaughn, 2009); (3) evaluation and specific intervention with the objective of excluding the possibilities of learning and/or behavior disorders in schoolchildren who do not make progress in the previous stages (Fletcher & Vaughn, 2009; Fuchs & Fuchs, 2006). The term ‘responsiveness’ refers to the responsiveness to preventive interventions.

Based on the hypothesis that an RTI tier 2 intervention program with executive functions in schoolchildren can help to identify students at risk for executive function and learning difficulties, the study aimed to develop and to analyze the clinical significance of a RTI Tier 2 executive function program for 1st grade level Brazilian schoolchildren in a pilot study.

## 2. Methods

This study was carried out after approval by the Research Ethics Committee (81064117.5.000.5406). This is a quasi-experimental study developed in two phases, Phase 1 being the elaboration of the RTI Tier 2 executive functions program for Brazilian schoolchildren and Phase 2 the analysis the significance clinical of program.

The theoretical bases for the elaboration of the RTI Tier 2 intervention program, called RTI-FEx were based on the theoretical model proposed by Miyake et al. (2000), considering the three main components of executive functions: ‘inhibition’; ‘working memory’ and ‘shifting’.

Each of the components was considered as an objective of the program, developed for application in a school environment, in the group modality. In this way, RTI-FEx was composed of 10 strategies, distributed over 9 sessions with an average duration of 40 minutes each, to be carried out weekly over 2 months and 1 week.

Phase 2 of this study was the realization of the applicability of the program developed in phase 1 of this study through the pilot study.

The initial sample comprised 71 children (age from 6 years to 6 years and 11 months, of both sexes) from two public schools (groups GI and GII). These were submitted to a pre-assessment protocol: Attention Screening Test by digit cancellation; Five Digit Test; Digit Span subtest, Track Testing, and Protocol for Early Identification of Reading Problems. Risk for difficulty in executive function was presented by 18/37 of the participants that completed the pre-assessment protocol and these were selected for the intervention program.

## 3. Results

The results of this study were analyzed using the JT Method (Jacobson, & Truax, 1991) for single-case analysis. This method provides a comparative analysis between pre- and post-intervention scores and aims to decide whether the differences between them represent reliable changes and whether they are clinically relevant.

To analyze the results of the clinical significance of the performance of schoolchildren in pre- and post-testing situations after application of the intervention response program RTI -FEx, they were named S1 to S8. Table 1 and Table 2 show the reliable change index (RCI) of each student in this study based on their performance based on the instruments used in pre- and post-testing situations.

*Table 1. Performance of schoolchildren in pré- and post-testing situations.*

Instruments used in the pre- and post-assessment protocol						
Schoolchildren	FDT	TAC1	TAC2	TAC3	DIG	TTB
1	RPC	RPC	-	RPC	RPC	RPC
2	RPC	RPC	-	RPC	-	-
3	-	RPC	-	RPC	-	-
4	RPC	RPC	-	RPC	-	RPC
5	RPC	RPC	-	-	-	-
6	-	RPC	-	-	-	-
7	RPC	RPC	-	RPC	-	-
8	-	RNC	-	-	-	-

Subtitles: RPC= reliable positive change; RNC= reliable negative change; FDT= five digit test; TAC1= attention test cancellation part 1; TAC2= attention test cancellation part 2; TAC3= cancellation attention test part 3; DIG= digits subtest; and TTB= trail test part B.

Table 2. Performance of schoolchildren in the tests of the Early Identification Protocol for Reading Problems used in pre- and post-testing situations.

Evidence of the Protocol for Early Identification of Reading Problems – PEIRP													
Schoolchildren	AK	RP	RI	SS	PWF	PS	PA	IPI	PWM	FAN	SR	WPWR	LCP
1	-	-	-	-		-	-	-	RPC	-	-	-	-
2	-	-	-	-	RPC	-	-	-	-	RNC	-	-	-
3	-	-	-	-		-	-	-	-	-	-	-	-
4	-	-	-	-		-	-	-	-	-	-	-	-
5	-	-	-	-		-	-	-	-	-	-	-	-
6	RNC	-	RPC	-		-	-	-	-	-	RNC	-	-
7	-	-	-	-		-	-	-	-	-	-	-	-
8	-	-	-	-	RNC	-	-	-	RNC	-	-	-	-

Subtitles: RPC= reliable positive change; RNC= reliable negative change; AK= alphabet knowledge; RP= rhyme production; RI= rhyme identification; SS= syllabic segmentation; PWF= production of words from the given phoneme; PS= phonemic synthesis; PA= phonemic analysis; IPI= initial phoneme identification; PWM= phonological working memory; FAN= fast automatic naming; SR= silent reading; WPWR= words and pseudowords reading; and LCP= listening comprehension of sentences from pictures.

#### 4. Discussion

The inhibition component was evaluated using the Five-Digit Test (FDT) and the Attention Cancellation Test (TAC). During the application of the FDT, all students were unable to perform the task in the pre-test situation, presenting difficulty in understanding the instructions for the procedure necessary to carry out the task. The same task was proposed in a post-assessment situation, where S1, S2, S4, S5 and S7 were able to perform it despite presenting a performance suggestive of clinical deficit.

Although it is not possible to state that the inhibition gains can be attributed to the intervention from the application of the FDT, since the students were not able to perform the task in the pre-test, there is a second test used to evaluate the inhibition component, the inhibition test. cancellation attention, an instrument that evaluates selective attention, which according to the literature is one of the skills involved in executive functions (Friedman, & Miyake, 2017). In this task, an improvement in performance was observed in part 1 of the test designed to assess selective attention (S1, S2, S3, S4, S5, S6 and S7) and in part 3 of the test, also designed to assess selective attention, but with alternation demand (S1, S2, S3, S4 and S7), being necessary to change the focus of attention in each line (Seabra & Dias, 2012).

Being the preliminary data, although it cannot be said that the gains in this component are due to the intervention and not just to the schooling process to which the students in this study continued to be exposed during the school year, it is important to mention, according to the literature, that, in addition to the ontogenetic development of executive functions, from around 12 months of age to early adulthood (Romine & Reynolds, 2005), there is a difference between the development of its different components, that is, some would consolidate before others (Miyake et al., 2000; Dawson & Guare, 2012; Diamond & Lee, 2011). Based on the theory proposed by Miyake et al. (2000), inhibition is the first component to be consolidated.

The working memory component was assessed using the digits subtest, which is an integral part of the Weschlers Assessment Scale (Wechsler, 2012).

Although the results presented, from the comparison between pre and post-test through the described subtest, have revealed a reliable indication of change for an S1 student, it is important to emphasize that the student was not able to perform the second part of the task during the pre-test situation. test, thus presenting a raw score for only the first part of the subtest. In the post-test situation, the same student had a better score in the first part of the test and a performance classified as preserved from the score and classification of the instrument itself, suggesting a gain in the test. performance on tasks involving working memory.

The alternation component was assessed using the path test: parts A and B (Seabra & Dias, 2012). Regarding the indicator of reliable change, there was a reliable change for two students, S1 and S4, and regarding S4, it is not possible to state that the gains in alternation can be attributed to the intervention from the application of the test, since the school he was unable to perform the task in the pre-test, as he did not master the alphabetical order evaluated in part A of the test, making it impossible to



measure his performance in alternation. In the post-test, the same student was able to perform both parts of the test (A and B), which, in turn, may reflect a gain with schooling.

According to literature, studies carried out on early identification of schoolchildren at risk for reading difficulties, using the phonological basis and the grapheme-phoneme mechanism (Fadini & Capellini, 2011), revealing, however, that metaphonological skills, phonological working memory, rapid automatic naming and reading are predictive skills for reading development, which must be taught in an instructional in the first two years of literacy, justifying the absence of indications of gains from the pre and post-test in the tests knowledge of the alphabet, rhyme production, syllabic segmentation, phonemic synthesis, phonemic analysis, identification of the initial phoneme, rapid automatic naming, silent reading, reading words and pseudowords, as well as listening comprehension of diseases from figures, since the intervention program did not focus on specific instruction aimed at these skills.

In the rhyme identification test, there was an indicative of reliable change for the student S6, an indication of reliable change, as well as in the test of word production from given phoneme, presenting an indication of reliable change for the student S2. Knowledge of major phonological units such as onset-rhyme develops independently of reading instruction, and can be observed in children aged between three and five years (Capellini, César, & Germano, 2017), when developing skill categorizing words, involving the act of attending to their constituent sounds, can have a considerable effect on their future success in learning to read and write (Bradley & Bryant, 1983). Thus, considering selective attention as the ability to select only what will be important for a given task at a given moment, focusing attention and not being distracted by various stimuli in the environment (Van Moorselaar, & Slagter, 2020), we can relate this finding to the gains shown.

In the phonological working memory test, there was an indication of reliable change for the student from S1, the same student who showed an indication of reliable change in the comparison of pre- and post-testing from an instrument that aims to assess working memory from of verbal stimulus. The phonological working memory system is considered responsible for the temporary storage of information (Baddeley, 2017), occurring through working memory the storage and manipulation of information for a short period, a skill necessary for the cognitive and effective functioning of activities. everyday activities, such as school performance. Thus, the results suggest a relationship between the development of executive functions, promoting reading skills, according to the literature (Diamond, 2013; Diamond & Lee, 2011), which has emphasized the importance of promotion of early development of executive functions and its relationship with school readiness, as well as its important predictive power on reading performance during the schooling process.

Although it cannot be said, from the preliminary data, that the gains presented are due to the intervention, since the improvement evidenced may be related to the neurodevelopment and schooling of the schoolchildren, as it is a pilot study, there was no comparison of the group studied with a control group. Therefore, an effectiveness analysis study will be carried out.

As for the hypothesis of this study, that an RTI tier 2 intervention program for the development of executive functions in schoolchildren from the 1st grade level of Elementary School I can help in the identification and early intervention in schoolchildren at risk for learning difficulties was partially confirmed, because in the pilot study there was an indication of improvement in the performance of rhyme identification skills, word production from given phoneme and phonological working memory. However, the limitation in the sample size of the pilot study did not allow us to attribute clinical significance only to the effects generated by the program, as there is still the educational and neurodevelopmental effect. Thus, future studies will be conducted to expand the sample in order to verify the effectiveness of this intervention.

The results showed that there was a reliable improvement in the components of executive function inhibition, working memory and cognitive flexibility for some schoolchildren in this study. In tasks of rhyme identification, production from the phoneme, phonological working memory, the results also showed that there was a reliable improvement, although the program did not focus on its development.

## 5. Conclusion

The program in this study proved to be applicable and, can be used as an intervention instrument based on scientific evidence that helps the development of executive functions and learning in RTI tier 2.

It was also possible to conclude that from the analysis of the clinical significance carried out to analyze the results of the program developed for this study, it showed an indication of improvement in the components of executive functions and in the predictive skills for reading acquisition, as there were positive changes in the response of the schoolchildren. when comparing the performance in pre- and post-testing situations.

## References

- Andrade, O. V. C., Andrade, P. E., & Capellini, S. A. (2014). Cognitive-Linguistic Profile in Students with Reading and Writing Difficulties. *Psicologia, Reflexão e Crítica*, 27(2), 358. doi:10.1590/1678-7153.201427217
- Baddeley, A. (2017). *Exploring working memory: Selected works of Alan Baddeley*. Routledge.
- Berkeley, S., Scanlon, D., Bailey, T. R., Sutton, J. C., & Sacco, D. M. (2020). A Snapshot of RTI Implementation a Decade Later: New Picture, Same Story. *Journal of Learning Disabilities*, 53(5), 332-342. doi:10.1177/0022219420915867
- Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read – a causal connection. *Nature*, 301(5899), 419-421.
- Capellini, S. A., César, A. B. P. C., & Germano, G. D. (2017). *Protocolo de identificação precoce dos problemas de leitura – IPPL*. 1ª. Ribeirão Preto, SP: Booktoy.
- Dawson, P., & Guare, R. (2012). *Coaching students with executive skills deficits*. Guilford Press.
- Diamond, A. (2013). Executive functions. *Annual review of psychology*, 64, 135. doi:10.1146/annurev-psych-113011-143750
- Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, 333(6045), 959-964. doi.org/10.1126/science.1204529
- Fadini, C. C., & Capellini, S. A. (2011). Treinamento de habilidades fonológicas em escolares de risco para dislexia. *Revista Psicopedagogia*, 28(85), 3-13.
- Fletcher, J. M., & Vaughn, S. (2009). Response to intervention: Preventing and remediating academic difficulties. *Child development perspectives*, 3(1), 30-37. https://doi.org/10.1111/j.1750-8606.2008.00072.x
- Friedman, N. P., & Miyake, A. (2017). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex*, 86, 186-204. https://doi.org/10.1016/j.cortex.2016.04.023
- Fuchs, D., & Fuchs, L. S. (2006). Introduction to Response to Intervention: What, Why and How Valid is It? *Reading Research Quarterly*, 41(1), 93-99. http://www.jstor.org/stable/4151803
- Gonçalves, H. A., Viapiana, V. F., Sartori, M. S., Giacomoni, C. H., Stein, L. M., & Fonseca, R. P. (2017). Funções executivas predizem o processamento de habilidades básicas de leitura, escrita e matemática?. *Neuropsicologia Latinoamericana*, 9(3).
- Jacobson, N. S., & Truax, P. (1992). Clinical significance: a statistical approach to defining meaningful change in psychotherapy research. In A. E. Kazdin (Ed.), *Methodological issues & strategies in clinical research* (pp. 631–648). American Psychological Association. https://psycnet.apa.org/doi/10.1037/10109-042
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive psychology*, 41(1), 49-100. https://doi.org/10.1006/cogp.1999.0734
- Reynolds, C. R., & Shaywitz, S. E. (2009). Response to intervention: Prevention and remediation, perhaps. Diagnosis, no. *Child development perspectives*, 3(1), 44-47. https://doi.org/10.1111/j.1750-8606.2008.00075.x
- Rodríguez, C., Areces, D., García, T., Cueli, M., & Gonzalez-Castro, P. (2021). Neurodevelopmental disorders: An innovative perspective via the response to intervention model. *World Journal of Psychiatry*, 11(11), 1017. doi:10.5498/wjp.v11.i11.1017
- Rudasill, K. M., Acar, I., & Xu, Y. (2022). Early Teacher-Child Relationships Promote Self-Regulation Development in Prekindergarten. *International Journal of Environmental Research and Public Health*, 19(14), 8802. doi:10.3390/ijerph19148802.
- Seabra, A. G., & Dias, N. M. (2012). Avaliação neuropsicológica cognitiva: Atenção e funções executivas (Vol. 1). São Paulo, Brasil: Memnon.
- Sullivan, Y. W., Davis, F. D., & Koh, C. E. (2022). Executive functions and information systems learning. *MIS Quarterly*, 46(2).
- Van der Ven, S. H., Kroesbergen, E. H., Boom, J., & Leseman, P. P. (2012). The development of executive functions and early mathematics: a dynamic relationship. *British Journal of Educational Psychology*, 82(Pt 1), 100-119. doi:10.1111/j.2044-8279.2011.02035.x.
- Van Moorselaar, D., & Slagter, H. A. (2020). Inhibition in selective attention. *Annals of the New York Academy of Sciences*, 1464(1), 204-221. doi:10.1111/nyas.14304
- Wechsler, D. (2012). *Wechsler Preschool and Primary Scale of Intelligence* (4<sup>th</sup> edition). San Antonio, TX.: The Psychological Corporation.

# AN EVALUATION OF FLIPPED CLASSROOM PEDAGOGY IN NATURAL SCIENCES LEARNING USING MOBILE VIRTUAL REALITY

**Mafor Penn**

*Department of Childhood Education, University of Johannesburg (South Africa)*

## Abstract

Integrating advanced learning technologies (ALT) like virtual reality in science classrooms has become an imperative goal in preparing learners for future ways of learning and careers. This ideal, therefore, has implications for teacher training and development. This paper evaluates flipped classroom pedagogy in Natural Sciences (NS) learning with mobile virtual reality (VR) applications. One of the main setbacks of introducing mobile virtual reality (MVR)-enhanced learning in educational settings is the need for more knowledge of sound instructional/pedagogic strategies for facilitating their adoption. The study therefore aimed at exploring techniques within a flipped classroom model that saw the integration of MVR technology in NS learning. 95 Natural Sciences students (in a teacher training program) were conveniently sampled to participate in the study. Data were collected from the qualitative analysis of student pre-lesson plans, video analysis of flipped classroom interactions and quantitative analysis of post-flipped learning quiz scores. Students worked in groups of five to interact asynchronously with MVR applications using cellphones and cardboard VR headgear to generate their own pre-lesson plans and concept maps for the actual contact class session. The analysis of these high-end lesson sequences showed that students' awareness of flipped roles compelled them to collaborate more, be creative, and change their approach to problem-solving. Aspects like knowledge sharing and pre-planning of questions for the instructor were also prompted by the experience. Higher-order thinking skills (HOTS) were developed holistically from the flipped learning experiences. Students also showed that more time spent engaging with MVR technology and the content led to deeper learning and better achievements in learning tasks. Challenges of the flipped pedagogy included more planning time, incompatibility of some mobile phones to MVR applications, fear of presentation and peer criticism. From the findings, some recommendations and implications related to autonomous learning and the development of HOTS in relation to flipped classrooms for science students' learning are also discussed in this paper.

**Keywords:** *Flipped classroom, Higher order thinking skills (HOTS), Interactive learning, Mobile virtual reality (MVR).*

---

## 1. Introduction and background

The versatility required by thriving organisations in the 21<sup>st</sup> century suggests that students must be trained to be self-propelling, creative and adaptable to a fast-changing world. In educational settings, flipped classroom pedagogical strategies empower students to learn concepts outside of the classroom through watching pre-recorded lectures, engaging in virtual laboratories, videos or reading materials and then using the allocated classroom time to apply that knowledge through collaborative, hands-on activities (Bishop & Verleger, 2013; Halili & Zainuddin, 2015). Using mobile virtual reality (MVR) in natural sciences learning can enhance this approach by providing students with immersive, interactive experiences that deepen their understanding of abstract or complex concepts when they autonomously study course materials. This research explores the gap in strategies that could be used to enact flipped classroom pedagogy and their efficacy in transforming Natural sciences learning. The main aim of the study is to investigate possible ways through which mobile virtual reality (MVR) could be adopted in educational settings using sound instructional/pedagogic strategies such as flipped learning. On the other hand, because flipped pedagogy is also usually burdensome to enact in science subjects which require practical work, MVR applications provide a worthy tool to engage students in a flipped classroom.

Advances in technology have had a significant impact on teaching and learning in educational settings from K-16 internationally. The flipped classroom pedagogy is one of the most popular teaching models that have emerged due to technological advancements. The flipped classroom model has been

widely adopted by educators as it offers students the flexibility to learn in their own spaces and at their own pace and facilitates an interactive and engaging learning experience. Mobile virtual reality (MVR) technology has created opportunities for educators to enhance the flipped classroom model further.

While the traditional classroom model is characterized by instructors providing lectures in class and students taking notes and asking questions, a flipped pedagogy involves the inversion of the traditional classroom roles. In this model, the instructor creates video lectures and provides slides, virtual laboratories, applications, or any other instructional materials for students to study at home (Lin et al., 2023). This enables students to study the materials at their own pace and convenience. During class, students become the focus and propel interactive activities, reinforcing the knowledge gained. This means peer-peer and peer-teacher interactions are at the fore of the model.

Benefits of the flipped classroom model include convenience and flexibility for students, autonomy in the learning process, access to learning resources, active learning, and peer-to-peer learning (Jong, 2023; Law et al., 2020)

Despite the numerous benefits of the flipped classroom model, its implementation can be challenging, especially for science subjects that require multi-representational tools and a practical approach. For instance, Subjects within the Natural sciences, such as physics, chemistry, space science and biology, require dealing with abstract ideas and engaging in practical activities to comprehend the content. In such subjects, learning is not only about understanding theories but also about developing practical skills. Consequently, the flipped classroom model must be modified to fit the needs of science subjects which is where MVR comes into play. This study there answers the following research questions:

- What is the role of MVR in flipped classroom experiences?
- How effective is MVR-based flipped classroom learning?

### **1.1. Mobile Virtual reality (MVR)**

Virtual reality (VR) technology offers an immersive and interactive learning experience in virtuality that allows students to explore complex concepts and theories in a practical way. The technology provides a simulated environment that engages students' senses, enhances visualization and presence, and reinforces learned concepts (Jong, 2023, Lin et al., 2023). Mobile virtual reality (MVR) is a more affordable option for VR integration, combining mobile phones with low-cost VR headsets like Google Cardboard for immersive experiences. MVR technology is easy to use, portable, and affordable. Furthermore, the technology provides an opportunity for students to learn in a personalized and engaging way.

The integration of mobile VR technology in the flipped classroom model presents opportunities for science educators to deliver an interactive and practical learning experience to their students. The use of mobile VR technology can enhance the flipped classroom model by providing students with practical learning experiences that reinforce concepts as well as other learning materials provided. Moreover, mobile VR technology can be used to explore virtual laboratories and simulations that could complement traditional lab work and foster remote experiential learning.

### **1.2. Flipped classroom pedagogy in Natural Science learning using mobile VR**

Fostering remote practical work in Natural sciences subjects could be complex and challenging. Using an MVR-based flipped experience, however, provides an opportunity for students to incorporate some exploratory practical work, for example, instead of completing a traditional dissection of a pig or frog in order to study the internal organs of living things, a VR application like Victory XR's frog dissection (<https://sidequestvr.com/user/102517>) for mastery of the same concepts, without harming any real frogs. Similarly, an application like the VR chemistry lab (<https://sidequestvr.com/app/11063/the-vr-chemistry-lab>) could provide chemistry students with a seamless experience in learning about laboratory safety and chemical reactions in a safe and controlled environment.

Studies have shown that the use of VR in natural sciences education can lead to improved academic performance, increased engagement, and enhanced critical thinking skills (Law et al., 2020; Lin et al., 2023). The integration of flipped classroom pedagogy and mobile VR can build on these benefits, allowing students to engage with course content in a more dynamic and interactive manner (Lu et al., 2021).

## **2. Theoretical underpinnings**

Theoretically speaking, social learning theory, emphasizes the importance of social interactions in the learning process. In a flipped classroom setting, students can interact with their peers and instructor during in-class activities, allowing them to engage in collaborative learning and receive feedback on their

understanding of instructional material. This approach has been found to promote deeper learning and enhance student engagement and motivation (Bishop & Verleger, 2013). Closely related to constructivism, the social learning theory promotes interactivity among peers through collaborative work. This research taps into these affordances of social learning in designing the MVR flipped classroom experiences for 95 students in the third year of a science teacher education program.

### 3. Methods

95 Natural Sciences students (in a teacher training program) were conveniently sampled to participate in the study. Data were collected from the qualitative analysis of student pre-lesson plans, video analysis of flipped classroom interactions and quantitative analysis of post-flipped learning quiz scores. Participants were divided into 19 groups, with each group having five students of varying abilities. All learning materials for preparing the flipped experience were uploaded to the institutional learning management system (LMS) Blackboard. To interact asynchronously, students had to download the MVR applications ARloopa and SolarsystemAR and, using cellphones and cardboard VR headgear, generate their own pre-lesson plans and concept maps for the actual contact class session. An embedded mixed-method approach was followed. Data were then gathered through artefacts, video recordings for observational purposes, classroom conversations, and quizzes. A content analysis of gathered data using Open and axial codes was used to generate baseline data to answer the research questions posed at the beginning of the inquiry.

### 4. Results

*RQ1: What is the role of MVR in flipped classroom experiences?*

The analysis of high-end lesson plans and sequence maps of what was done showed that students' use of MVR increased their awareness of the flipped roles. MVR compelled participants to collaborate more, visualize more, be creative, and change their approaches to problem-solving. Findings from the qualitative analysis of the interactive video lesson indicated that all 19 groups of participants followed a unique sequence of engagement in the selected content, as outlined in Table 1 below.

*Table 1. A Highlight of flipped MVR-based lesson sequence.*

<b>Engagement with pre-provided content</b>	<b>Engagement with MVR Applications</b>	<b>Collaborative Discussion</b>	<b>Engagement with learning Objectives</b>	<b>Plan lesson</b>
-The topic introduction Slides, diagrams, and videos. -Evidence of collaborative work in group conversations of the pre-text. -First-level display of HOTS by looking at ways of simplifying the content.	-Peer support in installing the mvr application and trying it out. -Self-talk moments when immersed in cardboard devices. -Relating MVR applications to the learning objectives. -Noting gaps in the application in relation to the learning objectives.	-Groups discussing the content again in line with the MVR application. -Peer-to-peer discussion on possible assessments and questions to pose during the class session. -Analysing the benefits of the MVR apps.	-Drafting lesson objectives against the learning outcomes with the use of the MVR application. -Highlighting gaps in understanding concepts.	-Planning lesson presentation for the contact session. -Delegating presentation roles. -Writing down possible misconceptions that could be addressed by the main instructor in class.

From Table 1, it is clear that adding MVR applications to flipped classroom learning resources, added a layer of group interactivity to the content. The collaborative learning experience became more engaging and participatory. MVR also provided another layer of visualisation of NS concepts besides the notes and pre-recorded lecture slides.

An analysis of video-recorded lessons showed three key higher-order thinking skills (HOTS) that were developed, including critical thinking in the task created to engage peers, creativity in showcasing

the MVR application selected for the flipped lesson and communication, in the quality of questions posed as well as the misconceptions brought to the fore.

*RQ2: How effective is MVR-based flipped classroom learning?*

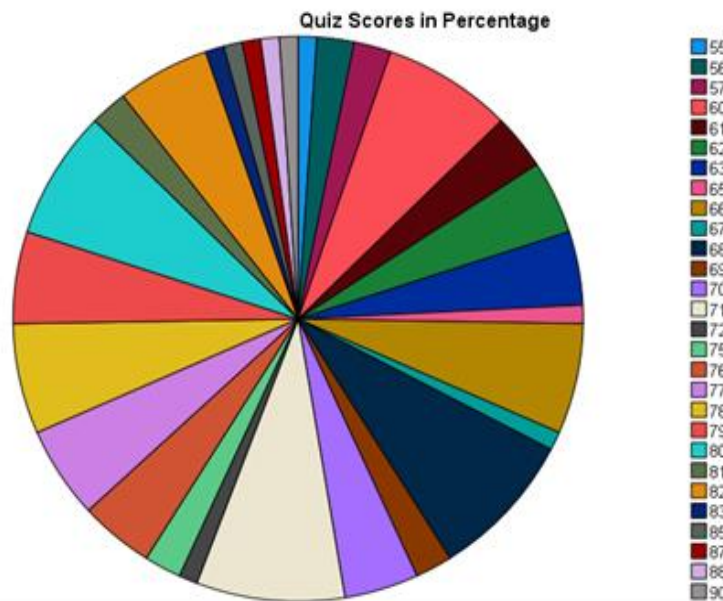
The results from the post-lesson quiz are shown in the descriptive statistics Table 2 below. These results showed that the lowest-performing student attained a score of 55%, and the highest-performing student obtained a score of 90%. This would typically not be the case for this group of participants, where a previous quiz on similar concepts showed a minimum score of 35% and a maximum score of 82%.

Table 2. Descriptive statistic of post-flipped class quiz scores.

	N	Range (%)	Min (%)	Max (%)	Mean (%)	S.D (%)
Quiz Scores in Percentage	95	35	55	90	71.38	8.406
Valid N (listwise)	95					

From Table 2, the mean score (M) of the quiz was 71.38%, with a standard deviation (SD) of 8.4%. The maximum quiz score was 90%, while the minimum score was 55%. The pie chart in Figure 1 below represents the mark distribution in percentiles for all the participants indicating a relatively good achievement in the given task.

Figure 1. Pie distribution of Quiz marks.



Following the distribution of marks from Figure 1, MVR-based flipped learning has a positive effect on the average achievement score of participant students. The added layer of engagement that MVR applications provide foster deep learning and interactivity.

**5. Discussion and conclusion**

Based on the findings of this research, the use of MVR in flipped classroom pedagogy within natural sciences learning has the potential to transform the way students engage with and understand scientific concepts. By providing an immersive, interactive learning experience, students can better understand the material and be better prepared for real-world applications of scientific knowledge. This study’s findings concur with recent studies, which show a positive outcome when VR and augmented reality (AR) are integrated in flipped learning models (Chang & Hwang, 2018; Jong, 2023, Lin et al., 2023). However, the study provides a unique contribution to the added group work dimensions that take place in a flipped classroom setting.

From the findings of this study, it is recommended that MVR learning resources be considered in facilitating remote and flipped learning experiences within educational settings, especially in NS. A group work approach has the potential to foster an added level of interactivity. Hence it should be considered as a sound pedagogical approach for implementing flipped MVR-based learning. For researchers, larger-scale studies using different pedagogical approaches like inquiry, argumentation, and problem-solving could be investigated using the MVR-based flipped learning model.

### References

- Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *2013 ASEE Annual Conference & Exposition*, Atlanta, Georgia.
- Chang, S. C., & Hwang, G. J. (2018). Impacts of an augmented reality-based flipped learning guiding approach on students' scientific project performance and perceptions. *Computers & Education*, *125*, 226-239.
- Halili, S. H., & Zainuddin, Z. (2015). Flipping the classroom: What we know and what we don't. *The online Journal of Distance Education and E-learning*, *3*(1), 15-22.
- Jong, M. S. Y. (2023). Flipped classroom: motivational affordances of spherical video-based immersive virtual reality in support of pre-lecture individual learning in pre-service teacher education. *Journal of Computing in Higher Education*, *35*(1), 144-165.
- Law, L., Hafiz, M., Kwong, T., & Wong, E. (2020). Enhancing SPOC-flipped classroom learning by using student-centred mobile learning tools. *Emerging technologies and pedagogies in the curriculum*, 315-333.
- Lin, H. C., Hwang, G. J., Chou, K. R., & Tsai, C. K. (2023). Fostering complex professional skills with interactive simulation technology: A virtual reality-based flipped learning approach. *British Journal of Educational Technology*, *54*(2), 622-641.
- Lu, A., Wong, C. S., Cheung, R. Y., & Im, T. S. (2021, April). Supporting flipped and gamified learning with augmented reality in higher education. In *Frontiers in education* (Vol. 6, p. 623745). Frontiers Media SA.

## **ASSUMPTIONS ABOUT LEARNING THAT UNDERPIN TEACHERS' FEEDBACK PRACTICES**

**Verónica Yáñez-Monje**

*Faculty of Education, University of Concepcion (Chile)*

### **Abstract**

This paper seeks to examine models of cognition and of learning and its possible alignment with formative assessment. This, using feedback as an entry point to have access to teachers' actions and interpretations in the intertwining that takes place between teaching, learning, and assessment. Data is informed by doctoral research conducted in three primary schools in England. The empirical work was undertaken by classroom observation and teachers' follow up interviews. The main findings foregrounded different participants' views. For some teachers the strategies used to provide feedback such as modelling skewed towards instruction, which resonates with the idea of making judgments about what is missing within tasks, with the teacher exerting the prime role within interaction by taking responsibility for the pupils' misunderstandings. Another relevant notion was assessment as learning (Torrance, 2007), which consisted of feedback actions focused on specifying what were the necessary features to be completed to meet the objective which resembled a hierarchical sense of how these elements or criteria should be taught and learnt (James, 2006; Marshall & Drummond, 2006). Results also depicted teachers' assumptions regarded to talk and shared learning, which trace some similarities with cognitive and constructivist perspectives of learning. The corresponding actions were enacted by encouraging their pupils to use conceptual and strategic resources in collaboration when discussing on their writing tasks. These practices also involved pupils' suggestions on the criteria already proposed by the teacher. Finally, the study also revealed a teacher's perspective portrayed as Questioning means learning, which reflected how teacher provided their students with evaluative experience when the task was ongoing. In this view, a link could be made with a sociocultural approach as students took ownership of both, the learning and the assessment process.

**Keywords:** *Feedback, learning conceptualizations, formative assessment.*

---

### **1. Introduction**

Formative feedback should be carefully examined, as many contributions have brought to the fore that the main tenet stemming from this perspective seems to be overturned within lessons. That is, many constraints emerge to support pupils to progressively become independent in their learning process (Klenowski, 2009; Mansell et al., 2009; Sadler, 2007; Swaffield, 2011). Research also has proved how different approaches to orchestrate key strategies such as questioning, sharing criteria, providing feedback and self-assessment, inside the classroom, might lead to facilitate or to undermine formative assessment. In other words, they might fail to keep within its spirit (Marshall & Drummond, 2006). According to Black et al., (1998, 2003) any classroom initiative within these four specific areas should not be considered as isolated techniques. These elements must be investigated by taking into account the social construction of classroom talk (Torrance & Pryor, 2001) and the teachers' beliefs about how students learn (Sadler, 2007, 2010; Black et al., 2003; Black & Wiliam, 2012; Elwood, 2006; Hargreaves, 2005; James, 2006; Klenowski, 2009; Marshall & Drummond, 2006; Mansell et al., 2009; Swaffield, 2011). In what follow, different learning outlooks are sketched out from theory as well as its implications for formative assessment.

James (2006) asserts that a behaviourist view of learning triggers feedback practices that emphasize interpreting pupils' performance as correct or incorrect, the criteria are settled out in a hierarchical sense, which entails that a set of skills are measured in order to identify what is still not achieved. Thereby, the teachers exert the role of reinforcing those missing elements by returning to more basic student abilities trying to push them to the next level. This can be understood as giving pupils extra



help to deal with targets or standards (Hargreaves, 2005). This notion reflects that the implementation of more complex view of learning and assessment are reduced.

Cognitive-constructivist theories of learning highlight how previous knowledge have influence over pupils 'capacity to learn new material, so they can understand concepts, the relationship amongst them and to develop a capacity of processing strategies (James, 2006; James & Lewis, 2012). Metacognition and self-assessment become essential features within this perspective and the work of the teachers is meaningful in helping students to retrieve knowledge structures to be applied in novel situations (James, 2006; James & Lewis, 2012). This author asserts that formative assessment, intertwined into teaching, turns out pivotal making possible to elicit pupils 'mental models. These ideas are developed to a greater extent within the sociocultural theories of learning. Vygotsky's work (1978) adds relevant insights for research and practice. Broadly, He advocates that language has a crucial influence on students' capacity to think, learning is conceived as a social and collaborative activity, his concept of the zone of proximal development (ZPD) demands transformations in educational settings. In interpreting his contribution James & Lewis (2012), argues that when learning is acquired within a group of peers, collective knowledge of the group is then grasped by the individual, but in this ongoing an iterative process, the individual is also creating new ideas which are externalized through dialogue and so they can be used again for the group. For James these notions challenge the theorization regarding the structures of grades and attainment levels reached step by step. Instead of that, the nonlinearity would be more appropriate as in the ZPD, a student might move forward or backward and in different directions by considering their individuality and their previous experiences that compose their unique profile. In relation to formative assessment, Vygotsky's contribution requires pupils taking ownership of their learning and of their own assessment. In this way, assessment becomes a process of inquiry, where all who are involved actively reflect on the learning process (Hargreaves, 2005). This also regards with saddler's (2010) notion of scaffolding as a process that gradually should come to an end, to the extent that pupils develop tacit knowledge to interpret feedback and can reach an in-depth understanding of the criteria. Thus, formative assessment should be enacted in a continuous and exploratory process of negotiation. This grounded on self-and peer assessment strategies which would open opportunities for discussion and hence for shared knowledge.

This paper analyses part of the findings stemming from a doctoral research conducted in England (Yáñez-Monje,2017). It reports on the views about learning that hold a group of participant teachers and its potential link with formative assessment. Feedback is used as a lens to explore interrelated classroom strategies such as sharing criteria which serve as a framework, on the one hand, to substantiate comments provided to pupils about the quality of the task being done, and on the other, to allow students to make judgments on their own pieces of work, and so, plan next steps for improvement. This drawing on empirical evidence within the fine grain (Torrance & Pryor, 1998) of classroom interaction followed by the teachers' own reflections on their work (Black et al., 2003; Marshall & Drummond, 2006).

## **2. Methodology**

The research was grounded on a qualitative paradigm (Berg & Lune, 2012, Silverman, 2011) by exploring in depth teacher-students exchanges and then having access to teachers' accounts on their actions. This trying to elucidate what were the notions that drove their pedagogical decisions when providing feedback and from here to explore how they see themselves in this interrelationship between assessment and learning.

### **2.1. Objectives**

The study was driven by the following overarching objectives:

- To examine the extent that assumptions about learning underlie teachers 'feedback practices.
- To explore the specifics notions that teachers recognize as salient within a formative assessment approach and how they explain their meanings.

### **2.2. Participants**

The research project encompassed four participant teachers of Year 5 classes and one of a Year 4 class from three different primary schools in London. The chosen schools were considered real contexts (Berg & Lune, 2012) the first two belonged to the same local authority in north London, the third pertained to a local authority in an area of west London. Thus, sampling selection was purposive or strategic trying to explore complexities and diversity of practices and interpretations, but not implied to reach representativeness (Cohen et al., 2011).

### 2.3. Data collection and analysis

Data collection was addressed through classroom observation and teachers' interviews. Observation aimed to capture the nuances that might not be verbalized by the teachers through other procedure of data gathering. Thirty-four lessons were observed by focusing on feedback events (Bloome et al., 2005, 2008). A micro ethnographic perspective was used to identify, select and scrutinize classroom episodes (Bloome et al., 2005, 2008). The audio-recorded incidents were listened and played back as necessary as well as looking at the data previously transcribed. Several steps were carried out for analysis. First, lessons were subdivided into phases. Second, the main elements within each phase were organized by determining its foremost purpose, and the organizational context that structure teacher-students exchanges, this based on Alexander's (2008) work, who refers to whole-class teaching, collective group work, and collaborative group work. Third, a closer examination of each phase was undertaken trying to recognize what part of a lesson seemed to have more potential for feedback to be enacted. Then, specific instances across lessons were chosen for further analysis using the theoretical insights from Sadler's (1989, 2007, 2010) contribution on students' exploration of quality and on the feedback content and focus. Likewise, the analysis focused on how teachers engineered questioning and how they appeared to interpret their students' responses (Black & Wiliam, 2012; Torrance & Pryor, 1998, 2001; Black et al., 2003; Alexander, 2008).

Interviews were applied by using a semi structured format in line with a research interview as advocated by Kvale & Brinkmann (2009) with a focus on nuances descriptions that portray qualitative diversity. Meaning coding as conceptualized by Kvale & Brinkmann (2009) was adopted in examining interview data. The coding process was iterative as data were constantly compared (Charmaz, 2006) by contrasting the teachers' descriptions of strategies they implemented and their interpretations of their own actions. This process was carried out within the transcripts, at different points of the interview situation and between the four participant teachers. It is important to note that this research provided a detailed account into verbal feedback and into written forms of feedback. The findings regarding both dimensions have been shared in wider audiences (Yáñez-Monje, 2022; Yáñez-Monje, et al., 2022). However, this paper, specifically, concerns to the alignment between feedback practices and the learning conceptualizations captured from the teachers' reflections. It is intended to unpack the contradictions and conflicting evidence so to portray in which ways what teacher think about learning might hinder or promote the possibilities for formative assessment to be enacted. This involved a consideration of extant literature on formative feedback but also on learning theories in order to provide an interpretation of teachers approaches.

## 3. Results & discussion

Data analysis revealed insightful perspectives that allow to understand how teachers think their pupils should learn and how this permeated their decisions, on the ways feedback was implemented and hence how formative assessment is interpreted. In what follows, the main codes that emerged when contrasting practices and teacher's views are reported.

*Modelling skewed towards instruction: teacher 1* wanted her students to have a sense of what quality looks like. She showed them some examples for discussion by inviting them to devise some templates together in order to trigger understanding. Notwithstanding, this purpose of getting the pupils to reflect on their work seemed difficult to enact fully as the interactions remained under her control in terms of rephrasing the students' answers into more appropriate forms; stating the main points for discussion; and summarizing the essential aspects of the intended quality in each activity. In her interview the teacher described two challenges or dilemmas encountered in translating this strategy into practice, namely, how much needs to be modelled, for children with different starting points in learning, and modelling cannot ascertain that pupils will identify next steps.

*The teacher role is defined by identifying what is missing:* this notion was also represented by *teacher 1* as her feedback practices within lessons focused on those elements that pupils were struggling to understand, in this way judgments were made on what needed to be repaired and the teacher assuming the main responsibility for what was hindering the students from learning.

*Talk fosters pupils' learning: teacher 2* developed the view that scaffolding of a writing task should involve talk. This implied activities to generate vocabulary, the oral rehearsal of sentences, discussion within group work, and collecting pupils' ideas which on some occasions comprised alterative propositions about how the task should be afforded. These findings support the view that criteria should not be completely fixed (Sadler, 1989, 2007, 2010; Torrance & Pryor, 1998, 2001; Black et al., 2003) and that their negotiation should be continuous throughout the learning task. By not exerting role of the final arbiter of quality (James, 2006), these teacher's practices and viewpoints have some resemblances with cognitive and constructivist theories of learning.

*Shared learning:* The notion of pupils generating ideas from each other, in preparing and devising pieces of writing, was explored more in depth by *Teacher 2* when describing his practice from a broader perspective. As the observation data illustrated that pupils' own initiative of posing questions or making suggestions was not unusual, the participant was asked to elaborate further on this matter. He described two intertwined ideas that shed light on his beliefs about his students' involvement in lessons. First, he highlighted the relevance of creating a learning environment that encouraged the pupils to engage in the learning task and to not be afraid to share their ideas. Second, whilst some children faced more difficulties with the learning task, he wanted all his students to have a go at completing it. This is why he saw it as important for all of them to engage in team work so as to be able to hear and learn from each other's contribution, which evoked Vygotsky's notion of zone of proximal development (1978).

*Assessment as learning:* a notion based on Torrance's (2007) ideas was used to portray how teacher 3, expected her pupils accomplished a number of features that were defined in a task, which in turn, were delineated within a success criteria list. For instance, when modelling the writing of a descriptive text, the feedback focused first on personification, then on effective verbs, alliterations and so on. This meant that each aspect of quality was discussed separately. Thus, in the view of James (2006) this can be interpreted as decomposing the whole complex aim of writing into different parts. Consequently, it could be argued that there were some points of connections with behaviourist theories of learning.

*Questioning means learning:* teacher 4, adopted the view of getting the pupils to think during the interaction by letting them to take part and devise a model for writing by using their peers' suggestions. The teacher pieces of advice were modified by some students' spontaneous ideas which opened the possibilities for the negotiation of quality. Feedback was exerted with the purpose of collecting evidence about how pupils were articulating the task, thereby, criteria had a provisional character, and they were not intended as an end (Marshall & Drummond, 2006). Within this teacher's account pupils were provided with evaluative experience thus they had an active role within learning and assessment.

#### 4. Conclusions

A view of learning oriented towards getting pupils to accomplish a pre-determined sequence of goals or objectives involved that all the procedures undertaken within formative interaction emphasized the clarification of the criteria and instructions. Thus, it was not the practices that were important rather what was worth to be analysed was the intentions behind them.

The relevance of talk and collaborative learning enhance the opportunities for formative action. When pupils were encouraged to participate, they were able to make suggestions for improvement that were slightly different from the teacher original proposals.

Classroom interactions that allowed discussion and collaborative work, not only amongst peers but also between the teacher and the students by determining what counts as quality in a piece of work, offer more clearly a room for formative feedback to take place in accordance with its original tenets. All in all, this research documented how the teacher's underlying principles of learning might open up or close down the possibilities for formative assessment to be effective.

#### References

- Alexander, R. J. (2008). *Towards Dialogic Teaching. Rethinking classroom talk*. Cambridge: Dialogos.
- Berg, B., & Lune, H. (2012). *Qualitative Research Methods for the Social Sciences*. California: Pearson.
- Black, P., & William, D. (1998). Assessment and Classroom Learning. *Assessment in Education. Principles, Policy & Practice*, 5(1), 7-74.
- Black, P., Harrison, C., Lee, C., Marshall, B., & William, D. (2003). *Assessment for Learning: Putting it into Practice*. Maidenhead: Open University Press.
- Black, P. & William, D. (2012). Developing a Theory of Formative Assessment. In J. Gardner (Ed.) *Assessment and Learning* (pp. 206-229). California: SAGE Publications.
- Bloome, D., Power Carter, S., Morton Christian, B., Otto, S., & Shuart-Faris, N. (2005). *Discourse Analysis and the Study of Classroom Language and Literacy Events. A Microethnographic Perspective*. Lawrence Erlbaum Associates.
- Bloome, D., Power Carter, S., Morton Christian, B., Madrid, S., Otto, S., Shuart-Faris, N., & Smith, M., (2008). *On Discourse Analysis in Classrooms. Approaches to Language and Literacy Research*. New York: Teachers College Press, Columbia University.
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research Methods in Education* (7th ed.). London: Routledge.

- Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative research*. London: SAGE Publications.
- Elwood, J. (2006). Formative assessment: possibilities, boundaries and limitations. *Assessment in Education: Principles, Policy & Practice*, 13(2), 215-232.
- Hargreaves, E. (2005). Assessment for learning? Thinking outside the (black) box. *Cambridge Journal of Education*, 35(2), 213-224.
- James, M. (2006). Assessment, Teaching and Theories of Learning. In J. Gardner (Ed.), *Assessment and Learning* (1<sup>st</sup> ed.) (pp. 47-60). London: SAGE Publications.
- James, M. & Lewis, J. (2012). Assessment in Harmony with our Understanding of Learning: Problems and Possibilities. In J. Gardner (Ed.), *Assessment and Learning* (2<sup>nd</sup> ed.) (pp. 187-205). London: SAGE Publications.
- Klenowski, V. (2009). Assessment for Learning Revisited: An Asia-Pacific perspective. *Assessment in Education: Principles, Policy & Practice*, 16(3), 263-268.
- Kvale, S. & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research* (2<sup>nd</sup> ed.). California: SAGE Publications.
- Mansell, W., James, M., & the Assessment Reform Group (2009). *Assessment in Schools. Fit for purpose? A commentary by the teaching and Learning Research Programme*. London: Economic and Social Research Council, Teaching and Learning Research Programme.
- Marshall, B., & Drummond, J. (2006). How teachers engage with assessment for learning: lessons from the classroom. *Research Papers in Education*, 21(2), 133-149.
- Sadler, D. R. (1989). Formative Assessment and the Design of Instructional Systems. *Instructional Science*, 18, 119-144.
- Sadler, D. R. (2007). Perils in the meticulous specification of goals and assessment criteria. *Assessment in education: Principles, Policy & Practice*, 14(3), 387-392.
- Sadler, D. R. (2010). Beyond feedback: developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education*, 35 (5), 535-550.
- Silverman, D. (2011). *Interpreting Qualitative Data* (4<sup>th</sup> ed.). London: SAGE Publications.
- Swoffield, S. (2011). Getting to the heart of authentic Assessment for Learning. *Assessment in Education: Principles, Policy & Practice*, 18(4), 433-449.
- Torrance, H., & Pryor, J. (1998). *Investigating Formative Assessment. Teaching, Learning and Assessment in the classroom*. Buckingham: Open University Press.
- Torrance, H., & Pryor, J. (2001). Developing Formative Assessment in the Classroom: using action research to explore and modify theory. *British Educational Research Journal*, 27(5), 616-631.
- Torrance, H. (2007). Assessment as learning? How the use of explicit learning objectives, assessment criteria and feedback in post-secondary education and training can come to dominate learning. *Assessment in education: Principles, Policy & Practice*, 14(3), 281-294.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Process*. Cambridge, MA: Harvard University Press.
- Yáñez-Monje, V. (2017). *Exploring Teachers' Interpretations of Feedback in Primary Literacy Classroom Settings* [Doctoral dissertation, King's College London, England]. Retrieved from [https://kclpure.kcl.ac.uk/portal/en/persons/veronica-yanezmonje\(9432e582-108b-489e-9db7-9aec91dd227d\).html](https://kclpure.kcl.ac.uk/portal/en/persons/veronica-yanezmonje(9432e582-108b-489e-9db7-9aec91dd227d).html)
- Yáñez-Monje, V., Aillon-Neumann, M., & Maldonado-Elevancini, C. (2022). The relevance of feedback messages in communicating quality in educational classroom settings. *Education and New Developments*, 1, 91-95. <https://doi:10.36315/2022v1end020>.
- Yáñez-Monje, V. (2022). Assessment criteria and formative feedback: teachers' perspectives. *HUMAN REVIEW. International Humanities Review / Revista Internacional De Humanidades*, 11(5), 1-16. <https://doi.org/10.37467/revhuman.v11.3875>

# PERFORMING SMALL PROJECT ASSESSMENT IN CIVIL TECHNOLOGY THROUGH HEUTAGOGY APPROACH TEACHING AND LEARNING PROCESS

**Khojane Geoffrey Mokhothu**

*Central University of Technology, Free State (South Africa)*

## Abstract

A small project is one of the formal assessment tasks used in Civil Technology, along with preparing for the stage of the actual project that integrates theory and practical work. The aim of the study was to promote and assess the heutagogy approach in the teaching and learning process in Civil Technology small project assessment. While the main objective was to assess the impact of heutagogy as a teaching and learning approach to achieve a small project assessment in Civil Technology. Moreover, the proposition of the study was that the degree of teaching and learning freedom in Civil Technology promulgates creativity, innovation, critical thinking, and problem-solving application. The study used a mixed-method approach consisting of a questionnaire and a semi-structured interview to gather data. The participants of the study were Civil Technology students, both males and females, from different cultural groups enrolled at one of the Universities of Technology in South Africa. Additionally, the study occurred between the 2020 and 2021 academic years, while the teaching and learning process was more hybrid (online for theory, face-to-face for practical work and verbal presentation). According to the findings obtained by the study, it was determined that the proposition and objectives of the study were positive. However, close monitoring and supervision by the lecturer on integrating theory and practical work should be more active and proactive in the heutagogy approach of teaching and learning.

**Keywords:** *Small project, heutagogy, Civil Technology, theory and practical work.*

---

## 1. Introduction

The integration of theory and practical work is a critical platform to discharge the effective teaching and learning process in the Civil Technology subject. Assessments in Civil Technology are conducted in several ways, such as theory, investigation, simulation, and all levels of practical work, which are small project and practical assessment task (DBE 2014). Therefore, this research explores the performance of small task through a heutagogical approach.

## 2. The Conceptualisation of the study

### 2.1. Heutagogy approach

*"Teach how to think not what to think"* (Margaret-Mead, nd). Heutagogy is an approach of self-determined learning and brings together some of the principles provided by these numerous approaches to learning (Kenyon and Hase, 2001). This is also an effort to question certain notions about teaching and learning that still dominate in teacher-centered learning, in particular the necessity of, as Bill Ford (1997) persuasively puts it, "knowledge sharing" rather than "knowledge hoarding" (Kenyon and Hase, 2001: 3). Furthermore, heutagogical approach acknowledges the need for flexibility in learning, in which the teacher gives resources, but the learner designs the actual course of action by negotiating the learning. As a result, students may read around crucial problems or concerns to establish what is of interest and relevance to them, and then negotiate more reading and assessment activities. In the latter case, assessment becomes more of a learning experience than a technique for measuring achievement. (Hase & Kenyon, 2000; Nikolovska, Grizev & Iliev, 2019: 148).

## 2.2. Small project

Small project It is an actual project in a small-scale model or doing any part of an actual project that is regarded as most challenging to provide students with first-hand practise and technique development. Moreover, Ntshaba (2012: 4) stressed the importance of small projects as an element of summative assessment for student competency maintenance (DoE, Curriculum and Assessment Policy Statement, 2014: 30; Ntshaba, 2012: 4). In addition, Ntshaba (2012: 4) views modest projects as allowing students to participate in design activities and understand how internal limitations and processes affect designs (DoE, 2014; Sonar, 2021: 1).

## 2.3. Civil Technology as a subject

Civil technology is concerned with the concepts and principles of the built environment, as well as the technical process (DoE, 2014: 9). It includes the application of scientific principles as well as practical skills. The subject strives to construct and improve the built environment to improve the individual and societal quality of life while also ensuring the sustainable use of the natural environment. Civil Services, Construction, and Woodworking are the three core areas of study (DoE, 2014: 9; DoE, 2014: 11; Maeko, 2016; Mokhothu, 2020; Mtshali, 2020).

## 3. The aim of the study

The aim of the study was to promote and assess the heutagogy approach in the teaching and learning process in Civil Technology small project assessment.

## 4. The objective of the study

The main objective was to assess the impact of heutagogy as a teaching and learning approach to achieve a small project assessment in Civil Technology.

## 5. Proposition of the study

The proposition of the study was that the degree of teaching and learning freedom in Civil Technology promulgates creativity, innovation, critical thinking, and problem-solving application.

## 6. Methodology

### 6.1. Context of the study

Theory class between lecturer and Civil Technology BEd (SP and FET) was conducted online via one of the recommended platforms by the university. While practical class were conducted face-to-face in the university Civil Technology workshop also at home for practical work (doing). The assessment small project was presented and discussed in class, consequently, was administered as individual task.

### 6.2. Participants

The participants of the study were Civil Technology students (N=64), both males (n=38) 59,4% and females (n=26) 40.6%, from different cultural groups enrolled at one of the universities of Technology in South Africa.

### 6.3. Measures

An individual assessment for the theory preparation report was provided to the student for conducting research on why reinforcing foundations or floor meshing is necessary (stage 1). At stage 2, students were ordered to design reinforced foundations or meshed floors according to the research they conducted. At Stage 3 of the individual assessment, students performed practical work, making a small project of a reinforced foundation or mesh floor. Therefore, during the submission date of the full assessment, "surprise" verbal assessment was introduced as stage 4; in a form of an open interview, all questions and answers were based on the individual's work one-on-one.

## 7. Results and discussions

Four tables below present the results of all four stages of assessment:

*Table 1. Research assessment.*

Stage 1	N	High score (%)	Lower score (%)	Average (%)
S 1	64	100%	55%	87.5%

*Table 2. Design assessment.*

Stage 2	N	High score (%)	Lower score (%)	Average (%)
S 2	64	100%	50%	82.8%

*Table 3. Practical work assessment.*

Stage 3	N	High score (%)	Lower score (%)	Average (%)
S 3	64	75%	50%	72%

*Table 4. Verbal assessment.*

Stage 4	N	High score (%)	Lower score (%)	Average (%)
S 4	64	65%	50%	66%

All three tables above, indicates the results from stage 1 to stage 4 of the assessments. Table 1 shows that all students managed to pass with the average of 87.5% and the score marks ranging between 100% highest and 55% lowest. In table 2 results indicate that students managed to pass with the average of 82.8% where the highest score was 100% and the lowest was 50%. While table 3 the results indicates that student achieved the average of 72% in the highest score of 75% and lowest of 50%. Table 4 indicated that all student managed to pass with the average of 66% the highest score was 65% and the lowest was 50%. All the results above managed to articulate that students managed to pass on their own freedom of space learning with less directives lecturer's but only instructions. Therefore, the results concur with Kenyon and Hase, (2001:3) heutagogical approach acknowledges the need for flexibility in learning, in which the teacher gives resources, but the learner designs the actual course of action by negotiating the learning.

## 8. Conclusion

According to the findings obtained by the study, it was determined that the proposition and objectives of the study were positive. However, close monitoring and supervision by the lecturer on integrating theory and practical work should be more active and proactive in the heutagogy approach of teaching and learning.

## References

- Department of Basic Education. [DoE] (2014). *Curriculum and Assessment Policy Statement*. Pretoria: Department of Education.
- Department of Basic Education. [DBE] (2014). *Civil Technology Guidelines for Practical Assessment*. Pretoria: Department of Education.
- Department of Education. [DoE] (2014, July 18). *Government Gazette – Republic of South Africa* (Vol. 589 No. 37840). Pretoria: Department of Education. <http://www.saflii.org/za/gaz/ZAGovGaz/2014/677.pdf>
- Hase, S., & Kenyon, C. (2000). From Andragogy to Heutagogy. In *ultiBASE In-Site, December 2000*. Melbourne: Royal Melbourne Institute of Technology.

- Kenyon, C., & Hase, S. (2001). Moving from Andragogy to Heutagogy in Vocational Education. In *Research to Reality: Putting VET Research To Work. Proceedings of the Australian Vocational Education and Training Research Association (AVETRA) Conference* (4th, Adelaide, Australia, March 28-30, 2001).
- Maeko, S. (2016). *Investigating the instructional practices of the practical component of Civil Technology for lecturer training in selected South African Institutions of Higher Learning* [Doctoral dissertation: Tshwane University of Technology, Pretoria, South Africa].
- Mokhothu, K. G. (2020). Investigating the impact of learn by doing in Civil Technology class: Students Action. In C. Mafalda (Ed.), *Proceedings of 8th International Conference on Education and New Developments (END)* (pp. 164-167). ISBN: 978-989-54816-2-1
- Mtshali, T. I. (2020). Critical thinking skills for Civil Technology practical assessment task (PATs). *World Transactions on Engineering and Technology Education*, 18(2), 237-241.
- Margaret-Mead. C. (nd). Building your Child's Critical Thinking skill. <https://rancholabs.medium.com/teaching-children-how-to-think-and-not-what-to-think-9ce6c8e33f51>
- Nikolovska, A, Grizev, A., & Iliev, A. (2019). History of Heutagogy as a Self-determined Learning. 2<sup>nd</sup> International Scientific Conference MILCON'9, Skopje (pp.147-153). ISBN: 978-9989-134-10-4
- Ntshaba, L. P. (2012). *A study of Technology Education Instructional Practices in Grade nine Classrooms: A Case Study of Three Senior Secondary Schools in the King William's Town District* [Master's thesis: University of Fort Hare, Alice, South Africa].



## **A STRENGTH-BASED MENTORSHIP PROGRAMME FOR NOVICE TEACHERS ILLUMINATED BY ACQUIRED STRENGTHS**

**Shaun Peens**

*Department for Languages and Social Sciences, Central University of Technology (South Africa)*

### **Abstract**

The lyrics from “Another brick in the wall’ by Pink Floyd released in 1979 inadvertently puts teachers on the backfoot, especially when the society can’t help to sing along. Although the song voices the feelings of many young adults pondering about teachers ruining their freedom by forceful actions of superiority, the majority of children, however, deem their primary school teachers as heroes. High school learners on the other hand, find themselves in a tussle with teachers; whether it might be an authority challenge or the need to be heard.

Annually novice teachers instinctively rock up at schools as young and energetic postgraduates hoping to impact children’s lives; often finding themselves exhausted after their first year, occasionally considering leaving the profession. Is this an indication that novice teachers are unprepared for reality? This paper will not dispute any level of content knowledge nor ability to teach but will investigate whether a one-year internship could be beneficial to young graduates entering the teaching sphere.

Professions in medical, engineering, accounting, and law require postgraduates to complete at least a calendar year internship prior to becoming full members. Some even expect their candidates to pass board exams including extending certain skills. On the other hand, our education students are only required to complete 21 weeks across their four years at university for full employment. Mastering some soft skills before postgraduate shoulder responsibility in the classroom setup could prove to be a valuable commodity in the education profession; with seasoned educators playing a vital part to instil these soft skills. Internships overall suggest that being present in the day-to-day activities often offer opportunities for growth which repeatedly include people management, integrating theory and practice.

The study will aim investigate how strengths-based coaching can be utilized to assist mentors and novice teachers during their internship year. Research about strength-based coaching indicate that applying formerly acquired strengths to new challenges, could guide an individual to a higher percentage of achieving success.

The Education Sector is under severe pressure to perform; therefore, an individual entering the sector knowing how to manage their strengths and address learners, will greatly contribute to communities with little hope for their children. This research would aim to motivate the introduction of an internship for educators instilling an appropriate level of preparedness of novice teachers, especially by pairing them with seasoned educators using Gallup and the Clifton Strengths assessments. The value of a strength-based mentorship program embedded in an internship structure for postgraduate education students serving in government school could soon become a necessity.

**Keywords:** *Mentoring, novice, strength-based, leadership, soft skills.*

---

### **1. Introduction**

This literature review represents an envisaged study based on whether novice teachers could grow in both their personal and professional capacity when suitable and sufficient support are offered from seasoned educators. This reversed responsibility on seasoned educators to anticipate the gaps and shortfalls novice teachers might experience; stepping into a servant-leadership role offering guidance, stability and instil confidence to novice teachers; will be the key driver on the efficacy for the need of a mentorship programme in the South African Education Sector.

## 2. Background

To add context the career paths of postgraduates in Education and Professional Accounting will briefly be compared. Both individuals spend around four years on campus completing their studies. Both have been exposed to work integrated learning (WIL) and presumably engaged in numerous student activities building character to develop holistically. On completion of their respective degrees, the future accountant will do a compulsory two- or three-year internship prior to a position as an Accountant, the norm being approximately three years. Senior staff understand that interns are finding their feet, learning new skills; mostly retaining their status as students for the foreseeable future.

In contrast, Education Postgraduates in South Africa (novice teachers) leave university as fourth-year students in December, gracefully walks into a school early January expected to be adults and at times take responsibility for Grade 12 learners. It proves to be a mammoth task to transform from a free-spirited student to a responsible adult in less than a month. The development gap might be a tad too great for any novice teacher to move from student to adult in such a short time frame without suitable support. Against these odds, South African Educators still manages to produce successful matriculants year after year, but the burden has to be lightened for novice teachers.

To date, the Department of Basic Education (DBE) has offered and implemented various support programmes to ensure stability in the education sector, although few exclusively support educators. Therefore, this research will aim to focus on the support of novice teachers who enters the work force with more than teaching on their plate.

## 3. Literature study

A motivation for this mentorship needs, derived from comparison to other professional careers where a required internship and at times a board exam is needed before an individual is allowed to practice. For example, a prospective Professional Accountant is required to do 3 years internship, and then write a Professional Examination assessment (SAIPA 2023). Auditors in South Africa CA(SA) are doing the same length of internship, but a further 2 assessments are required (SAICA 2023). In the medical profession, Doctors, Occupational Therapists, Pharmacists, Dentists, etc. are required to complete at least one practical year as well as an internship at a selected government hospital, with medical doctors doing two years of practical work in government hospitals (HPCSA Corporate Affairs 2017). Prospective Lawyers are also required to complete a two-year clerkship with four board exam papers in addition to an admission exam consisting of another four papers in two sittings (van der Merwe 2022).

Literature in terms of internships from the Accounting Sector will be discussed briefly. Albrecht noticed in a study that there is an expectation that internships lead to a closer relationship between the theoretical and technical knowledge when used in practice, guiding the development of personal competencies also known as soft skills (Albrecht et al. 1990). Results from a Romanian study suggests that the most important role to internships is to develop certain competencies which proven quite valuable in terms of notable contributions made by an internship; forming and developing students' competencies, practical and professional abilities in addition to increased ethical values added to a more informed understanding of the profession (Albu, Calu, and Guşu 2016).

Another study suggest that internships represent an instrument allowing to bridge theoretical and practical knowledge, for students to get better understanding between the shift from their expectations as students compared to the needs of the business environment in correlation with studies (Beard 2007; Beck and Halim 2008; Martin and Jack E. Wilkerson 2006) on the value an internship adds to the working environment.

Literature in terms of the medical profession points to the importance of clinical support for junior doctors at District Hospitals and standardisation of intern training at accredited facilities across South Africa (Miller, Mayanja, and Porter 2021). According to the researchers the objective of the internships are to instil confidence when managing emergencies and to gain experience. In addition the self-perceived readiness of medical interns completing their training to safely manage patients on their own was evaluated. Considering the lack of experience and confidence identified in Miller, Mayana and Porter's research, it becomes essential that senior medical doctors and on-site family physicians are attracted and retained where they could be able to support junior doctors.

This suggests that experienced individuals undeniably have knowledge and skills to convey to young graduates. In terms of the envisaged study, the Gallup Strength Based assessment can be valuable to find the strengths from individuals and apply them where needed. Individuals with definite gifts should be nourished to ensure stability in each profession.

Research by De Villiers, Van Heerden and Van Schalkwyk suggests the value internship in the medical fields are aiming at both interns and the value supervisors could add. From their study the intern supervisors indicated that interns were challenged by the transition from student to doctor, having to adapt to their new environment, extended working hours and deal with an increased workload. Clinical competencies, as well as attributes related to organisational acumen, social intelligence and personal characteristics, were identified as important to prepare interns for the workplace. Adding to the list of responsibilities, characteristics like diligence, reliability, self-discipline and a willingness to work emerged as stepping stones to employability (De Villiers, Van Heerden, and Van Schalkwyk 2018).

Realising the value supervisors add to preserve certain sectors, Education in itself should be a sector where we want to ensure stability, especially if we believe our children are our country's future. Australian research indicate that beginning teachers' lives have been scrutinised and studied over many years and extensive literature reported on their challenges, their need for support and the consequent effects on teacher attrition and student learning (Schuck et al. 2018). Their research are steers that early career teachers, Novice Teachers, are indeed in need of more support compared to what they are currently receiving. Schuck's research reinforces the initiative of this study by indicating similar approaches in New South Wales, Australia, where their study was conducted. The Department of Education in Australia requires each full-time beginning teacher be assigned to a mentor teacher and to be assisted by this mentor to gain accreditation, through professional learning linked to national teaching standards in an effort to address the concerns arising in the literature.

#### **4. Objectives**

Crisp postgraduates in education leave the university setup where lecturers, content and study guides advocate the how and when of their existence. As students, they have lived an era of freedom with limited responsibilities apart from passing their respective modules. Entering a school setup, the exact same individuals are now responsible for the success of approximately 200 learners; and in as little as two months since leaving university the work environment changes their thoughts and experiences.

This study will form part of a doctoral study envisaged to commence in 2023. Phase 1 of the study was for the researcher to complete the Gallup Strength Coaching course to become a formal coach, which will be the basis on which mentorship will be focused. With phase 1 done, the second step will be to approach schools and participants.

#### **5. Methods**

An active research pedagogy will be applied with mixed methods in a pragmatic paradigm. This combination of approaches will be implemented at five secondary school in the Motheo Educational District, South Africa by approaching an equal number of Novice Teachers and Seasoned Educators from each school.

The practical relevance of pragmatism as a research paradigm will be implemented during pragmatic research to analysed data. The purposeful use of quantitative data will be used to find the possible gaps and challenges novice teachers might experience via interviews. The perceived frustration seasoned teachers might experience when novice teachers join the team of educators could drive the conversation. From these gaps, challenges, and frustrations a strengths-based-mentoring collaboration session will be held. Qualitative research methods will be employed during this period discussing how participants deem a suitable mentorship programme could benefit sustainable teaching (Mitchell 2018).

Feilzer explored the practical relevance of pragmatism as a research paradigm implementing partial pragmatic research that exploited the inherent dual use of both quantitative and qualitative research methods to analyse data. The research supported the use of mixed method research in a pragmatism approach in abductive reasoning to produce socially useful knowledge and can confidently serve as a rationale for formal research design in addition to a more grounded approach to research (Feilzer 2009). From pragmatic epistemology, the pragmatists believe that there is a single real world, but different people can have different views about that real world. For this vast point of views, it will be important to ensure participants from various backgrounds and level of experiences where the pragmatist seeks knowledge according to the circumstances in which the phenomenon occur. (Brierley 2017; Kaushik and Walsh 2019; Research Articles 2019)

Since individual feedback are paramount, the researcher will indulge in a qualitative research approach, including scrupulous literature review. Formal interviews will be held; including pre- and post-questionnaires to measure possible growth during an active research pedagogy study.

The researcher enrolled for a Gallup strengths-based-coaching course as research tool to utilise during the interviews. Since the purpose is not to redesign existing mentorship programmes, Gallup as an existing course has been selected to investigate whether Gallup could be used to define and motivate the implementation of a mentorship programme which could add value to novice teachers. The aim will be to include participants whom might not be subject related, but rather selected on eagerness to improve their personal skills and growth, assisting in evaluation and implementation need for a formal mentorship programme.

## 6. Discussion

For more than twenty-odd years education in South Africa, and possibly globally, have been reason to various uncomfortable situations. Whether it be pit toilet 25 years post-apartheid, bilingual schools in monolingual areas (or vice versa) or challenges to keep assets undamaged on school premises; we have a few challenges impacting school education on all levels, from macro-level (challenged education sector; school system), meso-level (socio-economic decline, eroding values in society, broken homes/single parents) as well as micro-level (the teacher and learner). The fact is: we need help, and as much as we can get to keep the ubuntu dream alive – believing that each learner should be treated as a ‘village child’ which requires all stakeholders to be present and take responsibility. Although educators cannot be held solely responsible for these challenges, we could and should start to hold one another accountable to be the best possible individual to provide support and guidance to learners. Our learners, especially the marginalised, the fatherless and the misinformed could benefit so much when a suitable support structure is in place to provide support to our novice teachers.

## 7. Conclusions

Considering that Romania, America and Australia have already responded to the challenges early career teachers are experiencing, this study are definitely relevant and could contribute to a dire need in the South African Education needs. To address the problem on hand, I will research the preparedness of novice teachers for the profession they plan to enter, as well as how valuable seasoned educators could be if they are paired with a novice teacher using strength-based assessments. The value of a mentorship program as part of an internship structure for post graduate education students serving in government school.

## References

- Albrecht, W Steve et al. 1990. “Objectives of Education for Accountants: Position Statement Number One.” *Issues in Accounting Education* 5(2): 307–12. <http://dx.doi.org/10.1080/0963928042000273825> (May 19, 2023).
- Albu, Nadia, Daniela Artemisa Calu, and Gina Raluca Gușe. 2016. “The Role of Accounting Internships in Preparing Students’ Transition from School to Active Life.” *Accounting & Management Information Systems / Contabilitate si Informatica de Gestiuine* 15(1): 131–53. <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=117033244&lang=es&site=eds-live>.
- Beard, Deborah F. 2007. “Assessment of Internship Experiences and Accounting Core Competencies.” *Accounting Education* 16(2): 207–20. <https://www.tandfonline.com/action/journalInformation?journalCode=raed20> (May 19, 2023).
- Beck, John Edward, and Hendrik Halim. 2008. “Undergraduate Internships in Accounting: What and How Do Singapore Interns Learn from Experience?” *Accounting Education* 17(2): 151–72.
- Brierley, J.A. 2017. “The Role of a Pragmatist Paradigm When Adopting Mixed Methods in Behavioural Accounting Research.” *International Journal of Behavioural Accounting and Finance* 6(2): 140–54. <http://eprints.whiterose.ac.uk/115066/> (May 23, 2023).
- Feilzer, Martina Yvonne. 2009. “Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm.” *http://dx.doi.org/10.1177/1558689809349691* 4(1): 6–16. <https://journals.sagepub.com/doi/abs/10.1177/1558689809349691> (November 24, 2021).
- HPCSA Corporate Affairs. 2017. “Criteria for HPCSA-Accredited Intern Posts - HPCSA.” <https://www.hpcsa-blogs.co.za/intern-guidelines/> (May 19, 2023).

- Kaushik, Vibha, and Christine A. Walsh. 2019. "Pragmatism as a Research Paradigm and Its Implications for Social Work Research." *Social Sciences 2019, Vol. 8, Page 255* 8(9): 255. <https://www.mdpi.com/2076-0760/8/9/255/htm> (March 6, 2023).
- Martin, Dale R., and Jr. Jack E. Wilkerson. 2006. "An Examination of the Impact of Accounting Internships." *The Accounting Educators' Journal* 16: 129–38. <https://aejournal.com/ojs/index.php/aej/article/view/70>.
- van der Merwe, Marko. 2022. "How to Become an Attorney in South Africa | Gawie Le Roux Institute of Law." <https://www.gawieleroux.co.za/blog/how-become-attorney-south-africa> (May 23, 2023).
- Miller, A. C., F. J.L.B. Mayanja, and J. D. Porter. 2021. "Assessing South African Medical Interns' Experience and Confidence in Managing Obstetric Emergencies." *South African Medical Journal* 111(11): 1098–1103. <https://doi.org/10.7196/SAMJ.2021.v111i11.15897> (May 22, 2023).
- Mitchell, Anthony. 2018. "A Review of Mixed Methods, Pragmatism and Abduction Techniques." In *17th European Conference on Research Methodology for Business and Management Studies*, eds. Paola Demartini and Michela Marchiori. Roma: Academic Conferences and Publishing International Limited, 269–72. [https://books.google.co.za/books?hl=en&lr=&id=gU9mDwAAQBAJ&oi=fnd&pg=PA269&dq=pragmatism+approach+in+research&ots=Eue5g\\_i2Q-&sig=v4h8fIzvLdnD6cRuGggybXi7XGI#v=onepage&q=pragmatismapproachin+research&f=false](https://books.google.co.za/books?hl=en&lr=&id=gU9mDwAAQBAJ&oi=fnd&pg=PA269&dq=pragmatism+approach+in+research&ots=Eue5g_i2Q-&sig=v4h8fIzvLdnD6cRuGggybXi7XGI#v=onepage&q=pragmatismapproachin+research&f=false) (November 24, 2021).
- "Research Articles." 2019. *The Pragmatic Paradigm - Helping Research writing for student & professional researchers*. <http://researcharticles.com/index.php/pragmatic-paradigm/> (March 6, 2023).
- SAICA. 2023. "Trainees | SAICA." <https://www.saica.org.za/become-a-member/future-members/trainees> (May 19, 2023).
- SAIPA. 2023. "TRAINEE ACCOUNTANTS - SAIPA." <https://www.saipa.co.za/trainee-overview/trainee-accountants/> (May 19, 2023).
- Schuck, Sandy et al. 2018. "The Experiences of Early Career Teachers: New Initiatives and Old Problems." *Professional Development in Education* 44(2): 209–21.
- De Villiers, M., B. Van Heerden, and S. Van Schalkwyk. 2018. "'Going the Extra Mile': Supervisors' Perspectives on What Makes a 'Good' Intern." *South African Medical Journal* 108(10): 852–57.

# MULTILINGUAL LEARNERS' PERCEPTIONS OF THE ROLE OF ENGLISH AND SCIENTIFIC LANGUAGE ON NATURAL SCIENCES LEARNING

**Nishana Wilson, & Lydia Mavuru**  
*University of Johannesburg (South Africa)*

## Abstract

South Africa has eleven official languages, and yet only two languages, English and Afrikaans are the Languages of Learning and Teaching (LoLT) in schools. Language is important in shaping the learning and teaching environment in a classroom. Teaching Natural Sciences in English in a multilingual classroom can be challenging when learners are not proficient in the language of LoLT. That complexity is exacerbated by the nature of scientific language which is designed and considered to be academic concise, precise, and authoritative, making scientific concepts inaccessible to most learners. This is an unfortunate situation because in science classrooms, learners are expected to read, comprehend, write, articulate, and use English and subject-specific terminologies. The authors of the current paper argue that both English language and scientific language create a learning barrier for the learners whose home languages are different from English, the LoLT. It is against this background that the current study being reported herein sought to determine multilingual learners' perceptions of the role of English language and scientific language in their learning of Natural Sciences. In a qualitative research design two grade 8 and 9 Natural Sciences classes and their teachers were selected from two high schools in township areas using purposive sampling technique. Data collection involved focus group interviews with learners and individual interviews with the teachers. Each teacher was observed once whilst teaching Natural Sciences to grade 8 or grade 9 classes. The qualitative data collected was subjected to content analysis and two main themes were obtained: 1. Learners' perceptions that English language and scientific language limit their understanding of scientific concepts; and 2. Teachers' assistance in mitigating challenges imposed by English language and scientific language experienced by English-second-language speakers. Learners from the two schools indicated that both English language which is their second or third language and scientific language imposed many challenges in their learning of Natural Sciences. These challenges included failure to read, write and understand Natural Sciences content. Those learners showed excitement at the prospect of learning science in their home languages as they were not comfortable with being taught in English. Teachers used code switching and hands on activities to mitigate language challenges in their classrooms. The study findings thus have implications for both curriculum policy implementation and continued teacher professional development.

**Keywords:** *Language of learning and teaching, Natural Sciences, scientific language, perceptions.*

## 1. Introduction

South Africa has a rich linguistic diversity considering that it has 11 official languages. This linguistic diversity co-exists in the science classroom alongside the subject-specific language of science which learners are expected to use and understand. According to a study by Stott and Beelders (2019), the majority of grade 8 and 9 learners in science and technology need assistance in developing reading and comprehension skills in English. Learners, especially in grades 8 and 9, perform poorly in Natural Sciences. These results might be linked to the perspectives of multilingual learners being taught science in English.

There is a realisation by teachers and researchers that most learners in South African township school classrooms are multilingual. They mostly speak African languages and English is usually not their strongest language. When they enter the science classroom, the content is delivered in English. The terminology and concepts in science can be difficult to conceptualise and science can essentially be considered as a language on its own (Motloun, Mavuru, & McNaught, 2021). Learners often utter statements such as 'English is not my mother tongue' and malapropism in their written work is noteworthy.

According to Yore and Treagust (2006), both teachers and learners' utterances in the classroom are critical for effective teaching and learning. To achieve understanding, the utterances must be made on

shared ground and in a common language (Yore & Treagust, 2006). In a way the use of English as a LoLT, marginalises some English second language speaking learners (Motlounq et al., 2021). The authors of the current paper argue that both English language and scientific language create a learning barrier for the learners whose home languages are different from English, the LoLT. Consequently, the current study sought to determine multilingual learners' perceptions of the role of English language and scientific language in their learning of Natural Sciences. The following research questions guided this study: 1. How do grade 8 and 9 multilingual learners perceive the role that English language and scientific language play on their learning of Natural Sciences? 2. How do science teachers assist multilingual grade 8 and 9 learners in overcoming language challenges in the Natural Sciences classrooms?

## **2. Literature review**

As found by Kurniawan et al. (2019), the learners' perceptions towards something significantly influence how they react to it. Learners perceive science to be extremely difficult and, as a result, perform poorly in the subject. Learners with this perception put forth less effort in science because they believe they will never improve, and when they receive poor results, they confirm that science is difficult (Kihwele, 2013). Such perceptions are worsened by the fact that the language of learning and teaching is different from the learners' home languages, especially learners from township schools.

Liu and Baird (2012) discovered that using a minority language and/or a lingua franca in the courtroom boosts confidence in the judicial institution. This could hold true in a classroom setting as well. Prah (2003) found that being taught in the mother tongue fosters a more creative and imaginative environment, thus learners in such an environment are generally more positive. On the same premise, it can be argued that when someone is negative towards the language of instruction, it may lead to a negative perception to anything that is taught in that language. Learners' perceptions are shaped by and large by society in which they live (Kihwele, 2013).

The study is guided by the sociocultural theory (Vygotsky, 1978). The sociocultural theory considers learning as a social practice that results from the interaction between the learner and the environment. In this case language is the medium of the learning and the interaction process wherein learners struggle to engage in a language different from their home languages. Language is also believed to be the primary means of mediation (Fahim & Haghani, 2012, p. 693).

## **3. Methodology**

This study follows a qualitative research design (Creswell, 2014). In this approach, the strong contact that occurs between the researcher and the respondents makes it easier for the respondent to contribute to the shaping of research (Eyisi, 2016).

### **3.1. Selection of participants**

Using purposive sampling technique (Patton, 2002), two grade 8 and 9 Natural Sciences classes and their teachers were selected from two high schools in township areas. All the selected teachers taught Natural Sciences in multilingual classrooms. In fact, English was not learners' home language and hence they only encountered the language during the teaching and learning process in the classrooms.

### **3.2. Data collection and analysis**

Data collection was done in two phases involving two focus group interviews with learners and individual interviews with the teachers followed by lesson observations. Firstly, two focus group interviews were contacted with learners in each of the two schools to investigate how grade 8 and 9 multilingual learners perceive the role that English language and scientific language play on their learning of Natural Sciences. The second phase of data collection involved each teacher being interviewed and then observed once whilst teaching Natural Sciences to grade 8 or grade 9 classes. A total of four lesson observations and two individual interviews for the teachers were made as part of data collection. The purpose of the lesson observations was to determine how teachers assist multilingual grade 8 and 9 learners in overcoming language challenges in the Natural Sciences classrooms. Focus group interviews with learners, individual interviews with teachers, and the lesson observations were audio and video recorded with permission from the participants.

Before analysing the data collected, the researchers transcribed the interviews and the lesson observations. Data was then subjected to content analysis (Bowen, 2009) in a process which Marshall and Rossman (1990) referred to as the process of 'bringing order, structure, and meaning to the mass of collected qualitative data'.

## 4. Findings

Data analysis resulted in two themes: 1. Learners' perceptions that English language and scientific language limit their understanding of scientific concepts; and 2. Teachers' assistance in mitigating challenges imposed by English language and scientific language experienced by English-second-language speakers. The details are presented in the subheadings that follow.

### 4.1. Multilingual learners' perceptions of the role of English and scientific language in the Natural Sciences classrooms

The findings come from the two focus group interviews with learners held in the two selected schools. This was meant to answer the first question: How do grade 8 and 9 multilingual learners perceive the role that English language and scientific language play on their learning of Natural Sciences? Table 1 shows an example of an analysis made from focus group interviews.

*Table 1. Example of the analysis of focus group interview data.*

Learners' responses	Categories	Sub themes
<ul style="list-style-type: none"> <li>English is difficult</li> <li>This is not my home language</li> <li>I dont even speak English with my friends outside the classroom</li> <li>It is unfair to us</li> <li>Why can't I learn in the language I understand</li> </ul>	Nature of English language	English pauses challenges as a language of teaching and learning of science.
<ul style="list-style-type: none"> <li>Science is complex</li> <li>Some of the topics do not make sense</li> <li>Some words are not even in English hence are hard spellings are hard to remember</li> </ul>	Nature of science language	Science has difficult words and expressions which make it difficult for learners to understand what they are taught.
<ul style="list-style-type: none"> <li>Science would be much easier</li> <li>I think I would like to learn Natural Sciences every day.</li> <li>I am sure I would pass Natural Sciences</li> <li>In any case my teacher mostly explains in Sotho after we read the textbook</li> </ul>	The use of home language in the classrooms	Learners showed a lot of interest on the prospect of learning science in their home language which is IsiXhosa.

The findings from the focus group interviews show the learners' perceptions in relation to nature of English language, nature of science language, and the use of home language in the classrooms. The learners perceived English language as a difficult language which causes them to perform poorly in science. The learners viewed the use of English as a language of learning and teaching as an unfair practice considering that it is not their home language. The unfairness comes from the fact that these learners must compete with colleagues who are English first language speakers as they get to write the same assessment tasks. Such frustrations are encapsulated in statements such as: "This is not my home language" and "Why can't I learn in the language I understand." As such, learners perceived English as pausing challenges in the teaching and learning of Natural Sciences.

The findings also depict science as a complex subject due to the use of terminologies that the learners are not familiar with. The learners pointed out that science language makes science concepts less accessible and as such they struggle to understand some topics. The following statement depicts the level of the complexity: "Some words are not even in English hence the spellings are hard to remember." Learners indicated that this unfamiliar language makes it difficult for learners to understand what they are taught.

In their responses learners showed excitement with the prospect of learning and being taught science in their home languages. They indicated that science learning will be so much easier and understandable as they will not have to learn two subjects (both English and science) in the science classrooms. The learners felt that the use of home languages will create a level playing field where they have an equal opportunity just like their counterparts (English first language speakers) currently enjoying being taught in a language that they are familiar with. The learners pointed out that they are positive about this as they understand concepts when their teachers utilized their home languages to explain complex science concepts and processes in the classrooms. The following statement shows that the learners are



positive about the use of home languages: “I think I would like to learn Natural Sciences every day”. They believed that it would make the subject easier to understand and enable them to pass with good marks.

#### 4.2. How teachers assist multilingual learners with language challenges in the Natural Sciences classrooms

This section presents findings that answer the research question: How do science teachers assist multilingual learners in overcoming language challenges in the science classroom? Two teachers from two different schools were interviewed and observed teaching. The purpose of teacher interviews was to establish the methods in which teachers assist multilingual learners and how the teachers deem these methods important or sufficient. The lesson observations were to corroborate whether the methods the teachers referred to during their interviews are in fact, put into practice during their lessons. Table 2 shows an example of the analysis of data to show teachers’ efforts.

Table 2. Analysis showing strategies teachers used to mitigate language challenges.

Types of strategies teachers used	Nature of assistance	Categories
<ul style="list-style-type: none"> <li>• Use of videos</li> <li>• Use of pictorial images and diagrams</li> <li>• Use practical investigations</li> <li>• Use of demonstrations</li> <li>• Use of simulations</li> <li>• Engaging learners in hands-on activities</li> <li>• Use of role play</li> </ul>	Reduction of the use of words	Teachers implemented strategies that reduce the use of words to mitigate language challenges
<ul style="list-style-type: none"> <li>• Learners writing scientific terms and seek translations in their homes languages</li> <li>• Code-switching between English and learners’ home languages</li> </ul>	Use of home languages	The use of learners’ home languages created a classroom environment where learners managed to communicate and understand teacher explanations.
<ul style="list-style-type: none"> <li>• Use of group work when doing activities or answering assessment tasks</li> <li>• Discussing meanings of terms in peer groups</li> <li>• Learners making presentations to practise communicating in both English and science languages.</li> </ul>	Fostering partnerships in the classrooms	Teachers fostered partnerships in the science classrooms where learners helped each other to mitigate language challenges.

From Table 2 teachers assisted learners to mitigate language challenges by: reducing the use of words; using home languages (code switching); and fostering partnerships in the classrooms. By using teaching strategies such as videos, simulations, illustrations and investigations, the teachers minimised the use of verbal communication which helped learners to understand concepts better. Excessive use of words in explanations would limit learner understanding since they lacked fluency and proficiency in the language of learning and teaching. It is evident that code-switching plays a pivotal role in breaking down scientific concepts to assist the learners’ understanding.

By fostering partnerships amongst learners in the science classrooms, the teachers created platforms where learners helped each other to mitigate language challenges. Teachers placed learners in groups so that they could work whilst assisting each other when doing activities or answering assessment tasks. Teachers also allowed learners to discuss the meanings of scientific terms in peer groups. Because most of the learners only got to communicate with each other in English during learners, teachers tasked them to do more by assigning them to make individual presentations in their groups and group presentations to the whole class.

#### 5. Discussions and conclusions

The findings showed that multilingual grade 8 and 9 learners perceive both English as a language of learning and teaching and science language as difficult and complex hence impeding their success in science assessment tasks. As such, learners have negative perceptions about science which causes them to perform poorly. These findings are commensurate with findings of a study by Kurniawan et al. (2019), where learners’ perceptions towards something significantly influenced how they reacted to it. Learners showed excitement at the prospect of being taught science in their home languages, which Prah (2003)

pointed out as an important development since being taught in the mother tongue generally creates a more positive learning environment. Previous research also found that the use of English as a language of learning and teaching marginalises some English second language speaking learners (Motloun, Mavuru, & McNaught, 2021).

Findings from both learner focus group interviews and lesson observations showed that the use of code switching played an important role in mitigating language challenges. Teachers created classroom environments where the teaching and learning process took consideration of how science also contributes towards learners' lack of understanding of scientific concepts and processes. This is commensurate with the sociocultural theory (Vygotsky, 1978) which was used to as the lens to interpret the findings. The strategies used created interactive opportunities for the learners in the science classrooms which are key for meaningful learning (Vygotsky, 1978).

What stands out clearly from the findings is that learners appreciated the prospect of being taught in their home languages and that teachers could employ teaching approaches which embraced all learners in the science classrooms despite the challenges faced due to the lack of proficiency in the language of instruction. The findings of the study provide meaningful guidelines for teacher professional development programmes to create necessary opportunities for teachers to be equipped with skills to utilising strategies that help learners access and understand science concepts despite their poor proficiency in the language of learning and teaching.

### References

- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27-40.
- Creswell, J. (2014). *Research design, qualitative, quantitative, and mixed method approach*, 4th ed. Thousand Oaks, California: Sage Publications.
- Eyisi, D. (2016). The usefulness of qualitative and quantitative approaches and methods in researching problem solving ability in science education curriculum. *Journal of Education Practice*, 7, 91-100.
- Fahim, M. & Haghani, M. (2012). Sociocultural perspectives on foreign language learning. *Journal of Language Teaching and Research*, 3(4), 693-699. <https://doi.org/10.4304/jltr.3.4.693-699>
- Kihwele, J. E. (2013). The perceptions of teachers, parents, and students on the effects of mobile phone use on student learning in Tanzania. *Journal of Education and Practice*, 4(25), 101-107.
- Kurniawan, D. A., Darmaji, A., Putri, Y. A., Jannah, N. & Puspitasari, T. O. (2019). Perception and Attitudes Toward Science: Condition of students in learning Natural Sciences in Indonesia. *International Journal of Scientific & Technology Research*, 8(10), 2293-2298.
- Liu, A. H., & Baird, V. A. (2012). Linguistic recognition as a source of confidence in the justice system. *SAGE Journals*. 45(10), 1203-1229. <https://doi.org/10.1177/0010414011434294>
- Marshall, C., & Rossman, G. (1990). *Designing qualitative research*. Newbury Park: Sage Publications.
- Motloun, A. N., Mavuru, L. & McNaught, C. (2021). Teachers' beliefs and practices when teaching life sciences using their second language [Special issue]. *South African Journal of Education*, 41(S1), 1-15 Art. #2005. <https://doi.org/10.15700/saje.v41ns1a2005>
- Patton, M. Q. (2002). *Qualitative research & evaluation methods*. Thousand Oaks: Sage.
- Prah, K. (2003). Going native: Language of instruction for education, development, and African emancipation. *Language of Instruction South Africa*. South Africa: Dar-es Salaam: E & D Limited.
- Stott, A., & Beelders, T. (2019). The influence of science reading comprehension on South African township learners' learning of science. *South African Journal of Science*, 115(1/2). <https://doi.org/10.17159/sajs.2019/5146>
- Vygotsky, L. S. (1978). *The mind in society development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Yore, L. & Treagust, D. (2006). Current realities and future possibilities: Language and science literacy – empowering research and informing instruction. *International Journal of Science Education*, 28(2-3), 291-314.

## **FACTORS INFLUENCING THE COMPREHENSION OF NON-LITERARY TEXTS BY CZECH PUPILS OF SECONDARY TECHNICAL SCHOOLS**

**Dana Vicherková, & Nela Nováková**

*University of Ostrava; Faculty of Education, Department of Pedagogy and Andragogy (Czech Republic)*

### **Abstract**

It is essential to develop reading comprehension of non-literary texts in primary and secondary technical school pupils with an interdisciplinary approach focusing on developing their critical thinking, transversal, (e) reading, and digital competencies in everyday situations. International PISA research (2000, 2009, 2019) has repeatedly pointed out the below-average reading literacy level among the fifteen-year-old Czech boys' community. Pupils at secondary technical schools in the Moravian-Silesian and Olomouc regions belong to the endangered groups in terms of their level of reading and digital strategies, especially regarding data processing and evaluation. A quantitatively oriented questionnaire survey investigated (external and internal) factors influencing the reader's understanding of non-literary texts through the lens of 384 pupils at secondary technical schools. A partial goal was to identify the types of non-literary texts the pupils like and the kinds of non-literary texts that are part of the recommended secondary school reading. The research results showed that Czech secondary school pupils do not comprehend the information in non-literary graphic representation. Informal Facebook texts with visualisation are popular among pupils. Administrative-style texts are the most common school-recommended secondary school reading at secondary technical schools in the Moravian-Silesian region.

**Keywords:** *Reading and digital literacy, text comprehension, non-literary text, secondary technical school pupils, critical thinking.*

---

### **1. Introduction**

The development of interest in reading and the effort to increase the quality of assignment strategies among Czech primary and secondary school pupils are still critical curricular goals of the long-term concept of the current education system and Framework Education Programs (FEP) across all levels of schools. The results of the PISA (2019) international research on the reading literacy of 15-year-old pupils showed that Czech pupils have improved overall, especially in the level of understanding of written information, compared to the results of the same research on reading literacy carried out in the first decade of the 21st century (PISA, 2009). However, the research results (PISA, 2019) suggest that fifteen-year-old boys remain in the borderline zone of average to below average compared to the international group of pupils. There is a growing interest in researching the factors influencing the level of understanding of written information from the perspective of secondary school youth, especially a sample of boys studying at technical secondary schools. An interest in the reality of the reader's experience with various types of texts, particularly those needed for everyday life, grows in the current information age influenced by the processes of industrial revolution 4.0 with manifestations of digitisation, automation, robotisation, and electronic communication. The cornerstone of the reader's education lies in the development of their cognitive area and capability to think about the problem by forming and harmonising attitudes, ways of behaviour, cultured morals, and interpersonal relationships. According to Podgórecký (1999, p. 171), the expression of learners' thinking can be defined as a category of communication competencies, i.e., "skills to communicate using language". Reading competencies are part of the set of communicative competencies. Today's secondary school pupils should understand the essence of expository, illustrative, descriptive, reasoning, administrative and other texts in paper, electronic, digital and hybrid texting. The aim of the quantitatively oriented research carried out at the Faculty of Education of the University of Ostrava (2023) was to find out what factors influence the reader's comprehension of non-literary texts by analysing the answers of 384 pupils of two secondary technical schools in the Moravian-Silesian and Olomouc regions of the Czech Republic.

## 2. View of current educational trends in the Czech secondary education system

Since 2012, the Czech education system has been searching for answers to changes in education policy, expected to improve the learning outcomes of Czech pupils in the long term, especially in primary and secondary education. Since 2011, Czech pupils have compulsorily participated in comprehensive testing in the last year of secondary school studies focusing on understanding information in various texts. Mandatory nationwide entrance exams have been implemented for all secondary school fields of study finished by the school-leaving examination in the Czech Republic since 2016. The trend leads to a transition from the internal evaluation of schools towards strengthening the external (independent) evaluation of educational institutions. Strategic decisions are currently being implemented in connection with the introduction of an effective, comprehensive assessment of the educational system, even in a transnational educational context, based on three fundamental approaches:

- excellence and equality,
- compatibility with the labour market in the conditions of globalisation of the world,
- the passage of the pupil through the educational system as part of lifelong learning.

## 3. Types of texts as a factor in the development of readership

The study (Kalenda, Kočvářová, 2017, p. 71) pointed to the problem of socio-demographic factors towards barriers in the learning process, e.g., situational, dispositional and institutional. Effective educational communication affects understanding in everyday communication acts, situations, interaction with different types of texts and their knowledge from the readers' point of view and their actual level of reading competency. The research by Vicherková, Šenkeříková and Lichá (2020) focused on the problem of secondary school reading of literary texts. The content analysis of the curriculum document "School educational reading list for secondary school-leaving examination" and the analysis of the requirements criteria for the common part of the secondary school-leaving examination, i.e. the catalogue of requirements for the common part of the secondary school-leaving examination (2016 - 2020) revealed that all ten analysed secondary school lists of literary works met all the main criteria contained in the Catalogue of Requirements (2020).

The starting point for the classification of different types of texts and structures can be understood from the point of view of the division of functional styles into six categories of texts: simple communication style (e.g. announcement, report, advertisement, official publications), journalistic style (e.g. review, gloss, commentary, feuilleton, reportage), professional style (e.g. report, explanation, description of work procedure), administrative style (e.g. application, resume, official letter), artistic style (poem, short story, play) and oratorical style (e.g. lecture). Mašková (2010, p. 108) classifies stylistic units according to the way the topic is treated and stylistic procedures, e.g., how the author ranks and selects means in relation to the goal of the speech into five categories: informative, narrative, reasoning, explanatory, descriptive.

Daneš (1995, pp. 174-175) claims that "every text is implicit to a greater or lesser extent, i.e. the reader understands more from it than what is said explicitly, i.e. in individual words. This is because every reader always deduces additional information, imagines, imagines. Moreover, since everyone has a slightly different knowledge of the world, a lot of different experiences, a different degree and mode of imagination and different inferential tendencies and habits, everyone creates their interpretation of a given text, and everyone understands it more or less in their own way."

### 3.1. Electronic and printed text, semiotically mixed text

Barták et al. (1993, p. 1109) defined a text as "a product of language, usually containing several sentences, bound together through grammar and semantics." A printed text is defined according to the approach of Barták et al. (1993, p. 1116) as "the result of the printing workflow by which colour is transferred from the printing form by pressure onto the paper."

Piorecký's research (2016, p. 14) dealt with the influence of "new media" on traditional forms of Czech literature and the problem of the appearance of new platforms in the web environment. The author is interested in "literary phenomena that appeared on the Czech Internet from the second half of the nineties of the 20<sup>th</sup> century practically to the present day, as well as the reflection of the new medium in literary texts published by the press."

According to Daneš (1995, 174 – 175), the illustrated text can be regarded as a semiotically mixed (intersemiotic) phenomenon. The author claims that "the image (in a broad sense and visual communication in general) occupies an increasingly important position in contemporary society and talks about "iconographic thickening" in visual culture, citing various circumstances leading to this phenomenon (among other things, television, and different illustrated materials in a large number of copies and with an extensive range of consumers – comp., e.g., Dölvers, 1993).

#### 4. Research methodology

In a quantitatively oriented questionnaire research, we focused on two secondary technical schools in two regions of the Czech Republic, the Moravian-Silesian and Olomouc regions. The study was carried out from December 2022 to January 2023. Data were obtained from 384 respondents (pupils), primarily boys (367, i.e. 95, 57%) from the total number of pupils in the 1st - 4th year of technically oriented secondary school studies. The semi-structured questionnaire contained 32 semi-open items sorted into seven categories (A - G):

- A. "Types of texts in terms of their popularity among technical secondary school pupils" (number of items: 5)
- B. "Types of texts in terms of the frequency of reading texts from the point of view of secondary school pupils" (number of items: 5)
- C. "Effects of reading a non-literary text on a secondary school pupil" (number of items: 3)
- D. "The importance of reading non-literary texts through the lens of a secondary school pupil" (number of items: 2)
- E. "School and Recommended Reading List" (number of items: 5)
- F. "Factors supporting the reading of non-literary texts" (number of items 7)
- G. "School and methods developing critical thinking, communication and reading" (number of items: 2).

##### Research objectives

The research aimed to determine factors influencing non-literary texts' reading by secondary technical school pupils. The sub-goals of the study were to find out what kinds of non-literary texts are popular with secondary school pupils and what kinds of texts technical secondary schools rank as recommended reading.

The research problem was decomposed into the following research questions:

1. Is there a connection between reading for knowledge and the perception of non-literary text as a learning aid (comprehension of information)? H1
2. Is there a connection between the popularity of reading formal (educational) texts with an image (visualisation) and the popularity of reading informal texts (e.g. on FB and social networks) with an image (visualisation)? H2

#### 4.1. Results

The research objectives and questions led to the formulation of two research hypotheses, which are presented simultaneously with the results of their statistical verification in the next chapter.

##### Descriptive research data

Descriptive data more narrowly characterises the reading of non-literary texts by the respondents. The research on the popularity of types of texts to read showed that 127 (33.07%) respondents like to read a professional kind of text, and 155 (40.36%) respondents most frequently read professional texts. According to 301 (78.39%) respondents, their knowledge growth is the most significant influence on reading non-literary texts. 182 (47.40%) respondents believe reading non-literary texts is entertainment, and 132 (34.38%) respondents consider reading non-literary texts a learning aid. 170 (44.27%) respondents confirmed an existence of a school-recommended list of non-literary texts. Brainstorming is the most common method for developing critical thinking, reading, and communication in teaching the mother tongue (Czech), according to 221 (57.55%) respondents. Save the last word for me is among the least used methods for developing critical thinking, reading, and communication in teaching the mother tongue (Czech), according to 321 (83.59%) respondents. Critical thinking, reading and communication in teaching technically oriented professional subjects (e.g. engineering) are primarily developed through the brainstorming method, as expressed by 198 (51.56%) respondents. On the other hand, the Diamant method is the least used according to 354 (92.19%) respondents.

##### Relational research results

Two hypotheses were tested using Pearson's Chi-square for the contingency table. The source data and corresponding statistical results are shown in the following tables.

Pupils answered questions 9 (whether reading non-literary texts affects their knowledge) and 10 (whether they consider reading non-literary texts to help learning and comprehension).

Table 1. Detected and expected frequencies to H1.

Pearson's chi-square = 2.675417 degree of freedom = 1 significance $p= 0.101909$			
Q 9	Q 10 - help in learning	Q 10 - entertainment, modern trends, and other	Line totals
Yes, it affects my cognition	107 (100.44)	183 (189.56)	290
No, it doesn't affect my cognition	26 (32.56)	68 (61.44)	94
<b>Column totals</b>	133	251	384

**Hypothesis 1**, stating that pupils who think that reading non-literary texts affects their knowledge consider reading non-literary texts more frequently as helpful in learning and comprehension, **was not proven** (Tab.1). There is no statistically significant relationship between reading non-literary texts for knowledge and reading non-literary texts as an aid in learning and comprehension.

Pupils answered questions 31 (whether their favourite texts to read include formal (educational) texts with images (visualisation) and 32 (whether their favourite texts to read have informal texts with images (visualisation) on Facebook (FB) and social networks).

Table 2. Detected and expected frequencies to H2.

Pearson's chi-square = 7.912727 degree of freedom = 1 significance $p= 0.0049088$			
Q 31	Q 32 – informal texts (with image/visualisation)	Q 32 – informal texts (without image/visualisation)	Line totals
<b>Formal texts (with image/visualisation)</b>	323 (318.75)	37 (41.25)	360
<b>Formal texts (without image/visualisation)</b>	17 (21.25)	7 (2.75)	24
<b>Column totals</b>	340	44	384

**Hypothesis 2**, stating that pupils who like reading formal texts (educational) with images (visualisation) also like reading informal texts with images (visualisation) on Facebook and social networks, **was proven** (Tab. 2). There is a statistically significant relationship between the popularity of reading formal texts with images (visualisation) and reading informal texts (e.g. on Facebook and social networks).

## 5. Discussion and conclusion

The paper results document the current relationship of pupils of secondary technical schools in the Moravian-Silesian and Olomouc Regions of the Czech Republic to various types of texts, their reading popularity, and reading and comprehending information for multiple purposes of reading. The research supported the need to work with printed, electronic, virtual and hybrid texting for everyday experience and the development of pupils' critical thinking. Furthermore, the research pointed to selected factors influencing the understanding of non-literary texts, e.g., the importance of motivational stimuli by talking about the text with friends, classmates, and parents. Pupils most frequently prioritise reading non-literary texts for everyday life, with professional texts belonging to their favourite. Pupils most frequently read electronic texts for fun and knowledge. Pupils read formal/informal texts on the Internet in their free time. Interestingly, pupils have more literary than non-literary texts in their library. This is related to the finding that schools recommend artistic literature in the recommended reading lists on the school website more frequently. Pupils perceive a non-literary text as reading for fun, an aid in learning, and a support/means of their knowledge growth. The research did not show a statistically significant relationship between reading non-literary texts for cognition and reading non-literary texts to aid learning/comprehension. The study showed a statistically significant relationship between the popularity of reading formal texts with images (visualisation) and reading informal texts (e.g., on FB). Research by Ramsay and Sperling (2015) focused on the problem of concretising the perspective from which readers (pupils aged 12-14) should read an expository text. The research results did not confirm the benefit of perspective concretisation before reading the informational text for pupils to understand the information. The research of Liebfreund and Conradi (2016) focused on the factors influencing the understanding of informational text among primary school pupils, i.e. the pupil's prior knowledge, vocabulary knowledge, ability to decode and the level of intrinsic motivation. Research has shown that vocabulary knowledge is critical to understanding an informational text. The secondary school curriculum, especially the School Education Programs (SEPs) of technically

oriented secondary schools, should emphasise creating opportunities to develop effective pupil communication through reading literary and non-literary – formal/informal – texts. In today's society affected by the (e)information transformation, it is necessary to support the digitisation of reading comfort regarding the development of reading and digital competencies, reading curiosity and the motivation to comprehend the information of everyday life in various types and forms of texts and speeches towards the need for lifelong education.

### References

- Daneš, F. (1995). Text a jeho ilustrace. *Slovo a slovesnost* [Text and its illustrations. *Word and Verbs*], 56, 174-189. Retrieved from <http://sas.ujc.cas.cz/archiv.php?lang=en&art=3636>
- Dölvers, H. (1993). Rivalisierende Diskurse in Text und Bild. *Zeitschrift für Semiotik* [Rival discourses in text and image. *Journal of Semiotics*], 15, 269–301.
- Kalenda, J., & Kočvarová, I. (2017). Proměny bariér ke vzdělávání dospělých v České republice: 2005-2015. *Studia paedagogica* [Changes in barriers to adult education in the Czech Republic: 2005-2015. *Educational Studies*], 22(3), 69-89.
- Liebfreund, M., & Conradi, K. (2016). Component skills affecting elementary pupils' informational text comprehension. *Reading and Writing*, 29(6), 1141-1160. Retrieved from <https://doi.org/10.1007/s11145-016-9629-9>
- Mašková, D. (2010). *Český jazyk – přehled středoškolského studia*. Třebíč: Nakladatelství P. Velanová.
- PISA (2009). *PISA 2009 results: Executive summary*. Paris: OECD. <http://www.oecd.org/pisa/pisaproducts/46619703.pdf> Paris
- PISA 2018 Results. (2019). What Pupils Know and can do (Volume I). Retrieved from [https://read.oecd-ilibrary.org/education/pisa-2018-results-volume-i\\_5f07c754-en](https://read.oecd-ilibrary.org/education/pisa-2018-results-volume-i_5f07c754-en)
- Podgórecký, J. (1999). Jak se lépe dorozumíme [How to Communicate Better]. Ostrava: Amosium servis.
- Ramsay, C. M. & Sperling, R. A. (2015). Reading perspective: Can it improve middle school pupils' comprehension of informational text? *The Journal of Educational Research*, 108(2), 81-94. <https://doi.org/10.1080/00220671.2013.838538>
- Vyhláška č. 177/2009 Sb., o bližších podmínkách ukončování vzdělání ve středních školách maturitní zkouškou [Decree No. 177/2009 Coll., on detailed conditions for ending education in secondary schools with the matriculation exam] (2009). Retrieved from: <http://www.msmt.cz/dokumenty-3/novela-skolskeho-zakona-a-novela-vyhlasky-c-177-2009-sb-2>.
- Vicherková, D., Šenkeríková, M. & Lichá, D. (2020). Vybrané faktory ovlivňující úroveň čtenářské gramotnosti žáků středních odborných škol technických v Moravskoslezském kraji České republiky. In ROZMANITOST PODPORY UČENÍ V TEORII A VÝZKUMU: Sborník anotací příspěvků XXVIII. výroční konference České asociace pedagogického výzkumu [Selected factors influencing the level of reading literacy of secondary technical school pupils in the Moravian-Silesian Region of the Czech Republic. In DIVERSITY OF LEARNING SUPPORT IN THEORY AND RESEARCH: Collection of Contributions Annotations XXVIII. annual conference of the Czech Association for Pedagogical Research] (pp. 285-287). Ostravská univerzita.

# INVESTIGATING THE IMPLEMENTATION AND ADMINISTERING OF ASSESSMENT POLICY AT TECHNICAL VOCATIONAL EDUCATION AND TRAINING (TVET) COLLEGE IN THE FREE STATE

**Paseka Ndleleni, Paseka Mollo, & Khojane Mokhothu**  
*Central University of Technology Free State (South Africa)*

## Abstract

Assessment policy serve as a guiding mechanism for determining how various assessment tasks should be administered and carried out. As a result, its implementation is critical. This study aims to investigate the implementation and administering of an assessment policy at one of the Technical Vocational Education and Training (TVET) Colleges in the Free State. The study's objective is to identify and justify the need for TVET colleges to implement an assessment policy. The study used a mixed-method approach that included both qualitative and quantitative methodologies to collect data. Face-to-face semi-structured interviews and a questionnaire were used to collect data from participants. Two assistant campus managers (academic) were interviewed, and six male and female National Certificate (Vocational) (NC(V)) lecturers of varying ages and years of experience in their careers completed a questionnaire. According to the research findings, all participants agree on the importance of implementing the assessment policy. The findings also revealed that there are concerns about whether the assessment policy is being properly implemented. The research suggests that a monitoring tool should be developed and implemented to ensure that the assessment policy is always followed at all levels. Furthermore, the paper recommends among others that the college should have workshops regularly to train lecturers and other stakeholders on the assessment policy so that it can be effectively implemented.

**Keywords:** *Implementation of assessment policy, administering of assessment policy, TVET.*

---

## 1. Introduction

The implementation of assessment policies should become a topic of interest in the TVET sector. This interest must capture the attention of all stakeholders in the sector to elicit a variety of factors that may be impeding policy implementation. In support of the above statement, Grindle (2017: 3) confirms that factors such as the availability of sufficient resources, the commitment of lower-level officials, and the political leverage of policy opponents can and do frequently intervene between policy implementation. As a result, the purpose of this paper is to investigate the implementation and administering of assessment policy at a TVET College in the Free State.

## 2. The conceptualization of the study

### 2.1. Implementation of assessment policy

*“Why do we do all this assessment and what does it accomplish?”* ... and procedures for assessing students are critical to public accountability (Astin and Antonio, 2012). The researcher believes that just because the assessment policy is in place does not imply that it is fully implemented.

### 2.2. Administering of assessment policy

Students, of course, come in for a heavy dose of assessment, first from admissions offices, later from the lecturers who teach their classes, and increasingly from administrators complying with state accountability requirements (Clark, 2011; Astin and Antonio, 2012). The preceding statement confirms the importance of the assessment protocol to ensure uniformity, compliance, and the implementation of assessment policy.



### 2.3. Technical Vocational Education and Training (TVET)

In this study, TVET refers to an education system that is outcome-oriented and is a continuous process of adapting workers' training toward acquiring the necessary skills. TVET is designed to provide an education system that aims to impart knowledge and skills for increased efficiency in the workplace, sustainable livelihoods, personal empowerment, and socio-economic development, thereby facilitating proper adjustment in knowledge economies and rapidly changing work environments (Okorafor and Nnajiifo, 2017: 613; Buthelezi, 2018: 365).

### 3. The aim of the study

The aim of the study is to investigate the implementation and administering of an assessment policy at one of the Technical Vocational Education and Training (TVET) Colleges in the Free State.

### 4. The objectives of the study

The main objective of the study is to identify and justify the need for TVET colleges to implement an assessment policy.

### 5. Proposition

The most important aspect of the curriculum is assessment, and the implementation and administering of its policy are critical to promoting effective teaching and learning.

### 6. Methodology

#### 6.1. Participants

Participants included assistant campus managers (academic) (ACM) and senior lecturers. The total number of participants was 8, with 4 (50%) females and 4 (50%) males from various ethnic groups.

#### 6.2. Procedure

First, the researcher obtained permission to collect data. Second, the questionnaires were given to 6 senior lecturers to complete and were scheduled to be collected the following day. After receiving the completed questionnaires, quantitative data was generated. Finally, the face-to-face interviews with 2 assistant campus managers were held on the same day but at different times. The interview was scheduled to last between 30 and 45 minutes. The voice recorder was used to collect data from the interviews to produce qualitative data via transcription. The generated data, both qualitative and quantitative, were analyzed and presented.

### 7. Results presentation, interpretation and discussion

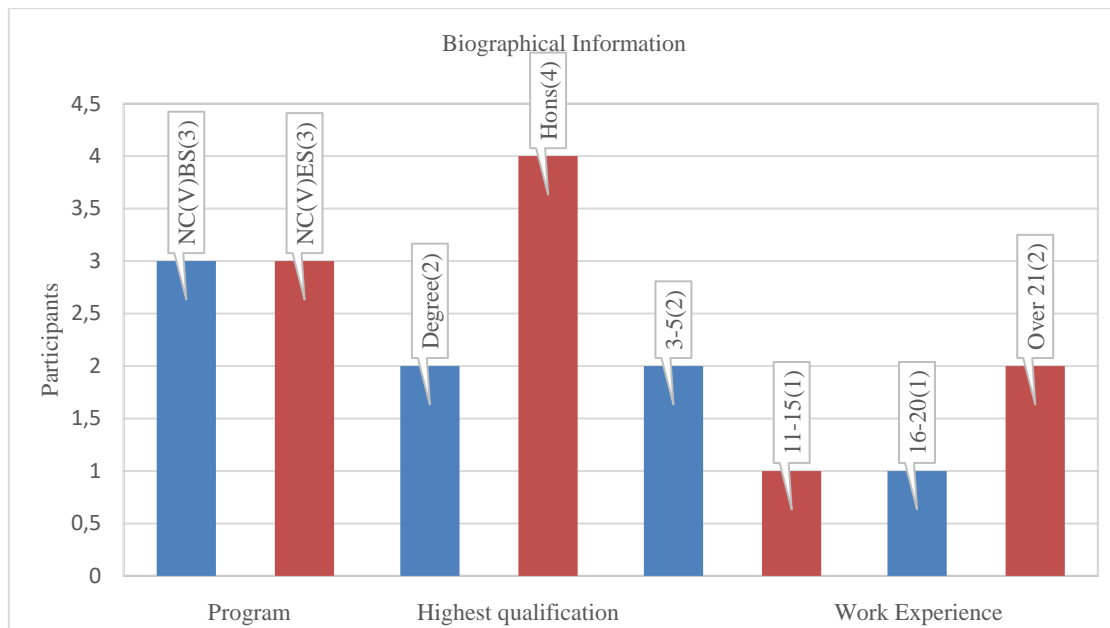
#### 7.1. Biographical detail

Table 1 shows the biographical information of the participants who completed the questionnaire.

Table 1. Frequency Table.

		Frequency	Percentage %	Valid Percentage %	Cumulative Percentage %
<b>Q1. Program</b>					
Valid	NC(V) B. Studies	3	50.0	50.0	50.0
	NC(V) E. Studies	3	50.0	50.0	100.0
	Total	6	100.0	100.0	
<b>Q2. Highest Qualification</b>					
Valid	Degree	2	33.3	33.3	33.3
	Honors Degree	4	66.7	66.7	100.0
	Total	6	100.0	100.0	
<b>Q3. Work Experience</b>					
Valid	6 - 10	1	16.7	16.7	16.7
	11 - 15	1	16.7	16.7	33.4
	16 - 20	2	33.3	33.3	66.7
	Over 21	2	33.3	33.3	100.0
	Total	6	100.0	100.0	

Figure 1. Bar chart: Senior lecturer biographical detail.



- Program

According to the program results, both NC(V) business studies and NC(V) engineering studies had an equal number of participants (n=3), accounting for 50% of all participants in both programs.

- Highest qualification

According to the table above, senior lecturers who hold an Honors Degree (n = 4) are in the majority with 66.7% of the participants, followed by Degree (n = 2), with 33,3%.

- Work experience

In terms of work experience, Table 1 shows that senior lecturers with work experience of 3-5 (n=1) and 11-15 (n=1) years account for the same percentage (16,7%). Similarly, the senior lecturers with work experience of 16-20 (n=2) and over 21 (n=2) years, account for the same percentage (33,3%).

## 7.2. Quantitative data

The questionnaire results are presented in Table 1 below.

Table 2. The implementation and administering of assessment policy.

A	The management and administration of the assessment for the NC(V) programme at TVET College.	Valid			
		SD (1)	D (2)	A (3)	SA (4)
		No. of responses in percentage (%)			
1	I possess the necessary skills to manage and administer the assessment components.	0	0	3 50,0%	3 50,0%
2	A lecturer who is a subject expert moderate and approve my task before I administer it to the students.	2 33,3%	1 16,7%	1 16,7%	2 33,3%
3	I check, evaluate, and authenticate my students' work before presenting it as evidence in their portfolios.	0	0	1 16,7%	5 83,3%
4	Assessment policy establishes a framework for the management, administration, and implementation of all assessments.	0	0	3 50,0%	3 50,0%
5	My head of department appears to be using the assessment policy as a punitive tool to always reprimand me.	0	2 33,3%	0	4 66,7%
6	I am aware of the assessment policy's influence on student achievement.	0	1 16,7%	2 33,3%	3 50,0%
7	The assessment policy is open to my discretion and is subject to variation.	2 33,3%	1 16,7%	2 33,3%	1 16,7%
8	I understand my roles and responsibilities in the conduct, administration, and management of assessment, and it is my responsibility to assess students according to the policy.	0	0	1 16,7%	5 83,3%

1 = Strongly disagree (SD), 2 = Disagree (D), 3 = Agree (A), Strongly agree (SA)

The results of the questionnaire are projected in Table 1 above, which shows that all participants (n=6) are 100% agreeable to questions A1 and A4 because 50% agree and 50% strongly agree. Question A2 shows that n=2(33,3%) strongly disagree and n=1(16,7%) disagree, while n=1(16,7%) agree and n=2(16,7%) strongly agree. Question A7 reveals that n=2(33,3%) strongly disagree and n=1(16,7%) disagree, while n=2(33,3%) agree and n=1(16,7%) strongly agree. The findings on questions A3 and A8 are similar, with 16,7% of participants (n=1) agreeing and 83.3% of participants (n=5) strongly agreeing. Question A5 reveals that the majority of participants (n=4) (66.7%) strongly agree, while 33.3% (n=2) disagree. Finally, question A6 reveals that the majority of participants are agreeable, with n=2(33.3%) agreeing and n=3(50.0%) strongly agreeing, while only 16.7% of participants (n=1) disagree. All of the aforementioned outcomes imply that all of the participants have the necessary skills to administer the assessment components in accordance with the assessment policy. Furthermore, the findings indicate that the participants understand their role in the management and administration of the assessment NC(V) programme. As a result, the findings support Arfo's (2015: 42) claim that once a policy has been developed and adopted, the next critical stage is policy implementation, which includes actual policy delivery and action in response to policy intent. The study found that it is critical and necessary to implement an assessment policy at TVET colleges.

### 7.3. Semi-structured individual interview questions

The semi-structured individual interviews for the assistant campus managers are shown in Table 3 below.

Table 3. Semi-structured.

<p><b>1. Why, in your opinion, is it critical that the assessment policy be always implemented?</b></p> <p><b>Participant 1:</b> Implementing an assessment policy is critical for determining the effectiveness and efficiency of your teaching and learning as a lecturer. As the assistant campus manager (academic), my overall responsibility is to ensure that teaching and learning follow the ICASS guidelines, which are included in the policy.</p> <p><b>Participant 2:</b> To begin, a policy is a guideline that directs how we conduct assessments. As a result, it is critical that we adhere to the policy, remain consistent, and ensure that our assessments are of high quality.</p>
<p><b>2. What do you consider to be a difficult factor impeding the implementation of assessment policy?</b></p> <p><b>Participant 1:</b> As an ACM, you have stakeholders such as lecturers, assessors, and moderators. Some of them will fail to comply with the assessment plan, which impedes the assessment policy's implementation.</p> <p><b>Participant 2:</b> Some of our lectures do not follow the assessment policy; for example, as an assessor, the policy states that the assessor must mark within a certain time after conducting an assessment.</p>
<p><b>3. How do your senior lecturers, and lecturers perceive the implementation of the assessment policy?</b></p> <p><b>Participant 1:</b> Their opinion on the implementation of the assessment policy is favourable. Positive perception is important because it leads to positive outcomes.</p> <p><b>Participant 2:</b> The problem is that they complain about the workload because the assessment policy specifies timeframes. The policy states that once a task has been written, it must be moderated. Keep in mind that each of them has a role to play in the assessment process, and they are finding it difficult to fulfil their role within the timeframe specified.</p>
<p><b>4. How do you ensure that all parties involved follow and implement the assessment policy?</b></p> <p><b>Participant 1:</b> Overarching the process and ensuring its smooth operation is an irregularity committee, which I chair as the assistant campus manager (academic). The irregularity committee examines the difficulties encountered in each assessment.</p> <p><b>Participant 2:</b> In this case, I believe we can benefit from regular assessor training as well as monitoring the implementation of assessment policy.</p>
<p><b>5. How do you normally handle situations in which lecturers do not adhere to the assessment policy?</b></p> <p><b>Participant 1:</b> Normally, I call a meeting with the lecturer in question to get his or her side of the story, and then, if necessary, I take the necessary steps to rectify the situation.</p> <p><b>Participant 2:</b> Most people do get their things in order if you address them on a personal level. If the problem persists, I escalate it to the college management team, but this depends on the severity of the problem.</p>

The results of a semi-structured individual interview schedule for assistant campus managers (academic) are presented in Table 2. Based on the above results, the participants' overall opinion is that the assessment policy should be implemented. The preceding statement compensates Bacchi's (2014: ix) assertion that "policy is generally associated with a program, a course of action." Furthermore, the participants demonstrated their understanding of the factors that may impede the implementation of the assessment policy, as well as their role in resolving noncompliance. The preceding findings provided support for the conclusion that the level of the implementation of the assessment policy influences assessment outcomes.

## 8. Conclusion

In conclusion, the paper demonstrated that the assessment policy is the guiding mechanism for the administration and conduct of various assessment components and should be implemented and administered at all costs. The paper contributes to improving the management of assessment through collaborative responsibility to overcome barriers to the implementation and administering of assessment policy. These findings can help TVET policymakers develop shared assessment policy initiatives and resolve conflicts during the process of the implementation and administering of assessment policy. As a result, TVET colleges must develop an assessment policy training program that will be included on their yearly calendar. Regular training or workshops on the assessment policy would instil a desire to do more, ultimately intensifying the policy's maximum implementation.

## References

- Astin, A. W., & Antonio, A. L. (2012). *Assessment for Excellence: The Philosophy and Practice of Assessment and Evaluation in Higher Education* (2<sup>nd</sup> ed). United Kingdom: Rowman & Littlefield Publishers, Inc.
- Arfo, E. B. (2015). A Comparative Analysis of Technical and Vocational Education and Training Policy in Selected African Countries [Unpublished doctoral dissertation]. Durban: University of KwaZulu-Natal, South Africa.
- Bacchi, C. (2014). *Analysing Policy: What's the problem represented to be?* Australia: Pearson.
- Buthelezi, Z. (2018). Lecturer experiences of TVET College challenges in the post-apartheid era: a case of unintended consequences of educational reform in South Africa. *Journal of Vocational Education and Training* 70(3):364-383.
- Clark, I. (2011). Formative Assessment: Policy, Perspectives and Practice. *Florida Journal of Educational Administration & Policy*, 4(2), 158-180.
- Grindle, M. S. (Ed.) (2017). *Politics and Policy Implementation in the Third World*. Princeton: University Press.
- Okorafor, A. O., & Nnajiifo, F. N. (2017). TVET Policies and Practices in Nigeria: Why the Gap. *European Journal of Education Studies*, 3(4), 612-623.

# THE UGLY SIDE OF TEACHING PRACTICE: TEACHERS' PERCEPTIONS OF STUDENT TEACHERS' IMMORAL AND UNPROFESSIONAL BEHAVIOUR DURING TEACHING PRACTICE

**Jaysveree M. Louw**

*Department of Educational and Professional Studies, Central University of Technology,  
Bloemfontein (South Africa)*

## Abstract

Teaching practice (TP) is regarded as a crucial component in initial teacher training programmes because it affords student teachers an opportunity to put theory into practice. During TP student teachers (also referred to as pre-service teachers) are afforded the opportunity to explore the different educational contexts in which teaching and learning take place. It is expected of all B.Ed students (from 1<sup>st</sup> to fourth year, and PGCE students) to undertake TP, and to behave professionally and ethically during their TP period. However, the university often receives negative feedback about students' unethical and unprofessional behaviour from the *teaching community*\* after TP had been completed. This negative feedback was one of the motivating factors that prompted the writing of this paper. The second motivation was the findings of the portfolio content that students have to submit after TP. Some students' actions were dishonest, for example, they forged mentor teachers' signatures on forms. The purpose of this article was to obtain teachers' perceptions of how pre-service teachers conduct themselves during teaching practice. Individual face-to-face interviews were conducted with twenty-seven teachers and three school principals to collect data. The findings revealed that despite the fact that many students are generally well-behaved and ethical, a significant number of them are entitled, unprofessional, disrespectful and dress inappropriately when they are at the schools. From these findings one can conclude that certain student teachers behave in an undesirable fashion which negatively impacts on their future placements at schools. One of the recommendations is for student teachers to be adequately prepared by teacher education programmes to meet the requirements of teaching in the real classroom environment.

**Keywords:** *Teaching practice, teacher professionalism, behaviour, values, student teachers.*

---

## 1. Introduction

Teaching practice is a critical aspect of initial teacher education that prepares student teachers to become professional, skilled, ethical and competent teachers after completing their studies (Merc, 2004; Roy, Wieser, Dhlamini, & Thomas, 2016: 17). During TP students are afforded the opportunity to gain practical experience in the actual teaching and learning environment, namely the school. Marais & Meier (2004: 220-221) assert that the term TP represents the range of experiences to which student teachers are exposed when they work in classrooms and schools. It is a form of work-integrated learning that is described as a period of time when students work in the relevant industries to receive specific in-service training in order to apply theory to practice. Ehrich, Kimber, Millwater, & Cranston (2011) assert that teaching is profoundly a moral activity and teachers, whether they are in-service or pre-service, are expected to conduct themselves in moral ways. Values thus play a crucial role in pre-services teachers' path on becoming teachers. The Department of Higher Education and Training (DHET) decides how long student teachers must spend at schools to undertake their TP. The policy documents (Teaching Practice: Guidelines for Initial Teacher Education Programmes, no date; and the Policy on the Minimum Requirements for Teacher Education Qualifications, 2011) stipulate that B.Ed students must spend twenty weeks at the schools. Students who are registered for the PGCE must spend ten weeks at the schools. This duration is spread over four years.

---

\**Teaching community*: in this article the teaching community refers to mentor teachers, non-mentor teachers, principals and HODs at the schools. These are the participants that were interviewed and that sometimes contact the universities with their complaints.

## 2. Problem statement

The process of becoming a teacher is for many students a complex and challenging phenomenon. It is also the subject of multiple interests and ways of exploring its different dimensions, role-players and dynamics (Caires, Almeida, & Viera, 2012). One of the dynamics of becoming a teacher is TP that all prospective teachers have to undergo as part of their training. After completing their TP the student teachers are required to submit portfolios, which contain evidence of what they did at the schools (Taole, & Van Wyk, 2015: 189). The content of the portfolios is among others, attendance registers, mentor teacher feedback forms and lesson presentation forms. Most of these forms are signed (or should be signed) by mentor teachers. However, as was witnessed in the portfolios, some students forge signatures, while some fill in information themselves that was supposed to be completed by mentor teachers. In addition to these dishonest portfolio completion practices, occasionally principals and mentor teachers, and even teachers who are not mentors, contact the university to complain about how some student teachers conduct themselves. The complaints range from student teachers arriving late at schools, they do not dress professionally and appropriately, absenteeism without informing the mentor teachers, they are disrespectful towards teachers (e.g. by back chatting) and lastly, by sometimes not preparing for their lesson presentations. These complaints from the teaching community and falsified documents (and signatures) in the portfolios were what prompted the study. Although student teachers are orientated for TP in some of the courses, some of them disregard what they are taught. Mentor teachers also discuss (or should discuss) what is expected from student teachers at schools.

## 3. Aim of the research

The aim of the study was to obtain teachers' (mentor teachers, non-mentor teachers and school principals) perceptions of the questionable immoral and unprofessional behaviour of some student teachers during teaching practice. This behaviour was evident in teaching practice portfolios that student teachers have to submit, and through the complaints the university receives from the teaching community.

## 4. Significance of the study

Exploring the teaching community's views of student teachers' behaviour has the potential for improving the quality and effectiveness of teaching practice, and for improving student teachers' behaviour and conduct during teaching practice. It is important for student teachers to put their best foot forward because the way teachers behave has a direct impact on their interaction with learners, parents and their colleagues (Van Nuland, 2009). The way student teachers behave during TP can also be a deciding factor on whether or not they could be employed at the schools where they undertook their TP.

## 5. Literature review

### 5.1. Teacher professionalism

Student teachers are placed at schools mainly to observe lessons, co-teach and teach independently. During this period, they should conduct themselves professionally and ethically. Teacher professionalism is defined as 'a combination of training, knowledge, experience, attitudes and moral behaviour that defines the role of a teacher (Roy et al., 2016). It also refers to one's attitude towards one's work and how you approach your work. Becoming a professional teacher thus begins with initial teacher training. Unprofessional behaviour is any type of behaviour that creates difficulties in the workplace with the people you work with (Malan, 2015: 293). Although pre-service teachers are not employed in their respective schools and are not professional teachers yet, they are expected to model behaviour that is professional. Promoting professionalism of all teachers in South Africa is the vision of the South African Council for Educators (SACE). SACE is a statutory council which promotes and monitors professional conduct of teachers and manages continuous professional teacher development in South Africa. In addition, it must uphold ethical practices by teachers (SACE, 2002; Drake, Jackson, & Sotuku, 2016: 58). However, it is often difficult to decide whether actions and behaviours can be deemed as professional or unprofessional, and ethical or unethical. In this regard SACE's 'Code of Professional Ethics' is a guide that stipulates how teachers should conduct themselves. Policy documents such as the Employment of Educators Act 76 of 1998 (C-9) stipulate that misconduct refers, amongst others, to a breakdown in the employment relationship and an educator commits misconduct if he or she:

- falsifies documents or any other records;
- displays disrespect towards others in the workplace (no examples are given of disrespectful actions);
- commits an act of dishonesty (no examples are given of which acts are dishonest).

The code outlines principles of action and standards of behaviour. But professional conduct is not only about how people act – it is also about appearance. When student teachers dress smartly and appropriately, they convey a message that they take their TP seriously.

## 5.2. Values and their role in teaching

**5.2.1. What are values?** Values can be perceived as ideals or beliefs that guide our interaction with others in terms of what is good, beneficial, important, useful etc (De Witt, 2021: 424). Malan (2015: 291) states that values or ethics are a set of rules that regulates our lives and the decisions we make. They are passed down from parents to their children. They are a person's opinion of what is good or bad, acceptable or unacceptable – an enduring belief that a specific mode of conduct is preferable. Teachers are supposed to act morally and professionally while they are at work, and unprofessional behaviour is usually unacceptable at schools. Professional behaviour and actions rely on moral principles and these moral principles are helpful in guiding student teachers on how to behave morally during TP. The challenge is that moral principles are often relative to cultures or communities. Different cultures (and therefore different people) have a particular system of norms and values which influence their behaviour towards others (De Witt, 2021: 246). Values influence many activities at school as well as interaction among teachers and interaction among learners and teachers. The question is thus: if values are relative and play such an important role in school activities, which values should guide student teachers' conduct at schools, and even outside of the schools?

## 6. Methods

### 6.1. The participants

The convenience sample (also referred to as availability sampling or opportunity sampling) consisted of thirty participants: twenty-seven of these were teachers at the schools where student teachers were placed for teaching practice. Three of the participants were principals of schools where student teachers conducted their teaching practice. This method of sampling was selected because the teachers and principals were available and willing to participate in the study.

### 6.2. Data collection method

Face-to-face individual interviews were conducted with the participants. A combination of semi-structured and open-ended questions was asked. This method of interviewing was selected because it is more flexible and allows for the interviewees to also ask questions. Some key questions were formulated in advance (Nieuwenhuis, 2007: 87; Dakwa, 2015: 299).

### 6.3. Findings and analysis

Below are some of the questions the participants were asked, and the responses they gave.

Q1: We received complaints from some teachers about the worrisome behaviour of students during teaching practice. Can you give examples of how some students behaved?

*P1: The ones from University x are really problematic.*

*P2: We had students from two universities at my school last semester. Generally the ones from University z are well-behaved. But the ones from University x!*

Q2: Problematic how? (This was a follow-up question to P1's response).

*P1: Let me start with the way some of them dress. The other one was wearing jeans so tight she could not even climb the stairs. I mean really. And some come late and want to leave early. They don't want to do extra-murals. And this other one gave me an incomplete lesson plan. I did not mark nor sign it. (The interviewee was shaking her head).*

Q3: What about their ethical or moral behaviour? Because some teachers say the students can be disrespectful.

*P3: One came to school drunk one day. We could smell the alcohol from the gate. That's disrespectful and unprofessional. No respect for other teachers, their work and for the rules. And we brief them about the rules and the code of conduct for teachers. The other one lied about the lesson plan. But some are cute and work hard. And have good manners.*

*P4: And they speak to teachers as if we are their friends. They're not even teachers yet! And some of them – the forms I had to fill in and sign .....so untidy! They have no respect for me or their work. No pride! And some are so scared to work.*

*P5 (who is a principal): I don't want students from University x at my school anymore. They're so rude some of them. They must go to other schools. I will phone University x and tell them to place their students at other schools.*

**Q4: What do you think the university can do to change this behaviour?**

*P6: Don't the lecturers prepare the students? You must coach them. Give them a contract to sign. A contract that says they must abide by the teacher code of conduct.*

*P7: There are certain things that are not allowed at the schools. Life has rules. Schools have rules. The values of the code of conduct need to be respected.*

*P8: The way some of them behave.....if I were the principal I will never employ them. Some are just plain lazy. They do not know the value of hard work. And they don't know the meaning of please. No manners.*

Content analysis was employed to analyse the data. The content or responses were categorized into two main themes namely: unprofessional behaviour and unethical conduct of students. From the responses it is evident that the participants are of the opinion that some student teachers are entitled, have no respect and have no pride in their work ethic. Seemingly most of the complaints came from students from University x. Usually student teachers from different institutions are placed at the schools simultaneously, which makes it easy for the teaching community to compare students from different institutions.

## 7. Conclusion

Teaching practice is a period when student teachers are placed at schools to gain teaching experience, knowledge and skills. While at the schools they have to fulfil certain roles such as teaching, sometimes attend meetings and they often have to take part in extra-curricular activities. During this period student teachers are expected to adhere to the principles of professionalism as stipulated in SACE and adhere to the rules of the schools. Although many students do behave professionally and ethically, the findings indicate there are those that behave in unacceptable ways. Some examples that were cited by participants include late coming, laziness and dishonesty. Some of the portfolios were also suspicious – for example, different handwriting was used where one teacher was supposed to complete one form. This speaks to cheating and dishonesty.

## 8. Recommendations

There are various ways of improving student teachers' behaviour during practice. Student teachers should be adequately prepared and orientated by tertiary institutions for teaching practice. They should be trained about their responsibilities and conduct during teaching practice. The SACE ethical code of conduct should form part of teacher training programmes (and the teaching practice curriculum) from the 1<sup>st</sup> year of study. A partnership between schools and universities can be mutually enriching and beneficial for student teachers, universities and teaching communities. This partnership must be based on a common understanding of how student teachers should conduct themselves. Schools need to make clear what student teachers' expectations are – this should ideally be communicated to universities before the students are placed at the schools. Student teachers should be informed of conduct that is rude, disrespectful, dishonest etc. Examples of unacceptable and punishable behaviour (e.g forgery, stealing, arriving at school intoxicated etc.) should be communicated. Student teachers should be informed about the consequences of any misconduct during TP. Lastly, Dreyer (2015: 6) gives this important recommendation: student teachers must realise that they are guests in schools during their TP period and must abide by all rules and regulations of the school.

## References

- Caires, S., Almeida, L., & Vieira, D. (2012). Becoming a teacher: Student teachers' experiences and perceptions about teaching practice. *European Journal of Teacher Education*, 35(2), 163-178.
- Dakwa, F. (2015). The interview method. In C. Okeke & M. Van Wyk (Eds.), *Educational research: An African approach* (pp. 296-315). Cape Town: Oxford University Press.



- De Witt, M. (2021). *The young child in context: A psycho-social perspective*. (Rev. 2<sup>nd</sup> ed.). Pretoria: Van Schaik Publishers.
- Drake, M., Jackson M.-J., & Sotuku, N. (2016). The teacher and teacher personality. In C. Okeke, A. Abongdia, E. Adu, M. Van Wyk, & C. Wolhuter (Eds.), *Learn to teach: A handbook for teaching practice* (pp. 49-66). Cape Town: Oxford University Press.
- Dreyer, J. M. (2015). A positive and enriching teaching practice experience. In J. M. Taole (Ed.), *Teaching practice, perspectives and frameworks* (pp. 3-10). Pretoria: Van Schaik Publishers.
- Ehrich, L., Kimber, M., Millwater, J., & Cranston, N. (2011). Ethical dilemmas: A model to understand teacher practice. *Teacher and Teaching: Theory and Practice*, 17(2), 173-185.
- Malan, L. (2015). Work ethics and professional behaviour in the workplace. In E. Van Heerden-Pieterse (Ed.), *Life Skills: My journey, my destiny* (pp. 289-295). Pretoria: Van Schaik Publishers.
- Marais, P., & Meier, C. (2004). Hear our voices: Student teachers' experiences during practical teaching. *Africa Education Review*, 1(2), 220-233.
- Merc, A. (2004). Reflections of pre-service EFL teachers throughout their teaching practicum: *What has been good? What has gone wrong? What has changed?* [Master's thesis, Anadolu University, Turkey].
- Nieuwenhuis, J. (2007). Qualitative research designs and data gathering techniques. In K. Maree (Ed.), *First steps in research* (pp. 69-94). Pretoria: Van Schaik Publishers.
- Republic of South Africa. (1998). *Employment of educators Act 76 of 1998*. Pretoria: Department of Basic Education.
- Republic of South Africa. (2011). *Policy on the minimum requirements for teacher education qualifications*. Pretoria: Department of Higher Education & Training.
- Republic of South Africa. (n.d.) *Teaching Practice: Guidelines for initial teacher education programmes*. Pretoria: Department of Higher Education & Training.
- Roy, I., Wieser, C., Dhlamini, J., & Thomas, R. (2016). Teacher professionalism and identity. In C. Okeke, J. Abongdia, E. Adu, M. Van Wyk, & C. Wolhuter (Eds.), *Learn to teach: A handbook for teaching practice* (pp. 16-28). Cape Town: Oxford University Press.
- South African Council for Educators, Act 31. (2002). *Code of Professional Ethics*. The Education Labour Relations Council. Pretoria: Universal Print Group.
- Taole, J. M., & Van Wyk. (2015). Reflective practice in teacher education. In J. M. Taole (Ed.), *Teaching practice, perspectives and frameworks* (pp. 183-197). Pretoria: Van Schaik Publishers.
- Van Nuland, S. (2009). *Teacher codes: Learning from experience* (Project coordinated by M. Poisson). Paris, France: International Institute for Educational Planning.

## EMOTIONS LINKED TO CERTAINTY-BASED SELF-ASSESSMENT: A MULTIDISCIPLINE EXPERIENCE

**Ana Remesal<sup>1</sup>, María José Corral<sup>2</sup>, Iria SanMiguel<sup>2</sup>, Patricio García-Minguez<sup>3</sup>,  
Tomas Macsotay<sup>4</sup>, & Ernesto Suárez<sup>5</sup>**

<sup>1</sup>*Department of Cognition, Developmental and Educational Psychology, University of Barcelona (Spain)*

<sup>2</sup>*Department of Psychobiology, University of Barcelona (Spain)*

<sup>3</sup>*Department of Economics, University of Barcelona (Spain)*

<sup>4</sup>*Department of Humanities, University Pompeu Fabra (Spain)*

<sup>5</sup>*Department of Law, University Pompeu Fabra (Spain)*

### Abstract

This exploratory study presents data from various curricular areas in Higher Education: Primary Teacher Education, Secondary Teacher Education, Psychobiology, Microeconomics, Art History and Law. In all these areas, the instructors implement the same instructional program during a one-semester module to improve students' self-regulated learning behaviour. The project had two main goals: (1) enhancing students' learning engagement through certainty-based self-assessment and (2) researching the metacognitive and affective (motivational and emotional) implications of such instructional program in students' learning behaviour. Over 1000 students participate in these courses, responding to three progressive (discipline-related) multiple-choice online learning tests with a knowledge-certainty component at three different moments during one semester, incorporating the certainty-based marking (CBM). Certainty declaration activates deep metacognitive and emotional processes. We implemented the testing system in these courses only with a diagnostic and formative purpose. After each testing point, students responded to an accompanying reflection questionnaire that allowed the collection of their emotional reactions in a Likert-scale form. The students manifested positive/negative and activating/deactivating retrospective emotions (joy, pride, sadness, shame, anger) and prospective emotions (hope, boredom, indifference, fear, anxiety) in relation to the certainty-based self-assessment experience. Results indicate that the certainty-based self-assessment program triggered all of these emotions in different amounts. These results are positive news concerning the students' engagement in learning and particularly motivated self-regulated learning. This paper presents preliminary results concerning the students' emotional experience with this innovative diagnostic self-assessment program. Differences and similarities between areas and educational levels are exposed. The main result points to similarities outweighing differences.

**Keywords:** *Self-assessment, certainty-based marking, formative assessment, students' emotions, higher education.*

### 1. Introduction

This exploratory study presents a first approach in a multidisciplinary context. This multidisciplinary context is urgently needed in higher education to compensate for the over-exposure of education students (Quinlan et al., 2013). In our study, students from Primary Teacher Education, Secondary Teacher Education, Psychobiology, Microeconomics, Art History and Law were invited to participate in an instructional experience grounded on the so-called certainty-based marking (CBM) (Gardner-Medwin, 2019). Leclercq proposed this assessment strategy underlying CBM long before (Leclercq, 1982, 2003) to endorse metacognition during learning assessment processes (Chamberland & St-Onge, 2013). The CBM algorithm alters the habitual grading scale (1 to 10 points); thus, both students and instructors need to readapt to the new scale ranging between [-6\*items] and [+3\*items]. We implemented the testing system in our project only with a diagnostic and formative purpose. This knowledge-certainty component consists of a declaration of the subjective level of certainty/doubt about the correctness of one's answer to each question item. This certainty declaration activates deep metacognitive and emotional processes. A special algorithm inserted in the virtual campus adjusts

resulting grades to the connection of each of three levels of declared certainty (low, middle, high) and the correctness of response (error, hit). Up to now, research in higher education revolving around this specific assessment strategy is present in a variety of areas, such as the medical area (Smrkolj, Bancov & Smrkolj, 2022) or engineering (Yuen-Reed & Reed, 2015), among many others.

Nevertheless, all these previous studies present two critical areas of shortage. First, they are mono-disciplinary and only provide results on each particular area under different instructional conditions, making comparison impossible in practice. Second, they present merely CBM results but disconnected from other likely related psychological processes and constructs to understand the effects of such an assessment strategy. In this sense, we present a pioneer study. Our project pursued two main goals: (1) enhancing students' learning engagement through certainty-based self-assessment and (2) researching the metacognitive and affective (motivational and emotional) implications of such instructional program in students' learning behaviour. Particularly, we were interested in the students' emotional reactions taking positive-negative but also activating-deactivating emotions into account since they all affect the learning behaviour (Pekrun & Linnenbrink-Garcia, 2012).

## 2. Research questions and design

Despite the project aiming to analyse a longitudinal process, for this paper, we focus on the students' first experience with CBM-based self-assessment. Thus, we concentrate on the following research questions:

- RQ1: What is students' satisfaction with this first encounter with CBM?
- RQ2: What emotional reactions do students report at their first experience with CBM-self-assessment?
  - RQ2a: Are there differences in students' emotional reports regarding *educational level*?
  - RQ2b: Are there differences in students' emotional reports regarding *disciplinary areas*?

## 3. Method

The same instructional design took place in all participating courses. Students responded to a series of knowledge tests, including ten multiple-choice questions and a reflection questionnaire to report emotions triggered by the response experience under CBM conditions. The CBM algorithm implies the challenge of the habitual marking scheme. Marks are no longer between 0-10 points (as traditionally in the participating institutions) but move in a range between [-60, +30]. For the students' personal, qualitative interpretation of results, four quality levels of results were suggested to them: level 0 (-60 up to 0 points), level 1 (1-10 points), level 2 (11-20 points), level 3 (21-30 points). Further, students reported their satisfaction with this first experience (1-10 points) and their emotions (Likert scale 0-5 points). For the sake of space limit, in this paper, we will focus only on *retrospective* emotions, both positive (joy, pride, relief) and negative (shame, sadness, anger), as an individual evaluation of the CBM-based results. We applied a non-parametric test (Kruskal-Wallis') according to the ordinal nature of our data and the very unequal but also meagre response rate of two groups of students (Economics and Art History).

### 3.1. Sample

In the six course modules, 1492 students were enrolled; 1161 (77.81%) voluntarily responded to the first knowledge test in their respective course. After applying exclusion criteria (cases that were not first attempt, had missing data or used less than 20% of given time for response), 988 valid responses remained. However, when invited to contribute further to the study by responding to additional demographic and reflection questionnaires, the response fell to a final sample of 411 students. Table 1 presents descriptive data from the final participating sample of students. The majority were women (69.8%), with an average age of nearly 25 years. The response ratio of valid responses was 41.6%; however, it was very different depending on the disciplinary area, to the extreme that no students of Law responded to the reflection questionnaire. Consequently, this disciplinary area had to be discarded from further empirical analysis.

## 4. Preliminary results

Table 2 presents descriptive results about the students' first encounter with the CBM-based knowledge tests in their respective courses. The response time ratio results show that students had sufficient time for response (either 10 or 15 minutes, depending on each instructor's decision for each particular course). Having enough time for response is a condition for stress control, increasing the

probability that an additional feeling of time pressure does not worsen emotional reactions. In that table of results, we can observe that Psychobiology students had the best learning results, followed by prospective primary and secondary teachers. In contrast, Art History and Economics students had the lowest results; unsurprisingly, these latter students showed a minor participation ratio in the voluntary reporting of emotions (see Table 1).

Table 3 exposes results on the report of retrospective emotions as a reaction to the CBM-based self-assessment experience. Remarkably, the highest mean value for positive and negative emotions is 2.3 (joy, pride and shame), which is still low. In coherence with the direct CBM results presented in Table 2, in Table 3, we see that the students with higher results report more positive retrospective emotions (joy, pride, relief) than the students of Art History and Economics, who report more on negative retrospective emotions (shame, sadness, anger).

#### 4.1. RQ1: Students' reported satisfaction

Altogether, students report a relatively moderate to low satisfaction ( $M = 5.3$ ;  $SD = 2.5$ ) at this first encounter with the CBM system. When looking deeper into the two variables considered in this study:

- *Satisfaction. Educational level.* We found significant differences regarding subjects' satisfaction with the CBM results ( $\chi^2(1, 411) = 9.056$ ,  $p = .0026$ ); however, with a minimal effect size.
- *Satisfaction. Disciplinary area.* We found a significant difference regarding subjects' satisfaction with the CBM results ( $\chi^2(4, 411) = 20.323$ ,  $p = .0004$ ). In addition, Psychobiology students were more satisfied (6.5) with a Cohen's  $d$  of 0.48; the same effect size appeared for Economics students in their lack of satisfaction (4.1).

#### 4.2. RQ2a: Students reported emotional reactions regarding educational level

- *Emotional value (positive/negative).* We found significant differences for *joy* ( $\chi^2(1, 411) = 7.063$ ,  $p = .0079$ ), with very small effect size. There was no difference for *pride* or *relief*. We found no differences regarding negative emotions between students at Bachelor and Master degree.
- *Potential emotional effect (activating/deactivating).* At Master's level, positive emotions with activating effect (*joy/pride*) present a significant difference over deactivating *relief* at  $\alpha = 0.05$  ( $\chi^2(2, 305) = 7.34$ ,  $p = .025$ ), while negative emotions with activating effect present a more significant difference ( $\chi^2(2, 305) = 35.63$ ,  $p = 0$ ). At Bachelor's level, we do not identify any significant difference in activating (*shame/anger*) or deactivating emotions (*sadness*).

#### 4.3. RQ2b: Students reported emotional reactions regarding disciplinary areas

- *Emotional value (positive/negative).* We found significant differences for *joy* ( $\chi^2(4, 411) = 24.61$ ,  $p = .0001$ ), *pride* ( $\chi^2(4, 411) = 24.781$ ,  $p = .0001$ ), and *relief* ( $\chi^2(4, 411) = 14.313$ ,  $p = .0064$ ). Primary Teacher students' results had a small effect size regarding higher *joy* ( $M = 2.3$ ,  $d = 0.46$ ) and a medium effect size for more *pride* ( $M = 2.3$ ,  $d = 0.62$ ). In contrast, Art History showed a small effect size for low *joy* ( $M = 1.1$ ,  $d = 0.46$ ), and Economics students reported the lowest positive emotions with a medium effect size ( $M_{\text{joy}} = 0.9$ ,  $d = 0.62$ ;  $M_{\text{pride}} = 0.7$ ,  $d = 0.62$ ;  $M_{\text{relief}} = 0.4$ ,  $d = 0.77$ ). In coherence with the previous results on positive emotions, students of Art History and Economics reported the highest values of negative emotions. However, we found significant differences only for *shame* ( $\chi^2(4, 411) = 19.578$ ,  $p = .0006$ ). We found no difference in the report of *sadness* or *anger*. In the case of shame, Primary Teacher students had the lowest report with a medium effect size ( $M = 0.6$ ,  $d = 0.54$ ), while Art History and Economics had the highest, with medium and small effect sizes respectively ( $M_{\text{AH}} = 2.3$ ,  $d = 0.77$ ;  $M_{\text{E}} = 1.9$ ,  $d = 0.46$ ).
- *Potential emotional effect (activating/deactivating).* We do not identify any significant difference in activating (*shame/anger*) or deactivating emotions (*sadness*) across areas.

## 5. Discussion and conclusions

In this paper, we address only a tiny fraction of the project that we are currently undertaking. In contrast with previous research on emotions related to assessment, our study presents evidence of actual emotions in a natural educational setting, as opposed to laboratory, abstract experiments or off-context surveying (Bieg, Goetz, & Lipnevich, 2014). We have yet to find any previous literature to compare our results with, as previous publications on CBM do not inquire about related psychological

processes or constructs in connection with this alternative assessment experience. Hence, this section will offer our reflections on the presented results. These preliminary results lead us to several considerations:

First, there are low, perhaps restrained, emotional reactions, both positive and negative value, activating and deactivating. It is important to note that the testing system had merely a formative purpose, having the resulting marks no accreditation value for the students. We hypothesise stronger emotional reactions (both positive and negative) if the CBM marks would have a summative effect, based on literature on achievement emotions (Pekrun & Linnenbrink-Garcia, 2012).

Secondly, we found little difference in our results regarding educational level. Students at Bachelor's degrees and Master's degrees reacted similarly to this first encounter with the CBM-self-assessment system. Therefore, in that sense, this instructional strategy is equally valid for both levels. Considering the activating/deactivating potential of perceived emotions in the learning process, master students reported a more significant difference between activating and deactivating emotions, both positive and negative, than bachelor students. We need further investigation regarding the detail of the subject's age. In our sample, the mean age of master students was about 27 years, and the mean age of bachelor students was close to 20 years. However, there is one-third of students between 30-50 years of age in our sample. In the subsequent analysis, we shall pay attention to chronological age rather than educational level to identify possible differences between late adolescents and young to mid-adults' perceptions (Novacek, 2013).

Finally, we need to make some remarks on the low participation of students in some of the disciplinary areas. Notably, the two courses presenting the higher participation rate are Primary Teacher (70%) and Secondary Teacher (67%) education, both courses directly addressing in their programs learning contents related to learning processes themselves; meanwhile, the disciplinary areas different from education present a much lower response. In other words, students from the education area are much more prone to participate in the study. In contrast, students off of education might lack a reflection culture in relation with their learning process. Indeed, we need much more research into this; we need to learn more about the inherent complexity of teaching and learning in higher education and the specificity of content areas (Gotez et al. 2006; Quinlan, 2016). In our project, deeper analysis is still pending to consider a variety of individual variables regarding demographic aspects (age, workload, family responsibilities, personal tendency to risk-taking) and educational aspects (conceptions of assessment, mathematical competence regarding probability situations). In addition, we need to explore prospective emotions, as well as calibration and metacognitive reactions (attribution of results and plans for improvement or maintenance) to determine how the CBM assessment strategy might endorse self-regulated learning.

Table 1. Participants' description by disciplinary area.

Disciplinary area	Within area % response (decreasing)	Sample across area % response	Female %	Male %	Age M(SD)	Educational level
Prim. Teacher (n=37)	67.3	9.0	75.7	24.3	19.9(2.4)	Bachelor
Sec. Teacher (n=305)	67.2	74.2	66.5	33.5	26.7(6.6)	Master
Art History (n=12)	14.1	2.9	83.3	16.7	21.7(3.9)	Bachelor
Psychobiology (n=47)	7.7	11.4	89.4	10.6	20.1(5.4)	Bachelor
Economics (n=12)	5.7	2.4	40	60	20.8(3.3)	Bachelor
Law	0					Bachelor
TOTAL (n=411)	41.6	100	69.8	30.2	24.8(6.7)	

Table 2. Results on CBM (first description).

Disciplinary area	CBM result (decreasing) M(SD)median	Response time (%) M(SD)	Points [-60, +30]		Declared level of result (%)			
			Min.	Max.	Level 0	Level 1	Level 2	Level 3
Psychobiology	9.2(7.7)11	52.8(21.9)	-17	+22	10.6	36.2	34.0	19.1
Prim. Teacher	6.9(6.3)8	64.3(19.5)	-13	+19	13.5	51.3	29.7	5.4
Sec. Teacher	4.7(9.0)6	57.4(19.3)	-27	+24	25.6	46.2	22.3	5.9
Art History	4.1(4.1)4	59.5(13.2)	-4	+11	--	91.7	8.3	--
Economics	0.9(16.1)5	66.6(23.4)	-33	+21	30	50	10	10
Bachelor (n=106)	7.1(8.4)8	58.9(20.9)	-33	+22	12.3	49.0	27.4	11.3
Master (n=305)	4.7(9.0)6	57.4(19.3)	-27	+24	25.6	46.2	22.3	5.9
TOTAL	5.5(8.9)6	57.8(19.7)	-33	+24	22.1	46.9	23.6	7.3

Table 3. Results on reported satisfaction and emotions.

Disciplinary area	Satisfaction (decreasing) M(SD)median	Retrospective emotions, positive M(SD) 6 point Likert (0-5)			Retrospective emotions, negative M(SD) 6 point Likert (0-5)		
		Joy	Pride	Relief	Shame	Anger	Sadness
Psychobiology	6.5(2.6)7	2.2(1.3)	2.0(1.3)	1.7(1.3)	1.1(1.3)	0.6(1.2)	0.7(1.2)
Prim. Teacher	6.1(1.9)6	2.3(1.1)	2.3(1.3)	1.9(1.4)	0.6(1.2)	0.8(1.0)	0.7(1.1)
Sec. Teacher	5.0(2.5)5	1.6(1.3)	1.4(1.2)	1.3(1.3)	1.3(1.3)	0.7(1.0)	0.8(1.0)
Art History	4.5(2.1)4	1.1(1.6)	1.1(1.8)	1.2(1.4)	2.3(1.8)	1.3(1.4)	1.6(1.3)
Economics	4.1(2.9)3.5	0.9(1.1)	0.7(1.1)	0.4(0.7)	1.9(1.7)	1.3(1.2)	0.9(1.2)
Bachelor (n=106)	5.9(2.5)6	2.0(1.3)	1.9(1.4)	1.6(1.4)	1.2(1.5)	0.8(1.2)	0.8(1.2)
Master (n=305)	5.0(2.5)5	1.6(1.2)	1.4(1.3)	1.3(1.3)	1.3(1.3)	0.7(1.0)	0.8(1.1)
TOTAL	5.3(2.5)5	1.7(1.3)	1.5(1.3)	1.4(1.3)	1.3(1.3)	0.7(1.1)	0.8(1.1)

### Acknowledgement

This study was funded by the University of Barcelona. Research grant REDICE22-3060.

### References

- Bieg, M., Goetz, T., & Lipnevich, A. A. (2014). What students think they feel differs from what they really feel—academic self-concept moderates the discrepancy between students' trait and state emotional self-reports. *PLoS one*, 9(3), e92563.
- Chamberland, M., & St-Onge, C. (2013). Back to basics: keeping students cognitively active between the classroom and the examination. *BMC Medical Education*, 47(7), 641-643. doi:10.1186/medu.12218
- Gardner-Medwin, T. (2019). Certainty-Based marking: stimulating thinking and improving objective tests. In C. Bryan, & K. Clegg (Eds), *Innovative Assessment in Higher Education* (pp. 141-150). NY: Routledge.
- Leclercq, D. (1982). Confidence marking, its use in testing. *Evaluation in Education*, 6(2), 163-287. doi:10.1016/0191-765X(82)90011-8
- Leclercq, D. (2003). *Diagnostic cognitif et métacognitif au seuil de l'université. Le projet MOHICAN mené par les 9 universités de la Communauté Française Wallonie Bruxelles*. Liège: Editions de l'université de Liège. <http://hdl.handle.net/2268/17837>
- Novacek, P. (2013). Confidence-based assessments within an adult learning environment. In *IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2013)*, (pp. 403-406).
- Pekrun, R., & Linnenbrink-Garcia, L. (2012). Academic emotions and student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 259-282). New York, NY: Springer.
- Quinlan, K. M. (2016). How emotion matters in four key relationships in teaching and learning in higher education. *College Teaching*, 64(3), 101-111.
- Quinlan, K. M., Male, S., Baillie, C., Stamboulis, A., Fill, J., & Jaffer, Z. (2013). Methodological challenges in researching threshold concepts: a comparative analysis of three projects. *Higher Education*, 66, 585-601.
- Smrkolj, S., Bancov, E., & Smrkoli, V. (2022). The reliability and medical students' appreciation of certainty-based marking. *International Journal of Environmental Research in Public Health*, 19, 1706. doi:10.3390/ijerph19031706
- Yuen-Reed, G., & Reed, K. B. (2015). Engineering Student Self-Assessment through Confidence-Based Scoring. *Advances in Engineering Education*, 4(4).

# WHAT WE TALK ABOUT WHEN WE TALK ABOUT INNOVATION AND VOCATIONAL EDUCATION? A SCIENTOMETRIC ANALYSIS OF THE RESEARCH FRAMEWORK

**Felipe Guevara-Pezoa**

*Dirección de Investigación y Postgrado, Universidad Central de Chile (Chile)*

## Abstract

The role of education in innovation is well-established, but little is known about how innovation is understood in vocational education. This study used bibliometric analysis to explore the relationship between vocational education and innovation. The results showed that research on this topic is still limited, with only 539 articles published over a 53-year period. Furthermore, most authors (93.6%) only published one paper on the subject and none were affiliated with technical institutions. These findings suggest that research on innovation in vocational education requires a multidisciplinary approach and more collaboration between countries, authors, and institutions. Given the broad definition of innovation, it is likely that different contexts will yield different definitions. Thus, expanding research on this topic is crucial.

**Keywords:** *Education, innovation, vocational education, bibliometric analysis, technical education.*

---

## 1. Introduction

The literature suggests that education has an important role in driving innovation, with institutional cultures often identified as the primary barrier to knowledge transfer. Overcoming this challenge requires the use of intermediaries and a focus on experiential learning. Within this context, much of the existing literature emphasizes the role of universities as hubs for training in innovation (Jones & Grimshaw, 2016; Kitson, 2019; Valero & Van Reenen, 2019). To this end, several theoretical models and case studies have highlighted the need for curricular and organizational changes, as well as greater collaboration with external partners from both academia and industry (Kolomytseva & Pavlovska, 2020). Etzkowitz & Leydesdorff, (2000) influential study underscores the need for universities to become more entrepreneurial in nature. However, as noted by (Datta et al., 2019), given the heterogeneity of universities, strategic clustering is essential to increase their contribution to national innovation systems. This in turn necessitates the adoption of mechanisms that promote interest and facilitate collaboration with other stakeholders in the innovation system (Giraldo Gutiérrez et al., 2020).

Research in innovation systems also emphasizes the importance of technical education, which is seen to offer certain advantages over universities in some aspects of innovation, particularly due to its close relationship with small and medium-sized enterprises (Rosenfeld, 1998). Similarly, Brunet & Böcker Zavaró (2017) has called for greater contributions from the vocational education and training (VET) system to innovation in companies, especially SMEs, which may have limited resources for innovation. Such contributions can be facilitated by VET's mediating role between knowledge creators (i.e., researchers and institutions) and knowledge users (Moodie, 2006).

Against this backdrop, the present study seeks to analyze the intellectual and conceptual organization of research on innovation and VET. Specifically, we aim to provide insights into how this research field is structured and conceptualized. By achieving this aim, we hope to contribute to the advancement of research in this area, which is of critical importance for achieving sustainable economic growth and development.

## 2. Materials and methods

The search was carried out on Elsevier's Scopus database from January 1968 to December 2021 using several terms related to vocational education and innovation. After removing duplicates and

non-pertinent journals or topics, the selected articles were manually inspected to exclude those that were irrelevant to the quantitative analyses.

The systematic review included original and review articles in English and Spanish language from 25 distinct Scopus subject areas, whose title, abstract, or keyword contained at least one of the terms Vocational Education and Innovation, or, TVET and Innovation, or, Technical education and innovation, or, VET and innovation. The relevant bibliometric indicators extracted from the selected studies included the number of articles, sources, keywords, average citations per article, number of authors, authors appearances, article per author, annual scientific production and citations, top five productive authors, author's indices, top five cited articles and cited references, top five productive countries and institutions, top five relevant sources and top five relevant keywords and topics.

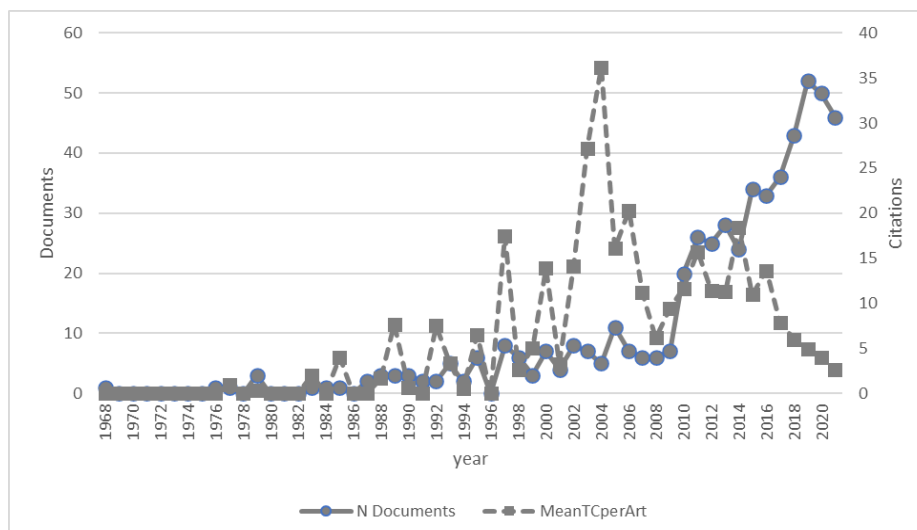
The collected data was analyzed using statistical graphs, descriptive analyses, and science maps generated by the bibliometrix R-package, an open-source science mapping program. Bibliometric indicators with the same ranking number were separated by a gap, and only the first five rated data for each indicator studied were considered for ranking reasons. The Hirsch index (h-index), and g-index were used to quantify the number of publications and number of citations per publication for each author.

### 3. Results

#### 3.1. Main information

The systematic review initially identified 1105 articles, but only 539 were included in the quantitative analyses. These articles had an average citation per article of 9.25 over the period from 1968 to 2021 and were authored by 1368 authors, with an average of 0.39 articles per author from 369 different sources. The annual percentage growth rate of article publication was 10.04%, with most of the growth occurring in the last 12 years and two peaks observed in 2013 (28 articles) and 2019 (52 articles). In terms of average total citations per article, the highest peak was observed in 2004 with a mean of 36.2 citations, while the lowest was 0.0 citations, with exceptions, between 1968 and 1996. These findings provide insights into the quantity and quality of published research related to innovation in vocational education and training (figure 1).

Figure 1. Annual Production and citations per article.



#### 3.2. Countries, institutions and productivity by affiliation

The analysis of the scientific production of the countries showed that the number of documents in which the corresponding author corresponds to a specific country varies from 1 article to 69 articles, as in the case of the United States. The most productive countries in terms of published articles related to innovation and VET were the United States (n=224, 41.6%), followed by the Netherlands (n=89, 16.5%) and the United Kingdom (n= 82; 15.2%). These 3 countries accounted for more than half (73.3%) of the productivity in the study area.

The highest number of citations was attributed to the United States (n=1444 with a mean number of citations per article of 20.93), followed by the Netherlands (n=702 with an AQM of 18.9) and the United Kingdom (n=563, with a mean number of citations per article of 13.1) (table 1).



Table 1. Top 5 most productive countries.

Country	Total Documents	Total Documents Corresponding Author	Total Citations	Average Article Citations (Corresponding author article)
USA	224	69	1444	20.93
NETHERLANDS	89	37	702	18.97
UNITED KINGDOM	82	43	563	13.09
AUSTRALIA	67	32	255	7.97
SPAIN	58	20	91	4.55

The University of Massachusetts Boston and the University of Washington in the United States occupy the first and second place in terms of institutional productivity, with 12 (2.2%) and 10 (1.8%) published articles, respectively. They are followed by Lobachevsky State University, Russia, with 8 (1.5%) published articles.

Among the top five institutions, there are no technical education institutions, all of them being universities (table 2).

Table 2. Top 5 most relevant affiliations.

Affiliation	Articles
UNIVERSITY OF MASSACHUSETTS BOSTON	12
UNIVERSITY OF WASHINGTON	10
LOBACHEVSKY STATE UNIVERSITY OF NIZHNY NOVGOROD	8
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS	7
TILBURG UNIVERSITY	7

### 3.3. Journals, articles and keywords

The study found that the "Journal of Vocational Education and Training" was the most productive source, with 35 articles published in the period of 1968-2021, followed by "Journal of Technical Education and Training" (n=10) and "International Journal for Research in Vocational Education and Training" (n=8) (table 3). Sixty percent of the most relevant journals (n=12) corresponded to sources from the field of education, and six of them were related to the field of technical education. The rest of the journals (n=8) belonged to fields outside education, such as public policy, management, science, engineering, and technology (data not shown).

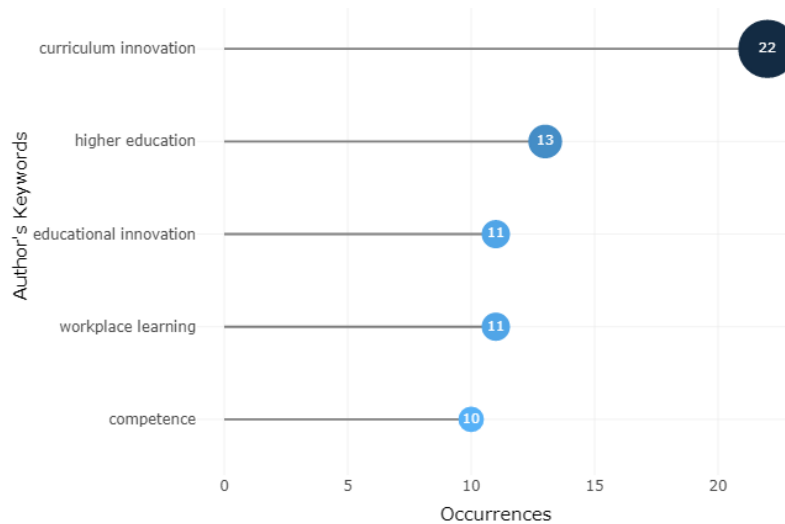
Table 3. Top 5 most relevant sources.

Sources	Articles	% of total
JOURNAL OF VOCATIONAL EDUCATION AND TRAINING	35	6,5%
JOURNAL OF TECHNICAL EDUCATION AND TRAINING	10	1,9%
INTERNATIONAL JOURNAL FOR RESEARCH IN VOCATIONAL EDUCATION AND TRAINING	8	1,5%
JOURNAL OF ENGINEERING EDUCATION TRANSFORMATIONS	6	1,1%
SUSTAINABILITY (SWITZERLAND)	6	1,1%

In terms of the most cited journals in the references of the 539 articles included, "Journal of Vocational Education and Training" was the most cited with 138 articles, followed by "Research Policy" (117 articles) and "Anatomical Sciences Education" (75 articles). Among the most cited articles and references, seventeen were original articles and three were review articles. The first ranked article was BIEMANS H et al, 2004 with 170 global citations and 9 local citations, followed by "DILULLO C, 2011" with 139 global and 1 local citation and "TRELEASE RB, 2016" with 123 global citations and no local citations (data not shown).

The analysis of the keywords assigned by the authors showed that after eliminating the terms contained in the search definition of the database (vocational, education, training, innovation), the three most relevant keywords were curriculum innovation, higher education, and educational innovation, appearing 22, 13, and 11 times, respectively (figure 2). When analyzing the evolution of keywords, it was observed that topics related to curricular innovation (pedagogy, educational innovation, and the like) addressed mainly between 2014 to 2016, have given way to topics related to entrepreneurship, technological innovation, and industry 4.0 (2016 to 2021) (data not shown).

Figure 2. Most relevant author's keywords.



### 3.4. Author productivity

The analysis of the authors revealed that Albizu, E and Lava C are the most productive authors with 5 articles, followed by authors who have written only 1 article, which accounts for 93.6% of the total number of authors. When it comes to the highest indexes, Albizu E and Lava C have an h-index and g-index of 4 (table 4).

Table 4. Top 5 most relevant author.

Authors	Articles	h-index	g-index
ALBIZU E	5	4	4
LAVA C	5	4	4
BRUNET ICART I	4	2	3
OLAZARAN M	4	3	4
OTERO B	4	3	4
TONER P	4	4	4

## 4. Discussion

This study analyzed the global scientific activity on the relationship of vocational education and training (VET) and innovation, using bibliometric indicators to help researchers better understand the history and future direction of research in this area. The study identified that the US, the Netherlands, and the UK were the main countries publishing and receiving citations in this field. However, research on the topic is still incipient, with only 539 articles specifically addressing innovation and technical education issues over a 53-year period (1968-2021). The study found that there is a lack of collaborative efforts between authors from different countries, and there is a need for more in-depth studies to evaluate the development of countries in promoting research on VET and innovation.

The study also found that there is a multidisciplinary approach needed in research on VET and innovation, with journals from different areas, such as management, business, and economics, publishing articles related to this topic. The authors suggest that if more articles are published in journals specialized in innovation, professionals in this area will be more aware of the existing gap, which would allow for an

increase in research in this area. Moreover, the study identified that the concept of innovation from VET has been approached mostly from improvements in teaching plans, and focused on higher education.

The study recommends that researchers need to address the gap in research on the relationship between VET and industry and establish guidelines for the integration of VET into innovation ecosystems. Finally, the study concludes that there has been a significant increase in the number of publications on VET and innovation in the last 10 years, probably because innovation is an attractive topic, but from the point of view of education, there is no consensus on how to adopt innovation in its work.

## 5. Conclusion

- Research on the relationship between vocational education and training (VET) and innovation has grown significantly in the past decade, with the US, the Netherlands, and the UK being the leading countries publishing and receiving citations.
- Only 539 articles specifically address innovation and technical education issues over a 53-year horizon, indicating that research on this topic is still incipient.
- There is a need for more in-depth studies to evaluate the development of countries in promoting research on VET and innovation.
- Collaborative efforts with authors from other countries are scarce, and there is a lack of research on this topic in Latin America.
- The relationship between VET and innovation should be more represented in the field of management or social sciences.
- There is a gap in research on the relationship between VET and industry, as the most cited articles focus on improvements in teaching and learning practices or the adoption of technologies and innovations in teaching practices.
- Recent publications have addressed topics related to entrepreneurship, technological innovation, and industry 4.0, indicating a shift in research focus.
- The study provides valuable insights into the history and future direction of research on VET and innovation, which can help researchers identify knowledge gaps and future research directions.

## References

- Brunet, I., & Böcker Zavarro, R. (2017). El modelo de formación profesional en España. *Revista Internacional de Organizaciones*, 18, 89. <https://doi.org/10.17345/rio18.89-108>
- Datta, S., Saad, M., & Sarpong, D. (2019). National systems of innovation, innovation niches, and diversity in university systems. *Technological Forecasting and Social Change*, 143, 27-36. <https://doi.org/10.1016/j.techfore.2019.02.005>
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Research Policy*, 29(2), 109-123. [https://doi.org/10.1016/S0048-7333\(99\)00055-4](https://doi.org/10.1016/S0048-7333(99)00055-4)
- Giraldo Gutiérrez, F. L., Ortiz Clavijo, L. F., & Zuñiga-Miranda, S. (2020). Políticas de Ciencia, Tecnología e Innovación en América Latina y el Caribe y su influencia en la producción y apropiación de la CTI. *Revista Linguagem & Ensino*, 23(1), 292. <https://doi.org/10.15210/rle.v23i1.17751>
- Jones, B., & Grimshaw, D. (2016). The impact of skill formation policies on innovation. In J. Edler, P. Cunningham, A. Gök, & P. Shapira (Eds.), *Handbook of Innovation Policy Impact* (pp. 108-128). Edward Elgar Publishing. [https://EconPapers.repec.org/RePEc:elg:eechap:16121\\_4](https://EconPapers.repec.org/RePEc:elg:eechap:16121_4)
- Kitson, M. (2019). Innovation policy and place: A critical assessment. *Cambridge Journal of Regions, Economy and Society*, 12(2), 293-315. <https://doi.org/10.1093/cjres/rsz007>
- Kolomytseva, O., & Pavlovska, A. (2020). The role of universities in the national innovation system. *Baltic Journal of Economic Studies*, 6(1), 51. <https://doi.org/10.30525/2256-0742/2020-6-1-51-58>
- Moodie, G. (2006). Vocational education institutions’ role in national innovation. *Research in Post-Compulsory Education*, 11(2), 131-140. <https://doi.org/10.1080/13596740600768901>
- Rosenfeld, S. (1998, May 28). Technical Colleges, Technology Deployment, and Regional Development. In *International Conference on Building Competitive Regional Economies*. International Conference on Building Competitive Regional Economies, Modena, Italy.
- Valero, A., & Van Reenen, J. (2019). The economic impact of universities: Evidence from across the globe. *Economics of Education Review*, 68, 53-67. <https://doi.org/10.1016/j.econedurev.2018.09.001>

# SONG-LEADING: AN OVERVIEW ON CONTRASTING DIDACTICS

**Gabriella Cavasino**

*PhD Student, Institut für Erziehungswissenschaft, University of Zurich UZH (Switzerland)*

## Abstract

Music and song singing is a widely used mean of expression and of cultural transmission between adults and children. In many institutions, this practice is led mainly by generalist teachers as one of the different parts of the children's school curriculum. Children's songs can be analyzed as specific objects that sum up and exemplify a coherent use of musical structures and rules, showing how they can be considered, as such, a cornerstone of the music education dispensed by generalist teachers in schools.

Previous studies focus on the teacher's actions during music lessons from an evaluating standpoint. In our research, we focus on describing and understanding the phenomenon from a didactic standpoint: we question what rules underlie the actions, what aspects of the actions are relevant for the teacher, what insight guides our observation as researchers. In the framework of the Swiss National Fund research project (2018- 2020), The song leading capacity: developing professionalism in teacher education, carried out by PH Schwyz and HEP-BEJUNE, we observe and characterize the development of pre-service teachers as well as the work of experienced teachers, through video analysis of lessons, interviews while viewing the filmed lessons, and field notes.

In this presentation, I report on two contrasting case studies of experienced generalist teachers, by analyzing their approach in teaching a children's song. Using the transcription system "Lesson Activities Map" (LAMap), created by our research team, I visualize the most important actions in a music lesson's sequencing, focusing on how the teachers organize the lesson, and how they implement classroom activities and visual supports relating to musical learning. In-depth analysis of important episodes, contextualized within the entire lesson by the LAMap, allows us to characterize the appearance of meaningful events: the way a specific song element is introduced provides detailed insights on the teachers' ability of explicitly or implicitly navigating the different rules and norms of each stratus of the song leading phenomenon in a way that allows them to follow, or fall out of, their self-determined course of action.

**Keywords:** *Song leading, interview analysis, video analysis, pedagogical content knowledge, core practices.*

---

## 1. Introduction

In this paper I present two case studies on song leading in the classroom. I have collected and analysed data of experienced generalist teachers introducing a new song to children from four to eight years old during a music lesson in school. The data collected consist of a video recording of one lesson transcribed through the LAMap system and the teacher's interview audio recorded after the lesson, while watching the video of the lesson, and then analysed contextualising the sequence of actions transcribed in the LAMap. In this paper, I will present the cases of Jenny and Norman as two examples of contrasting didactics in teaching children a new song.

## 2. Jenny's case study

Jenny is a generalist experienced teacher that regularly teaches music, among other subjects, in a primary school in the French speaking part of Switzerland. She does not have a specific music training, but she is familiar with music reading and writing, playing the piano, playing the guitar, and singing.

The LAMap of Jenny's Lesson (Figure 1) shows a very rich and varied set of music activities that precede or follow the introduction of the song or, better to say, some music elements of the song chosen by Jenny at this occasion. If we look at Jenny's sequence of actions, we'll be able to observe that Jenny performs, on one hand, some activities that pertain to a music lesson, such as singing a repertoire previously learned songs, performing and reading rhythmic patterns, performing melodic patterns such as the scale in

the Major mode, using classroom material for different kinds of music activities such as duplo to conceptualize and visualize rhythmic notations, cards to picture and metaphorize musical features like the tempo, legato or staccato lines, etc. On the other hand, Jenny performs activities that pertain directly to the song that she's set to introduce to the children. We'll see that the song, or elements of the song clearly appear in four occasions, separated in time but positioned in very specific moments of the lesson: the first time during an activity on the rhythm the second time before introducing an activity on singing, the third time in a long sequence that she considers demanding in terms of the children's ability to concentrate, before going into a very energetic activity of dancing and singing and at the very end for example, where she chooses to sing the song once again because, as she says herself, she wants the children "to calm down and go back home with that song in their minds", as if she's creating a haunting melody that resumes the musical experiences and rules of the day.

Figure 1. Jenny's LAMap.

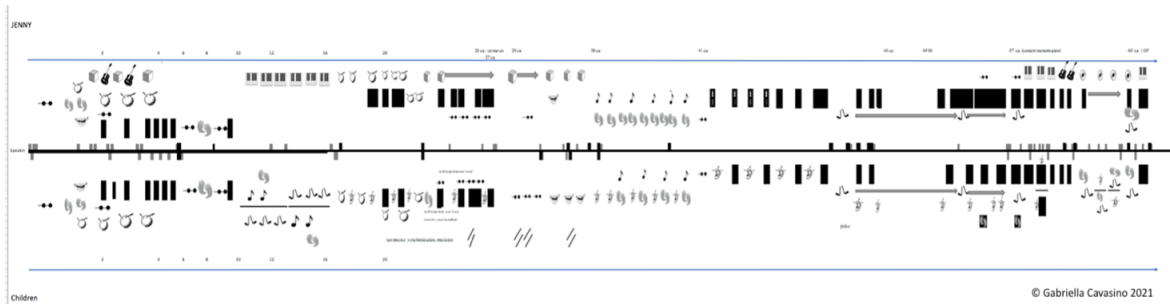
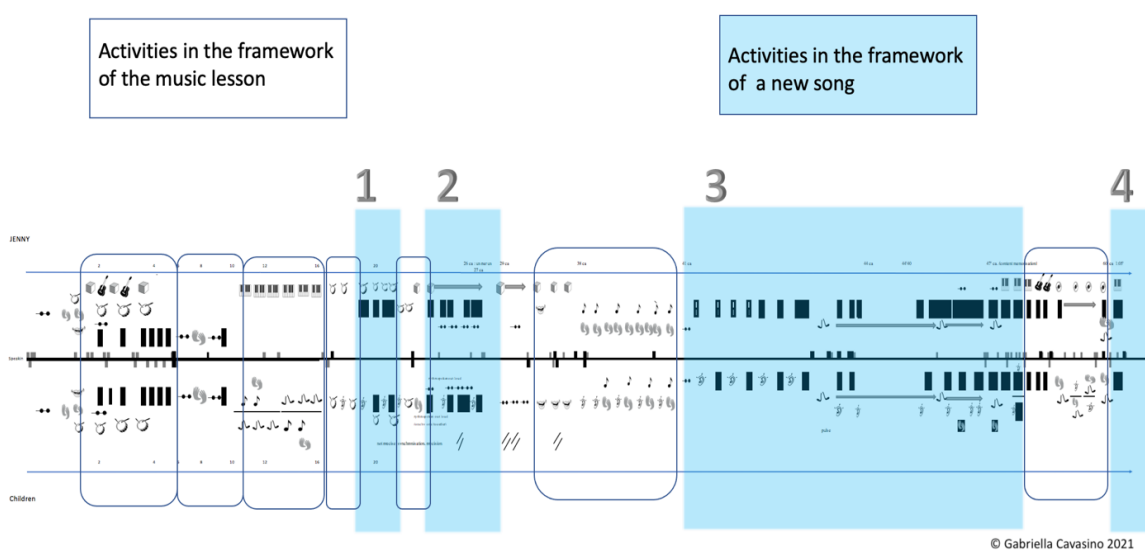


Figure 2. Differentiated sequences in Jenny's lesson.



We will now analyse the first episode in which the song appears, in order to gain more insight on Jenny's style of teaching.

After a short verbal interaction (see grey rectangles on the speaking line), Jenny starts an activity with some percussive instruments (see drum icon) and she specifically demands the children attention before performing alone or together with the children (see the ear icon). Then, as highlighted in the blue rectangle, she introduces the rhythmic pattern of the song's verse. What's happening here is the occurring of two modalities of conducting an activity pertaining rhythm: Jenny performs a series of pattern in a flow together with the children; every time that she changes pattern, she keeps repeating it observing all the children until she reaches a certain degree of synchronicity and then she changes to another pattern without stopping. At the very end she starts changing from a binary pattern into introducing a ternary pattern, which finds itself to be the pattern of the new song, then she stops and deliberately ask the children to listen and pay attention to the new pattern; eventually she performs it again along with the children, switching from the flow to a model/repetition mode of teaching. When commenting on this very episode of the lesson,

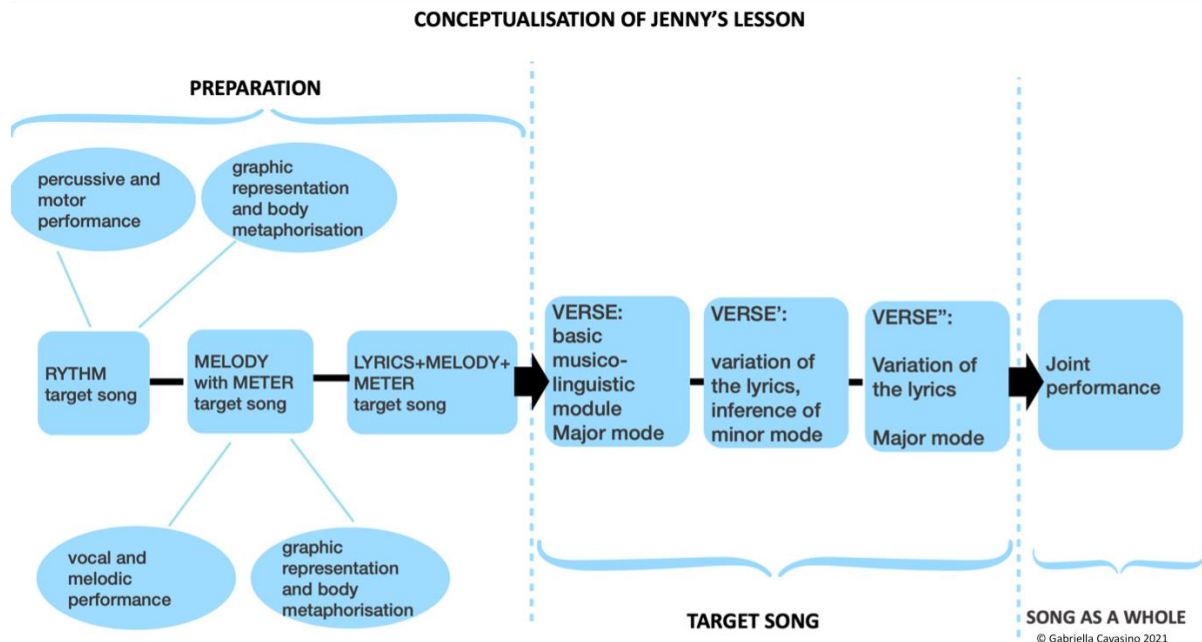
Jenny tells us: “When I introduce a new song, I first try to live it in the body, and I wanted that they listened to this specific rhythm. Not that they listened to it, but that they feel it in the body. I don’t use the words because I want them to acquire it like a dance, something natural, that is already there, like a lullaby that they had before...I dissociate it (the rhythm) from the words (of the song)”. We can observe that her words are reflected in her actions and that the flow mode of teaching during a known activity to the children, is used to introduce a specific element that is then made the focus of study through a model/repetition modality of teaching, highlighting the character of novelty and meaningfulness of a new music feature: the ternary tempo exemplified by the ternary pattern of the new song.

Figure 3. Picturing and singing.

The figure shows musical notation on the left and a photograph on the right. The notation includes a treble clef, a 2/4 time signature, and the instruction '2 (main, duplo)'. The first staff shows a rhythmic pattern of quarter notes: Ta\_ ti Ta\_ ti Ta\_ ti Tam. The second staff shows a melodic line with the same lyrics: Ta\_ ti Ta\_ ti Ta\_ ti Tam Ta\_ ti Ta\_ ti Ta\_ ti Tam. A blue bracket on the left side of the notation is labeled 'p6'. The photograph on the right shows a classroom table with colorful blocks (yellow, green, red) and a computer monitor.

On the second episode she shifts from the “performing” into the “picturing” of the pattern, through the use of Kodaly method’s syllables and classroom material that introduce the canonical western written notation of notes lengths, and at the end of the second episode, eventually, she introduces the melody. It’s only during the third episode that jenny introduces the words and explicitly works on the song alternating once again the modalities of flow and model/repetition.

Figure 4. Conceptualisation of Jenny’s lesson.

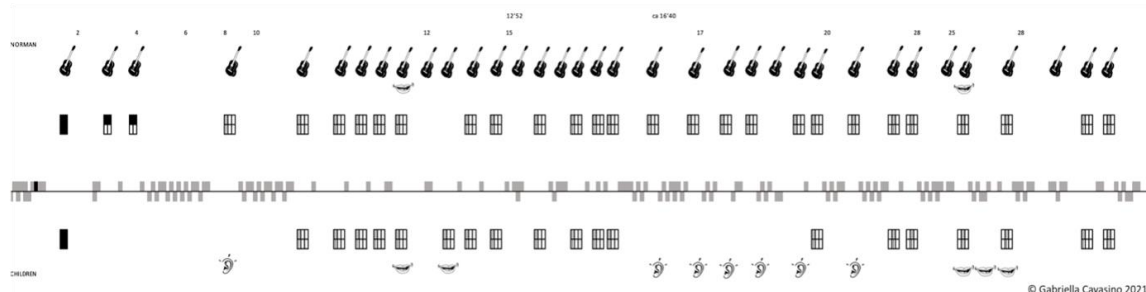


From this example, we can see how the internal rules of a children’s song can be isolated, embedded into general activities around general music features and deliberately stratified one upon the other until they are recomposed in their original structure, putting in relation, through seamless transitions, a specific song to the general context of western music’s norms and rules.

### 3. Norman's case study

Norman is an experienced generalist teacher, mostly self-taught guitarist, that regularly teaches music as well as other subjects in a French speaking Swiss primary school.

Figure 5. LAMap of Norman's actions.



As we can see from Norman's LAMap, in this case the song is, early in the lesson, introduced and maintained as the principal object until the end of the lesson.

At the beginning we see the joint performance, between Norman and the children, of a known song. Then we can see Norman and the children talking back and forth, until Norman deliberately asks the children attention (see the first ear icon) to introduce the new song through singing while playing along at the guitar. A conversation follows, in which Norman analyses the lyrics of the song with the children, pointing out words that are new to them in the meaning and the spelling; the scaffolding of the first and second verse follows, leading to performing one last time the first and second verse of the three verses song at the very end of the lesson.

A striking element in the LAMap transcription is the use of the guitar, an almost omnipresent element throughout the whole lesson, whether it accompanies the singing or is played while speaking. When asked about this detail, Norman comments: "I often play the guitar, at the beginning when I welcome them for the lesson or when they tidy up their desks for example. So, it's true that the guitar is not something separate, as to signal "now we make music".

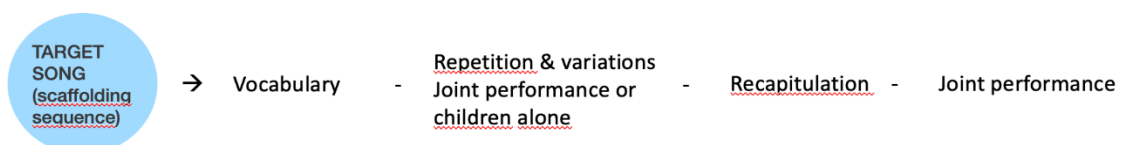
"The guitar is there all the time, the children play the guitar all the time, I have one especially for them, I give instructions while I play the guitar. It's very natural. It might not be always very clear, if you observe from the outside."

When we observe Norman's actions in detail, we see that the melody played at the guitar is a variation or a repetition of the song's melody or turn of chords: on one hand, the song is constantly implicitly reminded to the children through an immersive acoustic environment created by Norman. On the other hand, there's an explicit work on the words of the song. During the interview, Norman points out: "I like to sing to them first, so that they can hear what it's going to sound like, but it's true that vocabulary is important, so that they understand what it's about.

It's a work on vocabulary, on what it means, understanding what we're singing, to be more in the mood of the song".

The new song is an object to discover, first of all, as a whole, as it is presented at the beginning. It's for the children an evocative playground through the story that it recounts and the new words that it contains. The musico-linguistic grammar – the tonal, timing and poetic rules – remain implicit although ever present, structuring the course of the action.

Figure 6. Norman Scaffolding sequence.



Norman comments: "I don't have any formal goals about music, it's all about awakening their interest in musical instruments... To give them a taste for music, to experiment with the voice too. This is something that is very important to me. I also do musical activities but not around songs. It can be typing in rhythm or reproducing movements, or doing more percussive things, where I'll have other objectives, but for the songs, my aim is that they really enjoy singing, being together and also listening to one another."

When analyzing Norman words in relation to his actions, we see a deliberate intention to concentrate on immersing the children into the sound of the guitar and following the structural elements of the song, such as its chords sequence, its meter and the meaning of its lyrics. Very few activities are performed around the song: Norman asks the children to sing slower or faster in order to bring a variation into the constant repetition of the verses.

#### 4. Conclusions

In the cases presented above, we see two different ways of teaching a children song: one that contextualise the song within a whole series of musical activities and one that focuses the children on the song as a whole. The two styles face a similar challenge: how to keep the children's attention, and the two teachers aim to a similar goal: taking pleasure in doing an activity together, reproducing a song to a certain degree of fidelity to its intrinsic norms and rules.

In the first case, Jenny achieves this goal through organising the lesson into several activities that allow her to switch the children's focus to different topics, all the while following the *fil rouge* provided by the structure of a chosen song. In the second case, Norman keeps the children focus on the song through the use of the guitar. We can see how the strictly ruled musico-linguistic structure of a song can result in very different strategies for teaching. When analysing the two interviews, we see several emerging themes that guide the teacher's actions such as:

- a. the teacher-children way of interacting,
- b. the teacher's professional duties in the institution,
- c. the teacher's own goals, experience, values
- d. the subject matter inherent rules (i.e. the children's song grammar)

Through the interview analysis, we can define Jenny's and Norman's teaching capacity in the ability to explicitly or implicitly navigate the different rules of each stratum of the phenomenon that is song-leading in the classroom, so as to follow a self-determined course of action.

In Jenny's words:

**“I know what my goals are,** actually. Working on the rhythm, feeling the meter with the body. Learn the melody, discriminating higher and lower pitch, learning the scale. All my goals on the music theory level itself. It's also: to be able to synchronize myself to the group with simple gestures. Also performing rhythmic patterns. But also, for the students to sing in a group and to sing alone.

Making music, having fun making music.”



## **ABEPLANA: AS HOW TI TEACH WITH VIDEOGAMES IN KINDERGARTEN CLASS**

**Verónica Marín, Begoña E. Sampedro, Ana B. López, & Esther Vega**  
*Department of Education, University of Córdoba (Spain)*

### **Abstract**

The development of the so-called emerging technologies at the present time undoubtedly implies keeping in mind the classroom methodologies that teachers use in classrooms of any educational level. Said methodologies are characterized by the search for an introduction of the ICT linked to the development of the contents so that, through the implementation of different methodological strategies, it responds to the achievement by the students of the digital competence that Today's society demands tomorrow's future leaders. The Abeplana project's starting objective is to know emerging technologies, in general, and videogames in particular, available for the creation of learning situations, this is materialized in several specific objectives, being of our interest to present those referred to Objective 3.1. which is none other than: Learning, as future teachers, the potential of emerging technologies in general and videogames in particular in the principles that underpin the universal learning design (DUA), more specifically in the multiple forms of representation, action and expression and involvement and forms of commitment that can occur with the use of the same in infant and primary classrooms. The use of videogames in the classroom will encourage the development of their own and individual skills in the student so that they know not only how to respond to the requirements of the content they must learn, but also the social reality in which their future work will take place. To respond to these objectives, the following activities have been proposed, which have been carried out in the first semester of the 2022-2023 academic year at the Faculty of Educational Sciences and Psychology of the University of Córdoba in Spain. The work of Cébaillos et al. (2022) has indicated that once the video game is used, students develop better verbal, procedural and attitudinal learning, and this is the line that we have focused on in this project. Through a methodology based on service learning the teachers in training. The students or teachers in training, to address this general and specific objective, developed a series of didactic sequences, where the backbone was the video game. As a positive aspect, the students indicated that contact with the reality of the classrooms has allowed them to corroborate or rule out elements that they considered key to putting their activities into practice. They also pointed out the need for greater training by the curricula of Spanish universities in the critical use of digital tools in early childhood education classrooms.

**Keywords:** *Videogames, university student, innovation, learning by doing.*

---

### **1. Introduction**

The vertiginous growth of Information and Communication Technologies (hereinafter ICT) has revealed the great imbalance that is taking place between what society demands, what it generates or produces and how the various sectors are responding to said situation. Thus, the term known as the digital divide is gaining great relevance to the extent that inequalities become more significant, sometimes creating an abyss between the reality of the subjects and the social context. Overcoming this circumstance means, in the educational area, that both educational theorists and practitioners take the pulse of the situation, analyze the existing digital resources and, to a greater or lesser extent, incorporate them into the dynamics of everyone's classrooms. academic levels.

Included ICT in classes, at any educational level, has both negative and positive aspects. If as a major trigger of the first we focus on the one already mentioned above (digital divide), the teaching and learning processes will be slowed down; together with it we can incorporate the need for training by teachers for their imbrication in classroom methodologies, the lack of technological resources in the centers, etc. Regarding the second, we can indicate that the incorporation means making the content to be

learned more attractive, therefore an interactive and non-linear learning will be developed, which will make the motivation for the transmission of the content more dynamic.

In this line, the digital tools that have been created in recent years, such as educational blogs (edublogs), WebQuest, wikis, academic social networks..., mean that students and teachers, as well as parents see how what happens in society is reflected in the academic dynamics. And in this line, we find video games.

Demonized by one sector and praised by others, they are presented as a resource capable of incorporating aspects that help to develop the academic curriculum across all educational levels.

In general, video games are elements that have great potential (Sierra and Fernández, 2017), and present a continuous challenge to the mind, so in good hands they can project the best of people in various aspects of their lives. daily. For authors such as Navarrete-Cantero and Molina-González (2015), it provides them with their own worldview, as well as generating situations in which their development is expanded, since the video gamer uses self-regulation processes that can allow the different levels of influence are limited.

Since they appeared, videogames have had detractors and true "fans" who have either questioned their addictive, playful or educational capacity or have pointed out, in an excessive way, their great academic possibilities. Well, as Ramos and Botella (2016, p. 170) point out, "the versatility of video games allows us to grant them undeniable social power, made up of a whole language of oral, written, iconic, musical, numerical, and graphic communication".

The educational use of video games is increasing as we advance over time (Ardila-Muñoz, 2019; Conde-Cortabitarte et al., 2020) and numerous investigations have already been carried out around their presence in education. (Marín-Díaz et al, 2021; Zainuddin et al, 2020). In this sense, we find two lines of incursion, the application of videogames classified as educational, created specifically to promote some curricular content, and that which is based on the use of videogames that are not labeled as educational, so they are not The term gamification applies, but as Azorín (2014, p. 24) points out, "they offer the opportunity to work on usable content in the training of students". In this trend, we agree with Hamlen (2011) when pointing out that they can be considered as an educational resource since they coincide with the 7 dimensions in which learning is structured: knowledge, application, identification of the sport, fantasy, competition, entertainment, social interaction. and fun.

As Marín, Morales and Reche (2020, p. 96) affirm, "the potential of video games in the classroom lies in their ability to be conceived as a new way of understanding the learning of curricular contents (sometimes difficult to assimilate) from the daily life of digital native students", so that the previous experiences of teachers will determine their incorporation as resources in the development of curricular contents in order to promote their learning process. Consequently, it is necessary to design training actions that, as Hébert and Jenson (2017, 2019) point out, use video games in their methodologies so that the classroom action is carried out and a cognitive conflict is generated that causes the activation of the learning processes that allow reaching a correct resolution of the situations that the formative acts provide.

For all that has been stated so far, we believe that the use of video games that students usually use in their daily lives, can awaken interest in students for the unconscious learning of the contents, since their motivation will increase.

## 2. Method

### 2.1. Procedure

Within the teaching innovation project called «Learning to observe systematically to plan through gamification (ABEPLAMA) (2022-4-44006)» obtained in a public call at the University of Córdoba (Spain), the following objective has been established: partida The main objective of the project is to "analyze free and commercial gamified educational resources according to the curriculum of the Early Childhood Education stage". From this they have derived the following specific objectives:

1. Know emerging technologies, in general, and videogames in particular, available for the creation of learning situations.
2. Analyze free and commercial gamified educational resources based on the Early Childhood and Primary Education curriculum.
3. Learn, as future teachers, the potential of emerging technologies in general and videogames in particular in the principles that underpin the universal learning design (DUA), more specifically in the multiple forms of representation, action and expression and involvement and forms of commitment that can occur with the use of the same in infant and primary classrooms.

4. Design and implement tasks and activities related to the universal learning design (DUA) through the use of video games in infant and primary classrooms.
5. Learn to design a didactic unit linked to the use of video games and the basic knowledge that constitutes the contents of each area of knowledge in the infant stage and its correspondence and continuity with the Primary stage.
6. Apply in educational environments the didactic sequences created and designed for the different curricular contents selected for each educational level.

The activities that develop the aforementioned objectives are:

- Preparation, individually and in groups, by undergraduate students, of descriptors for the selection of free and commercial videogames that take into account the different curricular areas of the stage in which they are formed, as well as the areas of personal and social development.
- Search and classification of video games based on the matrix or evaluation target previously prepared.
- Experimentation in the classroom of the videogames selected by the students according to the classification previously elaborated.
- Learning and reflection on the why, what and how of learning as the basic principles of UDL, and its representation and characterization in the use of video games as an exemplary resource for problem solving that adjusts to the characteristics and different learning rhythms. of the students of the infant and primary stage.
- Design, creation and classification of different tasks and activities under the protection of the DUA and its principles (multiple forms of representation, action and expression and involvement and forms of commitment) working from a more inclusive perspective on the basic knowledge that constitutes the contents of each area of knowledge in the infant and primary stages, mediated by the use of videogames selected in the activity.
- Experimentation, in the Infant and Primary classrooms of the participating schools, of the videogames selected by the university students. In the event that face-to-face contributions are not allowed, the necessary actions will be promoted so that the centers carry them out without the presence of pre-service teachers.

### **3. Project development**

#### **3.1. Moment 1**

The first moment of development of the project consisted of the theoretical introduction of the students in what are the emerging technologies (video games and virtual and augmented reality), which ones can be implemented in the classrooms and why, for this they were provided with several examples of how Carry out curricular practice with a video game designed for education (gamification). All of this was developed in 3 one-hour sessions each within the subject Media Education and the educational dimension of ICT. Subsequently, and based on the contents that from the subject called Planning and innovation in early childhood education, they were given the guidelines to carry out a didactic sequence with a duration of 15 days, which is the model used in Spanish centers to implement the curriculum content.

#### **3.2. Moment 2**

Through a collaborative and cooperative work organization, the students designed 11 intervention sequences. All of them were sequenced in the same way, around 15 work sessions located in a temporary space of one quarter (3 months), in the same classroom of 3-, 4- and 5-year-old students. The main result achieved has been referred to the limitations in the implementation of these sequences, which is none other than the lack of digital resources on the part of the center as well as the lack of a good internet connection to be able to use video games that require constantly be connected.

For this, they were provided with tablets and virtual reality glasses, as well as a Nintendo brand game console and several games (Just Dance and Spyro the dragon).

### 3.3. Moment 3

Once the didactic sequences were designed, they were implemented in the Cervantes and Alcalde Jiménez Ruiz early childhood education centers in the city of Córdoba (see figure 1).

Figure 1. Abeplana en acción.



### 4. Conclusion

The digitization of society in general and of educational centers in particular have revealed a series of socialization spaces that have produced the creation of new perspectives in the way of approaching the teaching and learning process as well as in the way to promote the socialized work process, not only by relating them, but also by building our belief system, therefore the main benefit that we can find is the transformation of the learning process and the way of viewing the contents, bringing closer the values that today in society prevail and that are necessary so that once adults, children can be imbricated in the positive construction of community life.

Varguillas and Bravo (2020, p. 20) argue that «one of the fundamental objectives of education is to enable the student to be able to build their own knowledge based on their previous experiences and the information that they can access. In this sense, the use of facilitating methodologies that allow the student to learn and convert information into learning are of great importance. Specifically, we consider that the main benefits that have been achieved with the development of this project have been:

- 1) Promote collaborative and cooperative learning between students of both grades.
- 2) Promote interdisciplinary work not only between educational levels, but also among all members of the university educational community.
- 3) Arouse a positive vision, as well as the benefits of gamifying the learning processes.
- 4) Increase and stimulate the habit of reading in children of Infant and Primary education.
- 5) Promote learning in undergraduate students to promote digital literacy in children between 3 and 6 years of age, and the development of digital competence in children between 6 and 12 years of age.

### References

- Ardila-Muñoz, J. Y. (2019). Supuestos teóricos para la gamificación de la educación superior. *Magis*, 12(24), 71-84. <https://doi.org/10.11144/Javeriana.m12-24.stge>
- Azorín, J. M. (2014). El videojuego musical ¿un recurso para la educación musical en educación primaria? *Ensayos, Revista de la Facultad de Educación de Albacete*, 29(2), 19-36.
- Conde-Cortabitarte, I., Rodríguez-Hoyos, C. & Calvo-Salvador, A. (2020). Potencialidades y límites educativos de los videojuegos activos: una investigación basada en entrevistas a docentes de Educación Física. *Cultura, Ciencia y Deporte*, 15(43), 43-52. <https://doi.org/10.12800/ccd.v15i43.1398>

- Hébert, C., & Jenson, J. (2017). Digital Game-Based Pedagogy: Exploring Teaching Strategies for Classroom Teachers in the use of Video Games in K-12 Classrooms. *ECGBL 2017 11th European Conference on Game-Based Learning* (pp. 227-234). <https://www.proquest.com/openview/ceb355497a8455829e5f3dc600907046/1?pq-origsite=gscholar&cbl=396495>
- Marín, V., Morales, M., & Reche, E. (2020). Aprendizaje con videojuegos con Realidad Aumentada en educación primaria. *Revista Ciencias Sociales*, XXVI (Número especial 2), 94-112. <https://produccioncientificaluz.org/index.php/racs/article/view/34116/35958>
- Marín-Díaz, V., Sampedro-Requena, B. E., & López-Pérez, M. (2020). Students' perceptions about the use the videogames in secondary education. *Education and Information Technologies*, 25, 3251-3273. <https://doi.org/10.1007/s10639-020-10122-6>
- Navarrete-Cantero, L., & Molina-González, J. L. (2015). La influencia de los videojuegos de contenido apocalíptico en los adolescentes. *Arte, Individuo y Sociedad*, 27(2), 161-178. [https://doi.org/10.5209/rev\\_ARIS.2015.v27.n2.43176](https://doi.org/10.5209/rev_ARIS.2015.v27.n2.43176)
- Ramos, S., & Botella, N. (2016). Los videojuegos como herramienta de aprendizaje. Una experiencia de innovación con la ópera de Mozart. *DEDICA, Revista de Educação e Huminades*, 9, 161-170.
- Sierra, M. C. & Fernández, M. R. (2017). Percepción de los videojuegos en educación social: una visión de género. *IJERI: International Journal of Educational Research and Innovation*, 7, 135-148.
- Varguillas, C. S., & Bravo, P. C. (2020). Virtualidad como herramienta de apoyo a la presencialidad: Análisis desde la mirada estudiantil. *Revista de Ciencias sociales*, 26 (1), 219-232. <https://doi.org/10.31876/racs.v26i1.31321>
- Zainuddin, Z., Shujahat, M.; Haruna, H., & Chu, S. K. W. (2020). The role of gamified e-quizzes on student learning and engagement: An interactive gamification solution for a formative assessment system. *Computers & Education*, 145, 103729. <https://doi.org/10.1016/j.compedu.2019.103729>

## COVID-19: RETHINKING THE SKILLS REQUIRED OF 21ST CENTURY EDUCATORS

**Jan Pawlowski<sup>1</sup>, Dimitra Pappa<sup>2</sup>, Kati Clements<sup>3</sup>, & Sofoklis Sotiriou<sup>4</sup>**

<sup>1</sup>*Ruhr West University of Applied Sciences (Germany)*

<sup>2</sup>*National Centre for Scientific Research "Demokritos" (Greece)*

<sup>3</sup>*University of Jyväskylä (Finland)*

<sup>4</sup>*Ellinogermaniki Agogi (Greece)*

### Abstract

The skills required of 21st Century educators are constantly evolving as it is important for teachers to stay current and develop their skills and knowledge to best support their students' academic and personal growth. Overall, there are numerous competency frameworks that provide standards or guidelines that outline the knowledge, skills, and attitudes that educators should possess to effectively support student learning and development.

Technological skills are increasingly emphasised: There are several competency frameworks that describe digital skills of educators, i.e. the knowledge, skills and attitudes that educators need to effectively integrate technology into their classrooms and support student learning in a digital environment.

Each of these frameworks offers a unique perspective on what educators should know and be able to do to effectively support student learning and development in a digital environment. The recent COVID-19 pandemic has highlighted the need for digital skills frameworks for educators to be more comprehensive, relevant, and aligned to the challenges and realities of teaching and learning in a virtual environment. It became clear that the effective incorporation of digital technologies and innovative pedagogies into education requires a rethinking of the digital competence portfolio of educators. Competencies to transition seamlessly into digital learning scenarios, as well as competencies and skills to respond to psychological effects such as technostress, depression or isolation are required.

The present paper examines some of the most commonly used digital skills competency frameworks for educators and discusses future directions for their improvement based on the lessons learned from the COVID-19 pandemic.

**Keywords:** *Digital competence framework, educators, distance education.*

### 1. Introduction

Digital technologies are rapidly changing teaching and learning. Teaching in the 21st century is not the same as both teaching methods and priorities have changed. In addition to teaching core subjects, teachers must also instill and develop students' skills for the 21st century (P21, 2019). To ensure that students can develop, practice, and apply 21st century skills, teachers must be knowledgeable and competent in teaching and training students in 21st century skills.

Furthermore, education is increasingly enabled, supported, and guided by technology, including artificial intelligence, data management, ubiquitous technologies etc. However, the mere existence of digital technology does not guarantee its usefulness for quality learning. Educators need to learn how digital environments and resources can enhance and impact their classroom practice and learning experience. They need to be proficient in incorporating new technologies and using devices appropriately and effectively. This requires significantly different skills and competencies to function effectively in the classroom and respond to the demands of the 21st century. Technological skills in teachers are thus increasingly emphasised. There are several competency frameworks that describe the required digital skills of educators, i.e. the knowledge, skills and attitudes that educators need to effectively integrate technology into their classrooms to support student learning in a digital environment.

Each of these frameworks offers a unique perspective on what educators should know and be able to do to effectively support student learning and development in a digital environment. The recent COVID-19 pandemic has highlighted the need for digital competences frameworks for educators to be more comprehensive, relevant, and aligned to the challenges and realities of teaching and learning in a virtual environment. It became clear that the effective incorporation of digital technologies and innovative pedagogies into education requires a rethinking of the digital competence portfolio of educators. Competencies to transition seamlessly into digital learning scenarios, as well as competencies and skills to respond to psychological effects such as technostress, depression or isolation are required.

The following section presents some of the most commonly used digital competences frameworks for educators. We then discuss existing challenges and limitations, as well as propose future directions for their improvement based on the lessons learned from the COVID-19 pandemic.

## 2. Digital Competences for educators

The European Parliament and Council (2018) identified digital competence as one of the key competences that every person needs for “**personal fulfilment and development, employability, social inclusion, sustainable lifestyle, successful life in peaceful societies, health-conscious life management and active citizenship**”. Digital competence involves “the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society”. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking”.

In recent decades numerous **competence frameworks** have been proposed, outlining teachers’ required digital competences. Table 1 provides an overview of the most pronounced frameworks.

*Table 1. Digital competence frameworks for educators.*

Name	Author	Focus Areas	Scope
Digital Competence Framework for Citizens (DigComp)	European Union (2022)	The DigComp framework identifies the key components of digital competence in 5 areas: Information and data literacy, Communication and collaboration, Digital content creation, Safety, Problem solving	DigComp aims to be an enabling, descriptive and non-prescriptive reference framework for digital competence
European Framework for the Digital Competence of Educators (DigCompEdu)	European Union (2017)	the "DigCompEdu" framework provides a reference framework for the digital competence of educators, focusing on 22 competences organized into six areas: Professional engagement, Digital resources, Teaching and learning, Assessment, Empowering learners, and Facilitating learners' digital competence.	DigCompEdu is directed towards educators at all levels of education, from early childhood to higher and adult education, including general and vocational education and training, special needs education, and non-formal learning contexts.
UNESCO ICT Competency Framework for Teachers (ICT-CFT)	UNESCO (2018)	The UNESCO ICT-CFT addresses all aspects of a teacher's work: Understanding ICT in education, Curriculum and assessment, Pedagogy, ICT, Organisation and administration, and Teacher professional learning. The Framework identifies three successive stages of a teacher's development: Technology Literacy, Knowledge Deepening, and Knowledge Creation.	The UNESCO ICT-CFT is intended to inform educational policy makers, teacher-educators, providers of professional learning and working teachers on the role of ICT in educational reform
Technological Pedagogical Content Knowledge (TPACK)	Schmidt et al. (2009)	The TPACK framework identifies three primary forms of knowledge that need to be integrated to effectively teach specific content using technology: Content Knowledge (CK), Pedagogical Knowledge	TRACK describes the knowledge and skills required for effective technology integration in teaching. Other important relationships

Name	Author	Focus Areas	Scope
		(PK) and Technological Knowledge (TK)	between knowledge forms include: Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK)
The Norwegian Professional Digital Competence Framework for Teachers	Kelentrić et al. (2017)	The Norwegian Professional Digital Competence Framework for teachers describes 7 key competence areas of: subjects and basic skills, school in society, ethics, pedagogy and subject didactics, leadership of learning processes, interaction and communication as well as change and development.	Each of the 7 competence areas describes the knowledge, skills and competence to meet the requirements of each competence area and/or to action plan how to reach the described requirements
The International Society for Technology in Education (ISTE) Standards for educators	ISTE (2015)	The ISTE framework for educators includes seven competencies – profiles of the teacher as Learner, as Leader, as Citizen, as Collaborator, as Designer, as Facilitator and as Analyst	The educator section of the ISTE Standards provides a road map to helping students become empowered learners. Digital capabilities are implied in each profile/role.
Educators' digital competence framework (EDC)	Siina, C. (2022)	The EDC framework identifies 20 competencies organized into four sections: Knowledge development, Knowledge application, Knowledge sharing, Knowledge communication.	The EDC framework focuses on 'mobilising digital technology for improving inclusive and quality education for all children, with an explicit focus on the most vulnerable'.

These frameworks provide an understanding of what it means to be digitally competent as an educator. Overall, the common goal of all digital competence frameworks is to improve the teaching quality of educators in the digital age, i.e. to provide teachers with the necessary skills and knowledge to effectively navigate the digital landscape, improve their teaching practices, to empower and prepare students for the demands of the digital age. Digital competence frameworks consider multiple dimensions of digital competences, including technical skills, pedagogical knowledge, critical thinking, information literacy, digital citizenship and collaboration. Furthermore, they typically organise competencies into different areas, such as digital literacy, digital communication, digital content creation, digital collaboration, digital assessment, etc. The diversity of the examined facets illustrates the complexity of the task. It implies that digital competence requires more than just technical knowledge and encompasses a set of interconnected skills and attitudes. With technologies playing an increasingly important role in education, educators not only need to be able to use technology, but also to effectively integrate emerging tools and applications in teaching towards imparting 21st century skills. Educators' pedagogic autonomy in using technology is imperative. Teachers must understand and master the pedagogical use of digital technologies, as well as their potential and limitations. Therefore, alignment with curriculum standards and pedagogical approaches is central to digital competency frameworks.

### 3. Discussion: challenges moving forward

#### 3.1. The fast pace of change

As Information and communication technologies are rapidly changing, they are transforming both the scope, and the methods and instruments of teaching and learning in formal education. The Fourth Industrial Revolution (IR4.0) is characterized by disruptive technologies, processes, and practices. The educational paradigm that emerged ("Education 4.0") is challenging core assumptions of traditional education. Education 4.0 is increasingly enabled, supported, and guided by technologies such as **artificial intelligence (AI), machine learning (ML), data analytics, mobile technologies, robotics, Internet of**



**Things, Cloud Computing, Big Data Analytics**, etc. (González-Pérez & Ramírez-Montoya, 2022; Huk, 2021). The Fourth Industrial Revolution is an ongoing process that continues to shape and evolve our world today. Possible future paradigms of education beyond Education 4.0 are constantly being discussed. Although significant strides have been made in integrating technology into education, there remains a need for comprehensive frameworks that provide guidance and support for educators to adapt their teaching practices to adapt to the changing demands of the digital age. Educators strive to keep up with the rapid pace of change. As a result, developing and implementing frameworks to support teachers and schools in preparing for Education 4.0 and Industry 4.0 is an ongoing challenge. New technologies and trends are constantly emerging, making it difficult to create comprehensive and static frameworks that remain relevant over time.

The recently accelerated pace of technological advances makes it difficult to develop frameworks that can keep up with the evolving landscape. The rise of **generative AI** (such as ChatGPT) is having far-reaching implications for pedagogy and teaching practice, raising ethical concerns related to issues such as bias and privacy, and highlighting the importance of critical thinking (Lim et al., 2023). As technologies advance, it is expected that more frameworks and resources will be needed to help educators effectively adapt their practices to meet the evolving needs.

### 3.2. The emotional challenges of distance learning

The recent COVID-19 pandemic has demonstrated the need to strengthen the resilience of education systems (UNESCO, 2020). Resilience and flexibility have become key to adapting and forward planning. Overall, a distance learning educator should be able to effectively support student learning and development in a virtual or remote environment. In terms of educators' competences, beyond a strong understanding of the various technologies and tools used in distance learning, this also calls for pedagogical skills for online and remote learning environments, including the ability to effectively communicate with students online, and the skills and strategies to create a positive and safe learning environment, to manage student behaviour, and to maintain an organised and effective virtual classroom. Educators should have the competences needed to create and facilitate engaging and interactive online learning experiences for students.

Furthermore, they should have the ability to address potential challenges of distance learning. The COVID-19 pandemic demonstrated that ensuring learning continuity goes beyond the mere adoption of distance learning modalities. Increased dependence and exposure to the use of technology for distance education can jeopardise the **well-being of individuals** as the boundaries of school and personal life are harder to maintain and negatively-associated outcomes and side-effects of technology use may arise, such as **stress from technology use (technostress)** (Tarafdar et al. 2007). The lack of awareness, capacity and professional skills in teachers for the design and implementation of positive distance learning interventions represents a significant barrier, yet a comprehensive approach to training for **eLearning positivity** is lacking. To increase the preparedness and capabilities to avert such negative aspects of distance learning, new capabilities must be created. In this light, the aspects of positive psychology/positive computing, as a means for teachers to create positive views, emotions, and atmospheres in times of crisis, emerge as a necessary skill to address psychological/emotional aspects of distance learning.

## 4. Conclusion

Digital competence frameworks should help educators develop the necessary skills, knowledge, and confidence in effectively utilising technologies in their teaching practices. Overall, teachers need a combination of **technical, pedagogical and social and emotional competencies** to harness the capabilities and better deal with the challenges of educational technologies.

### *Acknowledgements*

This research has been co-financed by the Erasmus+ programme of the European Union (project ID: 2021-1-EL01-KA220-SCH-000027978, "POSITIVE LEARN: Distance learning positification: technostress relief and wellbeing").

## References

- European Parliament and the Council (2018): COUNCIL RECOMMENDATION of 22 May 2018 on key competences for lifelong learning, CELEX: [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0604\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0604(01))
- González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: systematic review. *Sustainability*, 14(3), 1493.
- Huk, T. (2021). From education 1.0 to education 4.0-challenges for the contemporary school. *The New Educational Review*, 66, 36-46.
- Kelentrić, M., Helland, K., & Arstorp, A. T. (2017). Professional digital competence framework for teachers. *The Norwegian Centre for ICT in education*, 134(1), 1-74.
- Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. *The International Journal of Management Education*, 21(2), 100790.
- Partnership for 21st Century Learning (P21), (2019) Framework for 21st Century Learning. Battelle for Kids Network. <https://www.battelleforkids.org/networks/p21/frameworks-resources>
- Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of research on Technology in Education*, 42(2), 123-149.
- Siina, C. (2022) Educators Digital Competency Framework. UNICEF Regional Office for Europe and Central Asia (ECARO)
- Tarafdar, M., Tu, Q., Ragu-Nathan, B. S., & Ragu-Nathan, T. S. (2007). The impact of technostress on role stress and productivity. *Journal of management information systems*, 24(1), 301-328.
- United Nations (2020) Policy Brief: Education during COVID-19 and beyond. [https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg\\_policy\\_brief\\_covid-19\\_and\\_education\\_august\\_2020.pdf](https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf)
- UNESCO (2018). UNESCO ICT Competency Framework for Teachers. Version 3.0. <https://unesdoc.unesco.org/ark:/48223/pf0000265721>

# **REPRESENTATIONS OF CONSUMPTION AT THE CHOCOLATE FACTORY. A CREATIVE WRITING TEACHING PROPOSAL ON POSITIVE CONSUMERISM**

**Christina Kalaitzi**

*Department of Early Childhood Education and Care, School of Social Sciences, International Hellenic University (Greece)*

## **Abstract**

The present study consists of a critical reading of Tim Burton's adaptation of "Charlie and the Chocolate Factory", accompanied by a positive consumer attitudes' teaching proposal for early childhood education. In the first part, a theoretical framework regarding representations of consumption practices in childhood within the context of various economic and social factors is presented. The case study outlines the way the film portrays in a sarcastic way distinctive consumer manners. Discourses of gluttony, competitive eating, nutritional indifference and famine are framed. What is clearly defined by the particular cinematic adaptation of the classic novel, are the consequences these young consumers suffer due to their ill consumption attitudes. Tim Burton's surrealistic representations of consumption practices frame the child's position in a capitalist era; they seem as if they are lurking to eat the most, or to eat the fastest, or to eat what is hard to find. In the second part, a Kindergarten teaching proposal regarding the promotion of positive consumer attitudes in early ages completes this critical reading. Based on film's notions and morals, two different creative writing approaches are outlined, recommending methodological ideas of teaching consumer behavior in early stages. The contribution of this particular study is to highlight children's cinema significant role as a means of influencing children's thinking on fundamental issues related with their capacity as citizens of the 21st century.

**Keywords:** *Consumption practices, Charlie and the Chocolate Factory, Tim Burton, kindergarten creative writing teaching proposal, positive consumer attitudes.*

---

## **1. Introduction**

Contemporary cultures of consumption, focused on pleasure and immediate gratification, explain our fascination with imagery of food as magic. In addition to literal meanings of hunger and satisfaction, consumption in literature -and its cinematic adaptation- often symbolizes negotiation of authority, and appetite for food stands for desire of power and control (Andrievskikh, 2018; Cannon & Barker, 1893). In his film adaptation of 'Charlie and the Chocolate Factory' (2005), Tim Burton frames exaggerated notions of consumption and offers a view in children's attitudes as consumers. It is the story of five children, Augustus Gloop, Veruca Salt, Violet Beauregarde, Mike Teavee and Charlie Bucket, who each finds a golden ticket inside of chocolate bars winning a tour to the world's most famous chocolate factory. In the end of the tour only one child remains and inherits the factory and a lifetime supply of chocolate.

## **2. Literature review: Representations of consumption at Tim Burton's cinematic adaptation of "Charlie and the Chocolate Factory"**

### **2.1. Socio-economic inequalities in consumption practices**

*Charlie and the Chocolate Factory* portrays representations of consumption practices in childhood within the context of various economic and social factors. In a capitalist era, where consuming is a way of life, five children are presented as consumers. Some belong to the upper class, while others to the lowest class. Some can afford anything they desire, while others are starving. Even in the magical world of the chocolate factory, realism infiltrates in the form of the brutal socio-economic inequalities of a world comprised of the haves and have-nots. The film mirrors the impoverished conditions of the universal urban poor -hence the multicultural cast of characters and the absence of specific place and time of setting- in the image of the deplorable living conditions of the protagonist, who irrespective of the fact that it's his annual chocolate bar, he shares it with his entire family. In the middle of this bleak realistic depiction of impoverishment, the candy bar then transforms, from a piece of food to a piece of hope: the only warmth in that cottage (Das & Laik, 2019).

The elimination of these exact inequalities –The Inventing Room of the Chocolate Factory- is what restores the balance of the cruel capitalist framework. The source of capitalist production houses gastronomical delights with magical properties that can change and restructure configurations of reality and provide solutions to real life problems. Various forms of chocolaty mouthfuls, such as the “Everlasting Gobstoppers” that never get any smaller, the “Hair Toffee” to combat hair loss and the magic chewing gum that really is a three-course dinner in disguise, consist of a composite of solutions to the fundamental problems of humanity, thus solving problems of death, decay, loss and lack (Das & Laik, 2019).

The centrality of food in *Charlie and the Chocolate Factory* thus forms a commentary on the real economic imbalances in a society where eating becomes a primary indicator of identity as manifested in the characterization of the families belonging to different socio-economic strata (Dawn-Stephenson, 2016) - from the famished Buckets, to the greedy Gloops, to the compulsive consumer Beauregardes. The effects of confectionaries on the consumption culture are thus enunciated through the various impacts it has on these characters.

Ironically, the children's transgressions end up in their being consumed by the object of their desire and being literally and grotesquely enmeshed in what they wished to consume. Thus, Augustus comes out decked in chocolate fudge; Violet becomes physically altered to look like a blueberry as she comes out with a violet skin; Veruca is covered with nut scrapings and filth, a consequence of going through the rubbish chute, and Mike Teavee, stretched back to a thinner self resembles to the flat-screen hyper-real dimension he seems to be most invested in. Only Charlie, through eating and restraint, re-enacts the need for control and moderation, and thereby achieves a sense of gastronomical redemption by acceding to the position of the chosen one – the winner of the test of character and the ultimate inheritor of the chocolate factory. (Das & Laik, 2019).

## 2.2. A novel typology of contextualized consumption behaviors

Rees (1988) concurs that Willy Wonka is a dreadful example of the unacceptable face of capitalism. He is the owner of an enormous factory which breeds consumers. The Chocolate factory can be interpreted as the capitalist economy where every single person could be characterized by the way they consume. The factory brings every child's true self into the surface. The gluttonous devours; the competitive heads to the prize ignoring all costs; the unselfish shares in moderation and consistency.

Illicit consumption behaviors are common among children who are spoiled, greedy, bratty, selfish, disrespectful to others and their belongings, anti-social, bullies. They do not respect others' properties; they do not share; they do not offer; they do not distinguish the necessary from the luxury. On the contrary, healthy consumerism is represented by a child who consumes unselfishly, offers, respects, shares his only bar of chocolate with his two famished parents and his four ill-nourished grandparents. When most of the other children seem incapable of controlling their consuming mania, their greedy or competitive nature, their unethical ego, there is one that leaves behind his own desires to provide for his famished family. But that is "weird" as Wonka remarks in the end, weird behavior for such an era.

Zarantonello & Luomala (2011) identified the context of materialism among other contextual chocolate consumption categories in their research. On the basis of this chocolate consumption category, the nuances of chocolate consumption in *Charlie and the Chocolate Factory* film's context are explored in this research to produce/generate/present a conceptually novel typology of five contextualized chocolate consumption behaviors: gluttonous consumption; extreme consumption; competitive consumption; technological and hyper-real consumption; and positive consumption.

## 2.3. Aim of the current study

The particular study aims to explore children's cinema as a means of influencing children's thinking on fundamental issues such as consumption practices and attitudes in early ages. More specifically, representations of consumption at Tim Burton's *Charlie and the Chocolate Factory* become the medium for familiarizing preschoolers with notions of consumerism and types of consumer behaviors and, thus, teaching positive consumption behavior through creative writing approaches at preschool stage.

## 3. Methodology

### 3.1. Research approach and sampling

The particular empirical research included the observation of the population sample during their participation in a teaching intervention conducted in a Greek public Kindergarten. The sample consisted of 20 preschoolers of typical development, between the age of five and six years old, since at this age their narrative skill is developed radically into distinctive developmental stages enabling the comprehension and generation of specific structural and morphological narrative elements (Applebee, 1978).

### 3.2. Data collection tool

The focus group was chosen as a data collection tool. Preschoolers were divided into small groups of three or four members and produced narrative speech while interacting with each other. Focus groups enabled the interplay among children, the constructive influence and the exchange of prior knowledge and experience concerning familiar fairytale characters and patterns. Focus group methodology enabled a better observation of the process of narrative production in action. Each group’s narratives were recorded and transcribed by the researcher (Wilkinson, 1998).

### 3.3. Framework: A creative writing intervention on promoting preschoolers’ positive consumerism

The intervention, whose design was based on previous research (Kalaitzi, 2020), follows the objectives of the Greek New Curriculum (Institute of Educational Policy, 2014) concerning the interdisciplinary connection of the learning areas of language (creative writing) and social sciences (consumer behavior). Preschoolers participated in groups into a series of fairytale board games and plot cubes games, all of which formed activities repeated as many times as needed in order for every preschooler to produce narrative speech. All students build on their prior knowledge which included the identification and reproduction of the narrative basic structure (Applebee, 1978).

The intervention was divided in two phases. Based on the film’s consumption behaviors typology, two different creative writing approaches were used. The first phase, aiming at the comprehension and use of the intertextual hero, included activities in which preschoolers tried to discern the different consumer behaviors of *Charlie and the Chocolate Factory*’s five characters, to introduce them into Grimm’s *Hansel and Gretel* and to retell the fairytale plot including the twist caused by the film’s intertextual heroes. The second phase followed, aiming at the comprehension and use of the pattern subversion, included activities in which preschoolers tried to distinguish the fairytale pattern of the opposing pair of characters (the good and the bad) in Grimm’s *Sweet Porridge* and to subvert the pattern by replacing the protagonists with the film’s opposing pair of consumers.

### 3.4. Context analysis of preschoolers’ narrative speech

Preschoolers’ performance was evaluated through context analysis of their narrative speech, on the basis that this qualitative approach treats data as representations of text, image, expression, subject or rhetorical patterns created to be identified, analyzed and interpreted by the researcher’s personal judgment (Huckin, 2004). Specific expression patterns (Tables 1 & 2) were set before the implementation of the intervention in order to form the data for identification, analysis and interpretation by the researcher. In particular, the clear and concise reference to a film’s character -introduced in Grimms’ *Hansel and Gretel* - while adopting a discrete consumer behavior, was identified as the narrative element of the intertextual hero. Similarly, the reversal of the Grimms’ *Sweet Porridge* pattern of the good and the bad opposing pair of characters was identified as the narrative element of the pattern subversion under the condition that the replacement of the opposing protagonists with the film’s opposing types of consumers leads to a new sequence of events.

Table 1. Expression patterns of the intertextual hero and plot twist identified in preschoolers’ narrative speech during the creative writing intervention.

Narrative element	Expressi on pattern	Example of narrative speech	Expression pattern identified
Intertextual heroes & plot twist	Attributing a consumer behavior to the film character	<p><i>Transcription 1</i></p> <p><i>Veruca gave the Witch a huge bag of gold to buy the gingerbread house with all candies. She didn’t eat the candies. All she wanted was to have them all for herself. Then she kept Hansel and Gretel with her and she made them her own servants without sharing any candy with them.</i></p> <p>.....</p> <p><i>Charlie offered himself to the Witch in exchange of letting Hansel and Gretel free. The Witch felt sorry for all three children and gave them all candies. Charlie proposed to share the candies, and some sell them on the market. They all earned money and filled their tummies.</i></p>	<p>Attribute a consumer behavior to the intertextual film character:</p> <p><b>“All she wanted was to have them all for herself [...] she made them her own servants without sharing any candy with them.”</b></p> <p>...</p> <p><b>“Charlie proposed to share the candies, and some sell it on the market.”</b></p>

Table 2. Expression patterns of the opposing pair pattern subversion identified in preschoolers' narrative speech during the creative writing intervention.

Narrative element	Expression pattern	Example of narrative speech	Expression pattern identified
<b>Pattern subversion</b>	<b>Replacing protagonists with the opposing consumers pair pattern</b>	<p style="text-align: center;">Transcription 2</p> <p><i>Once upon a time two siblings, Mike and Charlie lived together. They were very poor and hungry. One day an old granny asked them for a glass of water and for exchange she gave them a magic pot. This pot could make sweet porridge non-stop. Charlie asked just for a single bowl of sweet porridge and he ate it. He was hungry no more and he was happy. Mike started thinking that if they make some adjustments to the magic pot, it will make more than porridge. With his tools he started knocking and banging the pot until it broke into pieces. He got furious and he stormed out. Charlie, glued back the pieces and asked for sweet porridge in order to feed his poor neighbors too. The magic pot started working again but only for Charlie who was always grateful and sharing with food.</i></p>	<p>Replace of the good and the bad pair with the opposing consumers' pair:</p> <p><b><i>“Charlie asked just for a single bowl of sweet porridge and [...] He was hungry no more and he was happy.”</i></b></p> <p><b><i>“Mike started thinking [...] it will make more than porridge. With his tools he started knocking and banging the pot until it broke into pieces.”</i></b></p>

All data collected were interpreted as representations of text and the above expression patterns were analyzed as indicators of the narrative elements of the intertextual hero and the pattern subversion detected in the text produced. Preschoolers' narrative speech that was produced during the intervention was audiotaped and transcribed. For the purposes of this article a small token of the narrative speech transcripts was translated and adapted from Greek to English by the researcher. Both the examples of narrative speech and the identified expression patterns are included in Tables 1 & 2.

#### 4. Discussion

Discourses of gluttony, competitive eating, nutritional indifference and famine are framed. What is clearly defined by the particular cinematic adaptation of the classic novel, are the consequences these young consumers suffer due to their ill consumption attitudes (Downing, 2005). Tim Burton's surrealistic representations of consumption practices frame the child's position as a consumer in a capitalist era (Nivetha, 2019); they seem as if they are lurking to eat the most, or to eat the fastest, or to eat what is hard to find.

In Burton's cinematic adaptation, children are themselves ridiculed due to their consumption practices in a similar manner as the adults' control, which is forced upon the child's perception of nourishment that is always overthrown, ridiculed and defeated in Dahl's novels (Kalaitzi & Gavriilidis, 2019).

The extreme punishment of unhealthy consumption behavior in this particular cinematic adaptation ends with a surrealistic reintegration into an acceptable regularity (Davis, 2009): the positive consumerism wins, but in the same time this victory is questioned by the face of capitalism, Willy Wonka himself.

As marvelous and magical the food appearing out of thin air, Mr. Wonka's factory might seem to be serving the purpose of educating children about the commercial aspects of consumption (Davis, 2009). By portraying distinctive and extreme types of consumption behaviors, *Charlie and the Chocolate Factory* could be served as a medium for promoting positive consumer attitudes. The cinematic adaptation in particular might be considered as an even more approachable medium for early ages than the novel, since it combines narration, sound and motion picture.

The intervention showed that preschoolers are able to distinguish the different types of consumer behavior and use them in their intertextual characters arc. What is more, a consistency between the characters profile as a particular consumer type and their actions within the plot was noted. More specifically, the narratives produced during the creative writing activities included gluttonous consumers, greedy consumers, competitive consumers, hyper-real consumers and healthy consumers. These five types of consumers affected the plot in totally different ways, causing the corresponding plot twists and pattern subversions of classic fairytales. What should, also, be noted is that preschoolers' metafictional attribute all negative effects in consumers' profile, while they clearly highlight positive consumerism's benefits.

## 5. Conclusion

The contribution of this particular study to the field of scholarly approaches of children's cinema is to highlight its significant as an -approachable to early years- means of influencing children's thinking on fundamental issues related to their capacity as consumers in the capitalist era and to prove creative writing's dynamics as a teaching tool for provoking young children's imaginative expression on attitudes towards behavior matters.

## References

- Applebee, A. N. (1978). *The child's concept of story*. Chicago: University of Chicago Press.
- Andrievskikh, N. (2018). Sugar-Coated Fairy Tales and the Contemporary Cultures of Consumption. In P. Greenhill, J.T. Rudy, N. Hamer & L. Bosc (Eds.), *The Routledge Companion to Media and Fairy-Tale Cultures*. London & New York: Routledge.
- Cannon, K. L., & Barker, J. M. (1893). Hard Candy. In P. Snickars & P. Vonderau (Eds.), *Moving Data. The iPhone and the future of media* (73-88). New York: Columbia University Press.
- Das, A., & Laik, S. (2019). Eating Sugar: Gastronomical Narratives in Children's Literature. *heb-nic. in/cass-studies*, 3 (1), 13-22, CASS-ISSN:2581-6403.
- Davis, R. B. (2009). *Exploring the Factory: Analyzing the Film Adaptations of Roald Dahl's Charlie and the Chocolate Factory* (Thesis). Retrieved from: [https://scholarworks.gsu.edu/cgi/viewcontent.cgi?article=1071&context=english\\_theses](https://scholarworks.gsu.edu/cgi/viewcontent.cgi?article=1071&context=english_theses)
- Dawn-Stephenson, A. (2016). *The constructions of authorship and audience in the production and consumption of children's film adaptations* (Doctoral dissertation). Retrieved from: <https://eprints.soton.ac.uk/393687/1/Amanda%2520Stephenson%2520phd.pdf>
- Downing, L. (2005). Media Synergies and the Politics of Affect in Tim Burton's Charlie and the Chocolate Factory (2005). *M/C Journal*, 8(6).
- Huckin, T. (2004). *What writing does and how it does it: An introduction to analyzing texts*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- Institute of Educational Policy. (2014). *21st Contemporary school – New Curriculum* (Horizontal Act MIS: 295450, Subcontract 1 “Implementation of Curriculum in Compulsory Education”). Athens: Hellenic Ministry of Education and Religious Affairs.
- Kalaitzi, C. (2020). Creating contemporary picture short stories using intertextual heroes and plot subversion. An empirical research. In M. Carmo (Ed.), *Education Applications & Developments V*, Lisboa: InScience Press, Retrieved from: <http://press.insciencespress.org/index.php/press/catalog/book/21>
- Kalaitzi, C., & Gavriilidis, S. (2019). A reading of contemporary short stories dealing with food and humour. *Studying humor - International journal*, 6. Retrieved February 4, 2022, from: <https://ejournals.lib.auth.gr/humour/article/view/6905>
- Nivetha, S. (2019). Pornographic Dimensions of Food, Culinary Practices and Consumption in Tim Burton's Charlie and The Chocolate Factory. *heb-nic. in/cass-studies*, 3 (1), 104-109, CASS-ISSN:2581-6403.
- Rees, D. (1988). Dahl's chickens: Roald Dahl. *Children's Literature in Education*, 19, 143–155.
- Wilkinson, S. (1998). Focus group methodology. A review. *International Journal of Social Research Methodology*, 1(3), 181-203.
- Zarantonello, L., & Luomala, H. T. (2011). Dear Mr. Chocolate: Constructing a typology of contextualized chocolate consumption experiences through qualitative diary research. *Qualitative Market Research*, 14 (1), 55-82.

# DIGITAL CREATIVITY ABILITIES FOR DESIGNING SUSTAINABLE AND FAIR FUTURES. REFLECTING ON THE RESULTS FROM THE DM LEARNING LAB MADEIRA

**Valentina Vezzani**

*Department of Art & Design, University of Madeira / ID+ (Portugal)*

## Abstract

The ever-changing digitally enabled world we live in requires preparing young creatives and entrepreneurs with more suitable abilities and set of skills to face the challenges of ongoing digital transformations. The Erasmus+ funded project DC4DM aims to implement a human-centred educational model to train Digital Maturity Enablers. This new type of professionals would be able to drive small and medium organisations towards their digital maturity: owning specific creative digital skills, they would be able to extract value from what the technological landscape offers and respond to the human needs through the principles of ethics and sustainability. This paper aims to describe the DC4DM educational model and share some aspects of its first application at the *DM Learning Lab 'Feeding Madeira'*, a 10-days design-led workshop on the island of Madeira in July 2022. The workshop gathered 36 university students, diverse for country of origin and study background, 6 start-ups, and several local mentors and stakeholders to co-design 6 compelling future scenarios for the island of Madeira where digital technologies are enablers for the sustainable development. Finally, the paper reflects on summarised learnings from the *LLab1*, particularly from the educators' perspective.

**Keywords:** *Digital creativity, digital maturity, digital creativity abilities, HE education, design education.*

## 1. Training the Digital Maturity Enabler to shape sustainable and just futures

“As globalization and rapid advancements in technology continue to transform civic space and the world of work, education systems have grown increasingly disconnected from the realities and needs of global economies and societies” (WEF, 2020). The WEF’s Schools of the Future report (2020) highlights the need for new education models capable of responding to the new drivers of growth introduced by the Fourth Industrial Revolution (4IR) (WEF, 2020). The emerging technologies of our century – such as Artificial Intelligence, Machine Learning, IoT, Virtual Reality – are transforming the industrial economy requiring companies to start a process of digitalisation and transformation toward Digital Maturity (Canina & Bruno, 2021). As suggested by the EU *Digital Skills and Jobs Coalition* (EC, 2023), the WEF *Reskilling Revolution* (WEF, 2023), and the WEF’s *Future of Jobs Report 2020* (WEF, 2020), upskilling work force is key, particularly focussing on digital skills along with human skills such as complex problem solving, strategic and creative thinking, critical thinking, emotional intelligence, communication and negotiation, relationship and network building abilities (Canina & Bruno, 2021). Today’s education systems must provide new generations with this mix of ‘hard’ skills, such as technology design and data analysis, and ‘human-centric’ skills, such as cooperation, empathy, social awareness, and global citizenship, to enable learners to shape future inclusive and equitable societies (WEF, 2020). In the context of Higher Education, also, great change is required, particularly design and engineering education should co-evolve with the human, technological and cultural evolution considering that digital transformation is changing people’s mindsets, behavioural and social attitudes; also, all emerging digital technologies are changing the process of creating and innovating (Bruno & Canina, 2019). In this context, the Erasmus+ funded project “*Digital Creativity for developing Digital Maturity future skills*”<sup>1</sup> aims to implement and disseminate a human-centred educational model able to develop and empower digital creative abilities to strategically drive the application of future emerging digital technologies in any fields, achieving a Digital Maturity. The DC4DM project wants to provide HE educators and companies with a suitable set tools and methods to train and nurture the *Digital Creativity Enabler*, a digitally wise professional whose role is to interpret the digital landscape and suggest SMEs strategic paths towards innovative and sustainable solutions.

<sup>1</sup>DC4DM – Digital Creativity for developing Digital Maturity future skills is a three-year project funded by ERASMUS+ Programme - Key Action: Cooperation for innovation and the exchange of good practices. Project Ref: 2020-1-IT02-KA203-079913 [www.dc4dm.eu](http://www.dc4dm.eu)



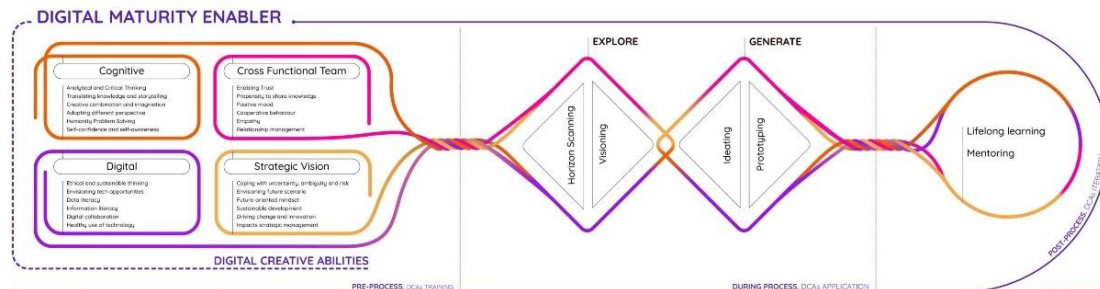
Through *Digital Creativity Abilities (DCAs)*, this professional can creatively extract value out from what the technological landscape offers while responding to human needs in an ethical and sustainable way. A *DM Enabler* has got either a design, engineering or managerial background and owns competencies such as: (a) Understanding technology potentialities and designing digital solutions through a human-centred design approach. This also requires consciously understanding and applying new technologies with full awareness of their potential impact from a social, ethical, economic, and environmental perspective. (b) Working smoothly within cross-functional teams. This means being able to communicate effectively with people coming from different disciplinary fields and developing a shared digitally minded culture. (c) Navigating and tackling complexity and uncertainty. (d) Envisioning possible future scenarios and defining long-term strategies by taking into consideration both opportunities and risks that digital technologies might generate.

## 2. The DC4DM educational model

Up-skilling future generations of creatives and entrepreneurs to proactively face the ongoing radical changes and deal with such ever-emerging digital challenges, means to encourage their awareness and understanding on core topics such as sustainability, technology foresight, cross-functional collaboration, data collection and sense-giving. The DC4DM educational model aims to support the development of a new set of skills to enhance their creative abilities while enabling them to spot and exploit the viable potentialities of emerging technologies. In a world where complexity – of information, knowledge, problems or challenges – is destined to simply increase, human creativity remains as an essential ability to successfully navigate it.

The DC4DM model (*Figure 1*) is based on three sequential phases: (1) the *pre-process* concerns the training of those types of knowledge and skills that are propaedeutic for the DM Enabler to go through the whole process; the training basically starts from developing the *DCAs*. (2) The *process* is based on a divergent-convergent Future Design Thinking approach; this phase aims to guide the DM Enabler through the design of new digital solutions with a projection toward the future. (3) The *post-process* consists in supporting the DM Enabler in iterating and continuing to add value to their abilities.

Figure 1. Training of the Digital Maturity Enabler through the DC4DM model.



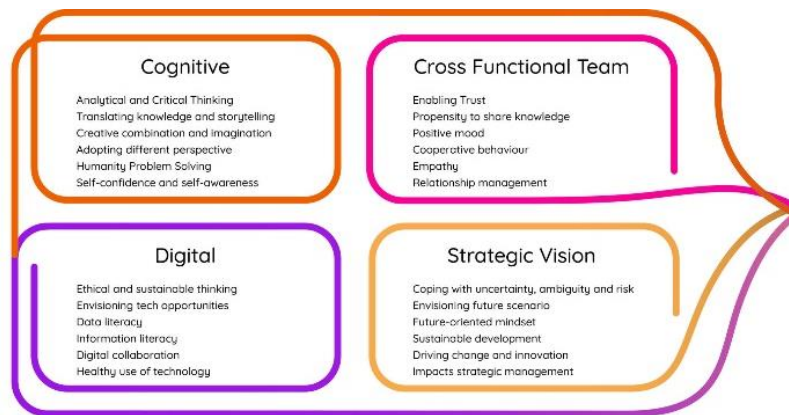
DM Enablers possess *Digital Creative Abilities (DCAs)* grouped according the Cognitive, Digital, Cross-functional Team, Strategic Vision dimensions. Such DCAs help DM Enablers to navigate disruption, make sense of complexity, and deal with uncertainty to envisage the medium and longer-term futures (5-15 years) of social and technology environments [9]. These DCAs are useful to face the ongoing digital transformation, because they include not only a broad range of skills (cognitive, social, emotional, etc.), but also disciplinary and procedural knowledge, attitudes and values that can guide a person to face the complexity of today and tomorrow’s challenges (*Figure 2*).

The DC4DM educational model intends to train these future talents through some foundation concepts, called *drivers*. These foundation concepts have the power to drive the creative process towards positive innovation and change. The drivers which have been identified as fundamental today and have been proposed in the DC4DM toolkit, are three and are: Tech-foresight, Ethics, and Sustainability. New drivers, as also new DCAs, may be identified according to the changes in the technological, socio-political, economic and environmental landscapes. In fact, to train Digital Maturity Enablers means also to constantly update what should drive the future digital talents and their creative process.

The DC4DM project includes different activities to transfer the DM method and tools within a European network of HEIs, SMEs and Startups, Business Incubators. On one side the *Digital Maturity* and *DM Sharing Days* act as informative events; on the other, the *Learning Labs (LLab)* consist in intensive design sessions where to provide the participants with suitable training and mentoring towards the development of the key digital creativity competencies. At *LLabs* students, SMEs & Start-ups get to work together on a given design challenge using those DC4DM methods and tools which make sense for the participants’ level of

experience, the selected theme and duration of the workshop itself. Finally, *LLabs* are also an opportunity for educators to learn how to use the DC4DM model and build experience in facilitating and teaching practices towards digital maturity.

Figure 2. The 24 Digital Creativity Abilities currently identified to prepare the next generation of DM Enablers.



The DC4DM model is product of research and testing which started already with the EU project Digital DIY (Digital Do It Yourself, 2023; Salvia et.al., 2016), and in order to become a practical and usable methodology for educators, companies, and individual learners, it was tested three times through three different *LLabs*: [LLab1] “Feeding Madeira” at Universidade da Madeira, Funchal (Portugal), July 2022; [LLab2] “Mobility” at Télécom Saint-Etienne, Saint-Etienne (France), November 2022; [LLab3] “Futuring Care” at Politecnico di Milano, Milan (Italy), February 2023. The three *LLabs* had in common the following objectives: to allow to learn about digital transformation; to guide participants to create a working environment that enhances the value of individuals, increasing personal motivation and fostering integration with other members of the group; to identify the main parts and procedures of a *training format* to be applied for the organisation of new *LLabs*. The three *LLabs* were organised and run differently because the goal was to understand how flexible and adaptable each part and phase of the model is; how to involve SMEs and Startups along the process to bridge their needs with the training objectives; and finally, how to engage students coming from different disciplinary background along the whole process. By organising and running three *LLabs* became clearer how critical the definition of the *training format* elements and instructions is, so as to adapt the DM process according to the type of participants and learning goals. Just to mention few elements: how to set up the working space; how to engage both students and companies throughout the process; how to build cross-functional teams which will work smoothly; how to select mentors capable to stimulate the participants’ thinking process; how to facilitate multidisciplinary teams; how to communicate tasks and tools in a clear and effective way.

## 2.1. The DM Learning Lab 1 “Feeding Madeira”

In the context of a small island in the Atlantic Ocean such as Madeira, the delicate balance between human needs and the availability of natural resources is under constant threat. This requires preparing future generations of creatives and entrepreneurs with the right mindset and skills to collaborate and ideate opportunities for sustainable futures. Today the goal is to learn to design and implement systems that can be distributive and regenerative, to benefit individuals and communities, local economies and the environment. The role of digital technologies is considered fundamental in this process of rethinking the way we design and implement future sustainable scenarios. Digitalisation is advocated in the scientific literature and public debate as an enabler and accelerator for the transition to a circular economy (Piscicelli, 2023).

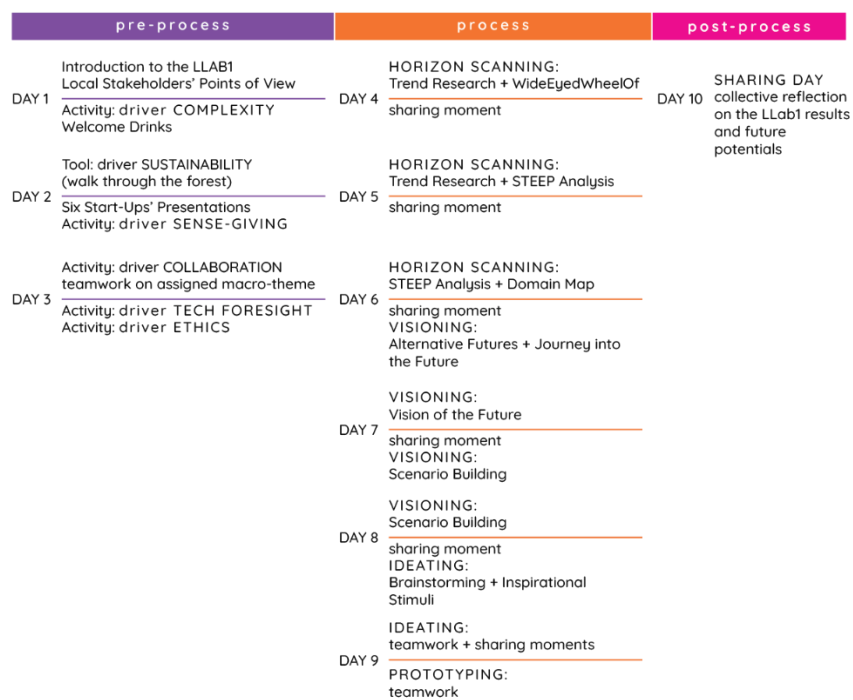
The *LLab1* “Feeding Madeira. Regenerative and Distributive Food Systems for Sustainable Island Futures” tried to challenge the participants in thinking about the island as a testbed for sustainable and potentially circular systems where digital technologies can enable the shift towards distributive and regenerative local food systems. Following the experience of the ‘Atlantic Wonder’ research activities (Bertolotti & Vezzani, 2021; Vezzani et al., 2019), the participants were invited to respond creatively to the general challenge through the lens of one of the following macro-themes: (1) *Agrobiodiversity* is our safety net; (2) *Forest & Water* as island life-blood; (3) *Pollinators* our saviours; (4) *Waste* as opportunity.

The *LLab1* involved 36 masters and undergraduate students from Politecnico di Milano, Télécom Saint-Etienne, Mines Saint-Etienne and Universidade da Madeira, with diverse study backgrounds in the areas of design, engineering and organic agriculture. Organised into six multidisciplinary and multicultural teams, the participants encountered numerous and diverse local stakeholders able to stimulate their understanding of the island challenges concerning sustainable development. Six local start-ups were selected, each one assigned

to one of the teams, to become part of this creative process towards Madeira’s digital transformation. The *LLab1* programme (Figure 3) was defined by interpreting the *pre-process* and *process* phases according to the special location and the focus on sustainability. In fact, compared to the other two *LLab* locations, the island of Madeira differs in terms of type of economy, resources and industrial development. The natural and rural character of the location obliged to focus first on the meaning of sustainable development and how to bring together the different types of expertise and knowledge which would allow to achieve it. The digital technologies indeed were presented to the teams as a means to foster that cooperation of expertise, encourage a new more-than-human perspective within the local population, imagine tech-solutions to boost a local regenerative economy which would care about the future of communities and natural ecosystems. The six teams were provided with a set of learning activities and tools to: (1) develop individual and team abilities in managing complexity and collaboration [*pre-process*] and (2) design future scenarios enhanced by digital technologies [*process*]. These activities and tools were shared through an open-access MiroMultiverse board<sup>2</sup> and Guidelines (DC4DM, 2023).

Finally, the six teams presented their ideas of sustainable future for the island of Madeira at the *Sharing Day*. This public event gathered the six start-ups, as some representatives from the public sector, local NGOs, and scholars to encourage a local conversation on digital technologies as leverage of positive change towards possible sustainable futures for the island.

Figure 3. The *LLab1* programme and activities. The scheme aims to highlight the adaptability of the *DM* model according to learning objectives, types of participants and main challenge.



### 3. Reflecting on what training the future digital talents means

The *LLab1* was special, not only because it was the first opportunity for the DC4DM consortium to reflect on the *DM* model and *training format*, but especially because it demonstrated that the learning experience can expand beyond a big group of international students and involve a local community, made of scholars, start-ups, staff from the public sector and even NGOs. Connecting a great diversity of people, types of expertise and points of view, beyond the dimension of each team, meant to boost those individual *Digital Creativity Abilities* specifically belonging to the ‘Cognitive’ dimension (Analytical and Critical Thinking; Translating knowledge and storytelling; Creative combination and imagination; Adopting different perspectives; Humanity Problem Solving; Self-confidence and self-awareness) and the ‘Cross-Functional Team’ dimension (Enabling Trust; Propensity to share knowledge; Positive mood; Cooperative behaviour; Empathy; Relationship management). It can be said that this first opportunity to test a set of activities, methods, tools that till that time was simply a theoretical model, allowed the educators who facilitated the teamwork and future-thinking process, to reflect on the importance of a collective effort in preparing young

<sup>2</sup>*MiroMultiverse* has been identified as the open collaborative platform through which share the DC4DM model and Toolkit. The final version will be accessible at <https://www.dc4dm.eu/model-and-tools/> from August 2023.

people to the challenges of the future, so that they can go through the design process quite smoothly. In fact, the *LLab1* showed how the human and relational skills concerning emotional intelligence, network building, communication and negotiation are even more important when the learners come from various disciplinary backgrounds and experiences, and present different levels of capacity in projecting themselves and their creative ideas towards the preferable, the probable, the plausible, the possible future (Voros, 2022).

Finally, on a *DM model* and *training format* level, new improvements were considered to: (a) simplify the process steps and quantity of methods and tools to offer; (b) turn some of the language less technical and make the toolkit more accessible; (c) involve the SMEs and Start-Ups more along the design process so that the learning process can be indeed shared and reciprocal.

The DC4DM project will conclude next August 2023 with the online publication of the *EDUbox*, a container of open-source educational materials for a *Digital Maturity Community* to expand. The DC4DM educational model has been designed to keep evolving according to ever changing digital scenarios and learning needs. New educators and trainers interested in preparing future creative talents to face the challenges of our world are invited to become part of the *DM Community* and contribute with their knowledge and expertise. In fact, “in the end, it all comes down to people and values. We need to shape a future that works for all of us by putting people first and empowering them. In its most pessimistic, dehumanized form, the Fourth Industrial Revolution may indeed have the potential to “robotize” humanity and thus to deprive us of our heart and soul. But as a complement to the best parts of human nature—creativity, empathy, stewardship—it can also lift humanity into a new collective and moral consciousness based on a shared sense of destiny. It is incumbent on us all to make sure the latter prevails” (Schwab, 2016).

## References

- Bertolotti, E. & Vezzani, V. (2021). Walk, talk and draw: Fieldwork in nature to unpack the complexities of sustainability. In *Proceedings of the 14th International Conference of the European Academy of Design, Safe Harbours for Design Research*, pp. (199-216). doi: 10.5151/ead2021-136
- Bruno, C., & Canina M. R. (2019). Creativity 4.0. Empowering creative process for digitally enhanced people. *The Design Journal*, 22(1), 2119-2131.
- Bühring, J. & Liedtka, J. (2018). Embracing systematic futures thinking at the intersection of Strategic Planning, Foresight and Design, *Journal of Innovation Management JIM*, 6(3), 134-152.
- World Economic Forum. (2020). *Schools of the Future. Defining New Models of Education for the Fourth Industrial Revolution* (REF 09012020). Geneva, Switzerland: WEF. Retrieved March 13, 2023, from [https://www3.weforum.org/docs/WEF\\_Schools\\_of\\_the\\_Future\\_Report\\_2019.pdf](https://www3.weforum.org/docs/WEF_Schools_of_the_Future_Report_2019.pdf)
- Canina, M. R., & Bruno, C. (2021). Design and Creativity for Developing Digital Maturity Skills. In H. Grierson, E. Bohemia, & L. Buck (Eds.), *Proceedings of the 23rd International Conference on Engineering and Product Design Education (E&PDE 2021)*. doi: 10.35199/EPDE.2021.46
- Canina, M. R., & Bruno, C. (2021). Digital Creative Abilities for Achieving Digital Maturity. In S. Nazir, T. Z. Ahram, & W. Karwowski (Eds), *Advances in Human Factors in Training, Education, and Learning Sciences. AHFE 2021. Lecture Notes in Networks and Systems*, vol 269. Springer, Cham. doi: 10.1007/978-3-030-80000-0\_4
- Digital Do It Yourself* (n.d.). Retrieved March 10, 2023, from <http://www.didiy.eu/>
- DC4DM Consortium. (2023). *DM Toolkit Guidelines*, Retrieved March 13, 2023, from <https://www.dc4dm.eu/wp-content/uploads/2022/11/DM%20Toolkit%20Guidelines.pdf>
- European Commission. (n.d.). *The Digital Skills and Jobs Coalition*. Retrieved March 13, 2023, from <https://digital-skills-jobs.europa.eu/en/about/digital-skills-and-jobs-coalition>
- Piscicelli, L. (2023). The sustainability impact of a digital circular economy. *Current Opinion in Environmental Sustainability*, 61. Elsevier. <https://doi.org/10.1016/j.cosust.2022.101251>
- Salvia, G., Bruno, C., & Canina, M. R. (2016). Digitally making as an opportunity for skilling and empowerment. In *This Place: Cumulus Association Biannual International Conference* (pp. 105-110).
- Schwab, K. (2016). *The Fourth Industrial Revolution: what it means, how to respond*. Retrieved March 10, 2023 from [www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/](http://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/)
- Vezzani, V., Gonzaga, S. & Bertolotti, E. (2019). Atlantic Wonder. Exploring Nature and Design in Madeira Island. *The Design Journal*, 22(sup1), 1603-1617, DOI: 10.1080/14606925.2019.1594994
- Voros, J. (2022). *A primer on Futures Studies, foresight and the use of scenarios*. Retrieved March 10, 2023 from <https://thevoroscope.com/publications/foresight-primer/>
- World Economic Forum (2023). *Reskilling Revolution*. Retrieved March 13, 2023, from <https://initiatives.weforum.org/reskilling-revolution/home>
- World Economic Forum. (2020). *The Future of Jobs*. Geneva, Switzerland: WEF. Retrieved March 13, 2023, from <https://www.weforum.org/reports/the-future-of-jobs-report-2020>

## LIFE SCIENCES TEACHERS' PLANNING OF LESSONS FOR FORMATIVE ASSESSMENT IN INQUIRY-BASED TEACHING

**Thandiwe Dlamini, & Umesh Ramnarain**

*Department of Education University of Johannesburg (South Africa)*

### Abstract

Formative assessment (FA) is considered one of the most powerful tools to enhance learning and influences the development of inquiry skills. However, few studies have addressed how Life Sciences teachers plan for formative assessment in inquiry-based teaching. A lesson plan is one of the crucial tasks for any science teacher since it assists in the presentation of a lesson. Lesson plans show how students will be moved toward obtaining specific objectives. This paper reports on five grade 10 Life Sciences teachers' planning for formative assessment in inquiry-based teaching. The ESRU framework guided this study. The ESRU cycle consists of four elements; the teacher elicits (**E**) questions to check students' ideas, the student (**S**) response, the teacher recognises (**R**) the students' response, and then uses (**U**) the student's response to promote learning. The ESRU comprises complete and incomplete cycles. A complete cycle is when all four elements are visible and incomplete if Elicit, Student response, and Recognise; or only Elicit and Student response. The lesson plan analysis looked at the ESRU cycles' elements in the questions planned to see if the questions were focused on the epistemic or conceptual dimensions. It also looked at how the entire lesson was planned. This research is a part of a more extensive qualitative study where data was collected through lesson observations, interviews, and lesson plans. The study was conducted to describe teachers' formative assessment practices in inquiry-based pedagogy. This paper reports only on lesson plans. One lesson plan was requested per teacher. Participants were purposively selected based on their teaching of the subject and conveniently sampled according to their proximity to the researcher's residence. Findings from all five teachers are as follows; when planning a lesson, it was evident that the five teachers planned for FA. In terms of ESRU, Eliciting and Using strategies were evident in the planned questions. The Student's response was not included when planning since it is the students' responses during the lesson and can only be captured when the teaching is happening. The Recognising strategies were also not included in the lesson plans since they depend on learners' responses. Four teachers planned more questions focused on epistemic than conceptual structures. The findings signal that there is still a need to train teachers to plan lessons that focus equally on conceptual and epistemic dimensions.

**Keywords:** *ESRU, formative assessment, lesson plan, inquiry-based.*

---

### 1. Introduction

There has been a call globally for science education to include 'inquiry' in science education (NRC, 2000). This has led to many countries reviewing their curricula and including inquiry-based teaching and learning. In the South African context, a lot is being done to amend policies to align with the 21st century, including inquiry-based teaching and learning (DBE, 2011). Scientific inquiry refers to "the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work" (NRC, 1996, p. 23). Inquiry Science-Based Education (IBSE) has been promoted as an inspiring way of learning science by engaging pupils in designing and conducting scientific investigations (van Uum, Verhoeff, & Peeters, 2016). Inquiry-based science teaching (IBST) is one of the strategies that can be used to teach science. IBST and formative assessment (FA) support the construction and development of knowledge through continuous assessment (Harlen, 2013). FA is defined as a continuous and cyclical process of gathering evidence about student learning and using that evidence to guide students' learning process through clear and detailed instruction and feedback (Black & Wiliam, 1998). FA is a pedagogical vehicle that skilled teachers commonly use to support their students in learning scientific practices and content (Dini, Sevian, Caushi, & Picón, 2020). Teachers cannot practice inquiry-based approaches in the classroom without using FA practices. FA is essential in

inquiry-based teaching since it allows teachers to ask learners questions when doing experiments or learning about specific content (Harlen, 2004). However, the value of inquiry-based teaching and learning and implementing such a pedagogical practice continue to be challenging for many South African teachers (Ramnarain & Hlatswayo, 2018). Therefore, there is a need to research how teachers plan lessons for formative assessment in inquiry-based teaching.

The framework that guided this study is the ESRU framework. Ruiz-Primo and Furtak (2007) developed the ESRU cycle of FA where a teacher elicits (E) questions to check students' ideas, then student (S) response, the teacher recognises (R) the students' response and then uses (U) the students' response to promote learning. The ESRU cycle can be considered a 'complete' cycle if all four elements of ESRU features are visible (Elicit, Student response, Recognize and Use) and 'incomplete' if not all the features of the ESRU are included (Elicit, Student response, and Recognize; or only Elicit and Student response in a single dialogue. This Framework was applied in the lesson plans; the focus was to see how the teacher prepares questions for Elicits and Uses when planning a lesson. Questions to Elicit and Use are essential to be included in the planning of lessons, because when the teacher Elicits a question, this allows learners to share information about what they are thinking or their understanding of a concept (Ruiz-Primo & Furtak, 2007). The Student's response is not included when planning since the students' responses can only be captured when the teaching is happening. The Recognising strategies are also not included in the lesson plans since they depend on learners' responses. The framework was also applied to the study to see if the planned questions focused on the epistemic or conceptual dimensions.

Ruiz-Primo and Furtak (2007) analysed the type of inquiry promoted during the ESRU cycles. Their model involves three main inquiry dimensions: epistemological, conceptual, and social. Regarding Eliciting questions, the eliciting strategies were analysed according to the epistemic and conceptual dimensions (See Table 1). Strategies for ESRU cycles by dimension. Epistemic structures are the knowledge frameworks that involve science rules and criteria of what counts as science: experiment, hypothesis, or explanations (Duschl, 2000, 2003). Epistemic structure focuses on developing and evaluating scientific reasoning. Conceptual structures are used when reasoning scientifically and focus on a deep understanding of concepts and principles, while *social processes* focus on how knowledge is communicated. According to Ruiz-Primo and Furtak (2007), both epistemic and conceptual structures are essential in helping learners to use the knowledge comprehended effectively in appropriate situations.

Table 1. Strategies for ESRU cycles by dimension (Ruiz-Primo & Furtak, 2007).

Eliciting	Recognising	Using
<p><b>Epistemic frameworks</b></p> <p>Teacher asks students to:</p> <ul style="list-style-type: none"> <li>• Compare/contrast observations, data, or procedures.</li> <li>• Use and apply known procedures.</li> <li>• Make predictions/provide hypotheses</li> <li>• Interpret information, data, patterns</li> <li>• Provide evidence and examples</li> <li>• Relate evidence and explanations</li> <li>• Formulate scientific explanations</li> <li>• Suggest hypothetical procedures or experimental plans</li> <li>• Compare/contrast others' ideas</li> </ul> <p><b>Conceptual framework</b></p> <ul style="list-style-type: none"> <li>• Check students' comprehension</li> </ul> <p>Conceptual structures Teacher asks students to: Provide</p>	<p>Teacher:</p> <ul style="list-style-type: none"> <li>• Clarifies/Elaborates based on students' responses</li> <li>• Promotes students' thinking by asking</li> <li>• Takes notes to acknowledge different students' ideas.</li> <li>• Repeats/paraphrases students' words</li> <li>• Revoices students' words (incorporates students' contributions into the class conversation, summarises what student said, acknowledge student contribution)</li> <li>• Captures/displays students' responses/explanations</li> <li>• Respond with yes/no or fill-in-the-blank-answer question.</li> </ul>	<p>Teacher:</p> <ul style="list-style-type: none"> <li>• Promotes students' thinking by asking them to elaborate their responses (why, how)</li> <li>• Asks students to elaborate based on their previous response.</li> <li>• Compares/contrasts students' responses to acknowledges and discuss alternative explanations Promotes debating and discussion among students' ideas/conceptions.</li> <li>• Helps students to achieve consensus.</li> <li>• Helps relate evidence to explanations</li> <li>• Provides descriptive or helpful feedback</li> <li>• Promotes making sense</li> <li>• Promotes exploration of students' own ideas</li> <li>• Refers explicitly to the nature of science</li> </ul>

Eliciting	Recognising	Using
potential or actual definitions apply, relate, compare, contrast concepts <ul style="list-style-type: none"> <li>• Compare/contrasts others' definitions or ideas</li> <li>• Check their comprehension</li> </ul>		<ul style="list-style-type: none"> <li>• Makes connections to previous learning</li> </ul>

## 2. Research question

How do Life Sciences teachers plan lessons for formative assessment in inquiry-based teaching?

## 3. Research design and methodology

The qualitative research design method was used for this study (Creswell, 2014). A case study approach was applied to understand teachers' planning of formative assessment in inquiry-based teaching. Five grade 10 Life Sciences teachers were purposefully sampled based on their teaching of the subject and conveniently sampled due to their proximity to the researcher's location (Merriam, 2009).

## 4. Data collection

One Lesson plan was requested from all five grade 10 Life Sciences teachers; before lessons were conducted. The teachers gave the researcher their lesson plans together with questions planned and worksheets related to their lesson. The lesson plan is a written description of this process, where the materials, the method, the time, the place of education, and the methods for evaluating the students are described in detail (Nesari & Heidari, 2014). Lesson plans are usually planned before the lessons since they guide the teacher throughout the study, and there must be lesson objectives/outcomes (Kiviet & du Toit, 2010). Kiviet and du Toit (2010) further explain that lesson plans show how students will be moved toward obtaining specific objectives. These lesson plans were analysed to examine how the ESRU framework and the ESRU strategies were applied to the questions. The questions were also analysed to see if the planning focused on epistemic or conceptual dimensions. See table 1, showing the ESRU strategies.

## 5. Findings

From teachers' lesson plans, it was evident that the five teachers do plan for FA. It was also evident that all five teachers did plan for Eliciting and Using, but only one did not plan for Using; he planned for Eliciting only. The Recognise element was not evident in the lesson plans since it requires actual teaching. The teacher needs to recognise students' responses, and is generally used based on the student's responses (Ruiz-Primo & Furtak, 2007). Four of five teachers planned more questions focused on epistemic than conceptual structures. This means they repeatedly focused more on 'procedures that involve inquiry rather than the process of developing scientific explanation' (Ruiz-Primo & Furtak, 2007, p. 78) when planning. The excerpts below are for Ms. Kubeka, and Ms. Thwala, whose lesson plans had similar topics both prepared lesson plans on Classification. Both lessons had evidence of planning that focused on Eliciting and Using questions, but Ms. Kubeka's lesson focused more on epistemic questions, and Ms. Thwala focused more on conceptual questions.

## 6. Ms. Kubeka's Lesson plan analysis

In Ms. Kubeka's topic was on Classification. When analysing the lesson, it was evident that she planned to elicit responses. The questions below are an excerpt from her lesson plan and are part of the eliciting strategy according to the ESRU framework. All the questions planned by Ms. Kubeka focused on the epistemic rather than the conceptual dimension. See Table 1 showing Strategies for ESRU cycles by dimension. The questions below are other examples of the questions attached to the lesson plan which were planned to ask learners.

1. How did you group the shapes for the first time?
2. Explain the process until the end.
3. Write down the characteristics of the shapes in each according to the way you have grouped them.
4. How are these shapes different?
5. How are these shapes similar?

In all the above questions, the teacher plans to request learners to *interpret information or data* according to the eliciting strategy (See Table 1).

When it comes to Using strategy, more questions were evident, and the teacher also planned to use her learners' responses to ask them how they have grouped the shapes. See an excerpt below from her lesson plan.

1. Give reasons why you separated them this way.
2. Why did you separate them this way?

In both the above questions, she plans that when learners explain how they have separated their shapes, he will *promote student thinking by asking them to elaborate on their responses*. These questions show that when planning a lesson, Ms. Kubeka prepared questions requiring her to use her learners' responses. Her planning was not limited to asking questions but also using students' responses to move them toward the learning goal (Harlen, 2013). Ms. Kubeka's questions focused on the epistemic rather than the conceptual dimension.

## 7. Ms. Thwala's lesson plan analysis

An excerpt from Ms. Thwala's lesson is extracted below. Her lesson was also on Classification. Even though Ms. Thwala's lesson also had evidence of eliciting and recognising. Unlike Ms. Kubeka, her lesson focused more on conceptual than epistemic structures.

1. What are nostrils?
2. On the binomial key, find the characteristics that belong to both mammals and birds.
3. Find one characteristic that is different from both mammals and birds.

When it comes to Eliciting strategy, in the lesson plan, there were questions prepared. The first question is an example of a question that *checks student comprehension*. This shows that in her planning, she knew learners' comprehension was necessary and should be checked. The second question is another Eliciting strategy where the teacher wants students to *interpret information or data* given to them. The last question shows that she prepares to elicit questions that require learners to *compare/ contrast observations, which* is another eliciting strategy. In the lesson plan, there was also evidence of questions planned for Using learners' answers to promote learning. See an excerpt of her questions below.

1. What are nostrils?
2. Why is it important to first classify by nostrils?
3. Do you think the taxonomy key/ biological key helps us to classify organisms?
4. How?

In the First question, the teacher plans to Use her learners' answers by *asking students to elaborate on the previous response*, which is *what are nostrils?* Then learners will elaborate on *why it is important to first classify by nostril*. The second question is a fill-in-the-blank-answer question, whereby a learner will answer with a yes or no. The teacher has also prepared to use the learners' responses by asking *why*, to probe learners to elaborate on their previous responses. Even though the *fill-in-the-blank answer question* is not an excellent eliciting strategy since it leads to learners responding with one-word answers (Shirley, 2009). However, she plans to use their answers by asking them to elaborate. Most of Ms. Thwala's questions focused on the conceptual dimension more than the epistemic dimension, unlike the other four teachers.

## 8. Discussion and conclusions

During the analysis of the lesson plans, there was evidence of Eliciting and Using strategy, the Recognising strategy was not evident in the lesson plans since it requires real-time, and teachers can only recognise students' responses in class when teaching. Lesson plans proved that teachers are aware that they should Elicit and Use learners' answers in class to promote learning or to move learners toward the learning goal (Harlen, 2013). According to the ESRU framework, their planning consists of complete



cycles (Ruiz-Primo & Furtak, 2007). Out of the five teachers, one teacher did not plan questions focused on Using learner's responses which made his learners miss out on the 'Use' aspect of the discussion, where the teacher provides "students with specific information on actions they can take to accomplish the learning goals (e.g., ask another question that challenges the students' thinking, 'Compares/contrasts the students' responses', 'Promotes debating/discussion', 'Promotes idea exploration' and 'Promotes thinking' (asking 'Why/how?') etc.) (Rached & Grangeat, 2021).

Four of the five lesson plans focused more on the epistemic than the conceptual dimension. The teachers' planning focused on the epistemic in the lesson plans. This caused learners to miss the skill and process of developing scientific explanations (Ruiz-Primo & Furtak, 2007). A study by Rached and Grangeat (2021) attests that most science teachers' lessons focus more on the epistemic than the conceptual dimension. This makes learners miss out on learning the conceptual structures of the content. Similarly, another study by Black and Wiliam (2004) discovered that teachers rarely engage learners in discussions that will reveal their conceptual understanding in classroom discussions. Conceptual structures are important because they help students understand concepts and principles as parts of larger scientific conceptual schemes (Ruiz-Primo & Furtak, 2007).

With proper planning of lessons, teaching and learning can take place smoothly. Inquiry-based teaching can also be promoted if the planned questions focus equally on the epistemic and conceptual structure so that learners can understand concepts and scientific knowledge deeply.

### References

- Dini, V., Sevian, H., Caushi, K., & Picón, R. O. (2020). Characterizing the formative assessment enactment of experienced science teachers. *Science Education, 104*, 290-325, doi: 10.1002/sce.21559.
- Ganajová, M., Sotáková, I., Lukáč, S., Ješková, Z., Jurková, V., & Orosová, R. (2021). Formative assessment as a tool to enhance the development of inquiry skills in science education. *Journal of Baltic Science Education, 20*(2), 204-222.
- Harlen, W. (2013). *Assessment & Inquiry-based Science Education: Issues in policy and Practice*. Trieste, Italy: Global network of Science Academics (IAP) Science Education Programme (SEP).
- Nesari, A. J., & Heidari, M. (2014). The important role on Educational Achievement of Irannian EFL Teachers' Attitudes. *International Journal of Foreign Language Teaching & Research, 3*(5), 25-31.
- Rached, E., & Grangeat, M. (2021). French teachers' informal formative assessment in the context of inquiry-based learning. *International Journal of Science Education, 385-406*, doi: 10.1080/09500693.2020.1740818.
- Ramnarain, U. D., & Hlatswayo, M. (2018). Teachers' beliefs and attitudes about inquiry-based learning in rural school district in South Africa. *South African Journal of Education, 38*(1), 1-10. doi:10.15700/saje.v38na1431
- Ruiz-Primo, M. A., & Furtak, E. M. (2007). Exploring Teachers' Informal Formative Assessment Practices and Students' Understanding in the Context of Scientific Inquiry. *Journal of Research in Science Teaching, 44*(1), 57-84.
- Shirley, M. (2009). *Model of Formative Assessment Practice in Secondary Science Classrooms Using and Audience Response System*. Ohio: Ohio State University.
- van Uum, M. S., Verhoeff, R. P., & Peeters, M. (2016). Inquiry-based science education: towards a pedagogical framework for primary school teachers. *International Journal of Science Education, 450-469*, DOI: 10.1080/09500693.2016.1147660.

## A PROPOSAL FOR TEACHING AND LEARNING IN PRIMARY SCHOOL POST-COVID-19

**Carlos Alberto Ferreira, & Ana Maria Bastos**

*Department of Education and Psychology, University of Trás-os-Montes and Alto Douro (Portugal)*

### Abstract

With the adoption of emergency remote education during the Covid-19 pandemic, students' teaching and learning practices changed from one moment to the next. According to the perceptions of 4th grade students in primary schools in northern Portugal, digital technologies were used to perform learning tasks, such as research projects, viewing and making of videos on curricular content and on topics of current reality, and taking quizzes using the Kahoot App. Such tasks involved working individually but also in small groups, and the use of teaching methods more focused on students. Therefore, in view of these students' perceptions and the literature review on teaching and learning in today's society, the aim of this work is to present a proposal for teaching and learning in primary school post-Covid-19, which is based on the use of active teaching methods for students, the performance of tasks that correspond to their interests and needs, as well as the complexity of learning they must carry out, in particular with the use of digital technologies, as well as their participation in the assessment of their learning processes so that they can adjust them and thus succeed in school.

*Keywords: Teaching, learning, proposal, primary school.*

---

### 1. Introduction

The emergency remote education registered in Portugal with the Covid-19 pandemic has led to changes in teaching practices and learning processes of students.

Having sought to gather the opinion of 4th grade students in primary schools about learning under this type of teaching, we confirmed the use of digital technologies for the continuity of learning and, with them, the use of teaching methods more focused on students and on the learning to be acquired. These students claimed to have been involved in research projects about natural and social reality, problem solving, viewing, and making videos, PowerPoint presentations, and taking quizzes using the Kahoot App. Through these tasks performed individually or in small groups, the students stated that they built their learning.

Taking this into account, these positive aspects of emergency remote education mentioned here by the students participating in the study and the literature on teaching and learning in the context of a society of information and knowledge and demanding in the roles of citizens, we aim, with this work, to make a proposal for teaching and learning in post-Covid-19. This proposal was drawn up considering the following axes: teaching and learning methods focused on students and the type of learning to be carried out; tasks performed individually or in small groups involving students in the study, research, analysis and resolution of problematic situations; the integration of digital technologies in the process of teaching and learning, as support for its implementation; the participation of students in the evaluation of learning, which should be continuous and based on criteria for evaluating learning tasks, with a view to self-evaluation of learning processes by students.

### 2. Theoretical background and design

With the emergence of the Covid-19 pandemic and social confinements that occurred from it, there was a need for closure of schools and the implementation of emergency remote education. During these periods of social confinement, the teaching and learning process kept going thanks to the use of digital technological resources that allowed the realization of synchronous classes and asynchronous moments of interaction between students, and between them and their teachers.

The move to emergency remote education, as a temporary response to an immediate problem (Bozkurt & Sharma, 2020), created an "educational disbanding" (Pacheco, Morgado, Sousa & Maia, 2021), as it forced teachers and students to adopt and adapt to the use of digital resources and tools for pedagogical purposes, such as online platforms (Zoom, Teams, Moodle, Chat among others), computer, tablet, smartphone with internet access. According to Oliveira, Corrêa and Dias-Trindade (2022, p. 5), "educators, even once resistant to the use of TDIs in the classroom, had no other option than to adopt government guidelines aimed at emergency remote education."

The use of digital resources and tools by teachers and students introduced changes in teaching and learning methodologies, focusing more on the interests, curricular and personal needs of students, giving them a more active role in the teaching, and learning process (Ferreira & Bastos, 2022). In fact, as Cosme, Lima, Ferreira and Ferreira (2021) refer, digital technological resources facilitate the construction of learning, especially through problem teaching, the use of the project work methodology, case studies and other teaching methods. With this type of active teaching and learning methods for students, their role and the teacher's role change, since it is up to the latter to create the pedagogical conditions for the students to build, interactively, the learning they need for school success and for the exercise of active, responsible and critical citizenship (Cosme, Lima, Ferreira & Ferreira, 2021). Therefore, it is up to them to guide students in problem solving and research on themes and problems about the reality in which they live. In turn, students must be responsibly involved in the learning tasks they are proposed for understanding natural or social phenomena or discussed and planned with teachers. With a more active role, interactive with classmates and with digital resources, and also a more creative role, students learn about the natural and social world, acquiring procedures, attitudes and values that allow them to respond to the challenges they face in life in a society of information and knowledge and demanding in terms of economy and of social coexistence.

It was considered that the use by students of digital resources during periods of emergency remote education which would allow them to have a more participatory and interactive role in the construction of learning, so we carried out a questionnaire investigation with open questions about the perceptions of 4th grade students in primary schools in northern Portugal about learning in the context of emergency remote education during Covid-19 pandemic (Ferreira & Bastos, 2022). From this study, we could verify that the students used the computer, tablet, and smartphone with internet access to perform learning. In addition to allowing them to participate in synchronous classes, these technological resources allowed students to read texts, take quizzes using the Kahoot App, conduct individual and small groups research on topics, proposed by or discussed with teachers, develop research projects, view, and make videos, and presentations in PowerPoint about topics of curricular programs or from prior research.

These results seem to show that the teaching/learning process was more focused on students' learning, structured by tasks that implied greater participation and interaction of students, also contributing to the acquisition of digital, personal, and social skills in them.

### **3. Objectives**

The Covid-19 pandemic and the adoption of emergency remote education because of the closure of schools led to changes in the teaching process, but also in the learning processes of students. It was for this reason that we conducted a study on the perceptions of 4th grade students in primary schools about learning in emergency remote education (Ferreira & Bastos, 2022). The results showed the use of digital technological resources for learning, such as the computer, tablet and smartphone connected to the Internet, the online platforms for classes and for the asynchronous interaction of students and teachers (chat, email), as well as YouTube, quizzes in the Kahoot application for school tasks. They also showed that for students, the teaching focused more on students' learning, structured with more participatory, interactive, and playful tasks, involving them in research/project and on topics from curricular programs or the natural and social reality in which they live.

Since the results obtained revealed changes in the pedagogical model adopted in the teaching and learning process, the objective of this communication is to develop a teaching and learning proposal for the 1st cycle in primary school post-Covid. This proposal is elaborated from the relevant aspects of learning in emergency remote education mentioned by 4th grade students in primary school and the literature review on teaching and learning in the context of a society of technology and information, complex and demanding for its citizens as the one in which we live in.

### **4. Methods**

The proposal for the teaching and learning process for the 1st cycle in primary school post-Covid has as its starting point the positive aspects of emergency remote education mentioned by students,

in particular with regard to the teaching and learning methodology used, the type of tasks performed for learning and the integration of digital technologies in that process (Ferreira & Bastos, 2022). We will also refer to the literature on teaching and learning centered on students and the learning they must perform, their interaction and the interaction they have with digital technologies as means of constructing multiple learning, essential for life in a complex and demanding society such as the one in which we are in.

This proposal, which we intend to present, has the following structuring axes:

- The use of active teaching and learning methods for students;
- The structuring of this process with learning tasks that imply students' problem solving, research and interaction, for the construction of complex and profound learning about the reality that students experience;
- The use of digital technological resources as a means of access to information and interaction for the construction of such learning;
- The evaluation as a continuous practice, done by the students and carried out by them to self-evaluate their learning processes, by being autonomous and responsible for them.

## 5. Results and discussion

The remote emergency education experienced by teachers and 4th grade students in primary schools in northern Portugal brought changes in the teaching and learning processes. Methods more focused on students and on the learning they had to perform were used, structured with tasks more directed to the resolution of problems by students, to research, in small groups or individually on topics or problems related to the natural and social reality and with the use of digital technologies for accessing information and for accomplishing those tasks, as well as for the continuous evaluation of the learning, done by the students (Ferreira & Bastos, 2022).

On the other hand, there are several references in the literature (Cosme, Lima, Ferreira & Ferreira, 2021; Nóvoa & Alvim, 2022; Pacheco, 2021; UNESCO, 2022) for the need to transform the pedagogical model used in schools and in the classroom (Nóvoa & Alvim, 2022), so that they are places of study and construction of learning by students (Nóvoa & Alvim, 2022).

Thus, we will present the proposal for teaching and learning according to the four axes mentioned above and agreeing that "a new social contract for education [which] will allow us to think differently about learning and relationships between students, teachers, knowledge and the world is needed" (UNESCO, 2022, p. XIII).

### 5.1. The use of active teaching and learning methods for students

To form citizens capable of living together and responding to the various challenges that the intercultural society of knowledge, technology, and of rapid change that we are currently experiencing, it is necessary to change the pedagogical model of schools and the teaching and learning process. It is, as Nóvoa and Alvim (2022, p. 15) refer, creating the "metamorphosis of school".

Although the educational responses given, from one moment to the next, by schools and teachers to the closing of schools during Covid-19 should not be "a pretext to institute any new educational normality" (Nóvoa & Alvim, 2022, p. 25), the experiences considered positive by students for a change in the pedagogical model should be used. And this is because the results of the study conducted with 4th grade students in primary schools on learning in emergency remote education showed a certain change in teaching and learning methods. In this context, the teachers involved the students, individually or in small groups, in research and projects on themes of natural and social reality, in the resolution of problematic situations that implied a greater participation of students in the construction of their learning (Ferreira & Bastos, 2022). Therefore, we sought a teaching more focused on the students' learning, which Cosme et al. (2021) refer to as a paradigm of learning. In this paradigm "children and young people are assigned the central place in the educational act" (Cosme et al., 2021, p. 17), because they are the ones who, through processes of research, discussion and reflection, build learning of a curricular nature, but also of knowledge, procedures, attitudes and values necessary for the understanding of the society in which they live and to have a responsible, critical, and democratic participation in it. For this reason, it is up to the teacher to facilitate the material and human conditions for learning, by helping and guiding the students through the processes of this construction. The teacher must promote discussion, research, interaction between students as means of knowledge of the world and realization of essential learning to the exercise of citizenship in democratic societies, but complex from the social, cultural, environmental, and economic point of view.

Thus, the exhibition method, used in a conception of school education created since the 19th century, has to give way to teaching and learning by problems, to the methodology of project work, to critical and creative thinking, to case study, laboratory work, among others (Cosme et al., 2021), which

provide opportunities for students to build complex and profound learning (Fernandes, 2022) to enable them to understand and act in the current reality.

## **5.2. Tasks for building learning**

If teaching methods must be focused on the students and the learning they need to do, school tasks also have to actively involve these students, so that the classroom is a space for study, research and collaboration between students, and between them and their teachers. Learning environments must be created which are characterized by the "involvement and participation of students, appreciation of study and research, cooperative learning, integrated and multi-thematic curriculum, pedagogical differentiation, etc." (Nóvoa & Alvim, 2022, p. 27).

It is intended, in this context, that the teaching and learning process be planned with students and structured by performing learning tasks that involve students, individually or in small groups, in processes of information research in different sources, reflection and discussion, with which they build the learning they need in curricular terms and for their active and responsible life in a demanding society. As Nóvoa and Alvim refer (2022, p. 29),

*The day-to-day school life cannot revolve around the 'class', but rather around the study. This implies a change in the teachers' role, emphasizing their responsibility to the overall educational work (monitoring, tutoring, support, etc., and not only 'lessons'), reinforcing their action in the production of pedagogical and curricular knowledge and evolving into forms of collaborative action.*

In fact, with the great availability of information and easy access for students, exhibition teaching cannot continue to be the only one in the classroom, with which students access the knowledge transmitted by teachers. Emphasizing the construction of the learning that students need for the continuation of studies and for their personal and social life, using digital technologies linked to the Internet, learning results from processes of study, research, analysis, and reflection in collaboration with classmates and the teacher.

The learning environment to be created, therefore, presupposes that students engage in research projects in small groups on themes of natural and social reality, from readings, analysis and discussions on social, civic, environmental, technological, intercultural texts and other issues that result from their interests and needs. Learning can still be constructed from the resolution of problematic situations involving students interacting in the search for answers to the problems posed by teachers or discussed with them. Study visits, viewing, and discussion of videos on topics or problems of today's world are learning opportunities.

## **5.3. Digital technological resources as a means for the construction of learning**

We live in a society where digital technological resources abound and schools, teachers and students must take advantage of their existence as means available for study and work and thus for the construction of learning. In agreement with Nóvoa and Alvim (2022) that these resources do not replace teachers and their role in the teaching and learning process, they should be integrated into it as means for accessing information, participating, and interacting in the performance of learning tasks.

In fact, with the great availability of information and easy access for students, if they have digital resources with internet connection, exhibition teaching cannot continue to be the only one in the classroom, with which students access the knowledge transmitted by teachers. The construction of the learning that students need for the continuation of studies and for their personal and social life, using digital technologies linked to the Internet, learning results from processes of research, reflection, and action in collaboration with classmates and the teacher.

The computer, tablet and smartphone connected to the internet are technological resources with which students can access, save, and analyze information, learn by taking quizzes in the Kahoot App, produce texts, make PowerPoint presentations, and summarized videos of the learning performed, participate in the evaluation of their learning, and do self-evaluation.

## **5.4. The continuous and participatory assessment by students of their learning**

If learning results from a construction process of the student, either individually or in interaction with classmates and with the teacher in the resolution of tasks proposed by the teacher or discussed with them according to their interests and needs, their assessment must be continuous and with their participation. We intended that the evaluation would be seen by teachers and students as a practice that allows the latter to check their learning and improve it (Fernandes, 2022), that is, an evaluation for learning (Black & William, 2009).

An evaluation for this purpose is of a formative and training nature of the students, which takes as its object the processes of performing learning tasks, in which evaluation criteria are defined in advance and the respective performance descriptors with which students can self-evaluate their performance in these tasks, obtain feedback with indications on what and how to improve in them, and checking their learning process (Fernandes, 2022; Ferreira, 2022).

It is through self-assessment and self-checking of their learning that students are better learners, will have a better formation, and be more successful in summative assessment (Black & William, 1998).

## 6. Conclusions

Emergency remote teaching has led to adaptations of the teaching and learning process, with changes in teaching methods, learning tasks and the integration of digital technologies. In fact, through the study carried out (Ferreira & Bastos, 2022), it was possible to verify that the students surveyed reported the use of teaching and learning methods more focused on students' learning, involving them in work and research tasks that allowed them to build interaction and participate more in the evaluation of their learning.

It was from these students' perceptions that we elaborated a teaching and learning proposal for students in 1st cycle primary school post-Covid-19. In this proposal we highlight the importance of diversifying teaching methods focused on students and the learning they have to build, involving them in tasks/works of individual or small group nature, in which digital technologies are means to help them perform these tasks, and the need for students to participate in the evaluation of these tasks, so that they are able to check themselves and therefore become autonomous and responsible for their learning and reach deep and complex understanding.

## References

- Black, P. & William, D. (1998). Assessment and Classroom Learning (1998). *Assessment in Education: Principles, Policy & Practice*, 5(1), 7-73.
- Black, P. & William, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*, 21(1), 5-31.
- Bozkurt, A. & Sharma, E. A. (2020). Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic. *Asian Journal of Distance Education*, 5(1), i-vi.
- Cosme, A., Lima, L., Ferreira, D., & Ferreira, N. (2021). *Metodologias, Métodos e Situações de Aprendizagem. Propostas e Estratégias de Ação*. Porto Editora.
- Fernandes, D. (2022). *Avaliar e aprender numa cultura de inovação pedagógica*. Leya Educação.
- Ferreira, C. A. (2022). Avaliação para as aprendizagens na formação inicial de professores: reflexões para uma prática sustentada. In C. Bianchessi (Org.). *Diálogos sobre formação de professores: olhares, saberes e Práticas - Volume 1* (pp. 145-160). Editora Bagai.
- Ferreira, C. A. & Bastos, A. M. (2022). Covid-19 and learning: perceptions of 4<sup>th</sup> grade students. In L. G. Chova, A. L. Martínez, & J. Lees (Eds.), *ICERI2022 Proceedings. 15<sup>th</sup> International Conference of Education, Research and Innovation* (pp.1331-1335). IATED Academy.
- Nóvoa, A., & Alvim, Y. (2022). *Escolas e professores, proteger, transformar, valorizar*. Salvador: SEC/IAT.
- Oliveira, R. M., Corrêa, Y., & Dias-Trindade, S. (2022). Avaliação Formativa em Contexto Digital com Tecnologias Digitais Interativas. *Estudos em Avaliação Educacional*, 33, e08329.
- Pacheco, J. A., Morgado, J. C., Sousa, J., & Maia, I. B. (2021). Educação básica e pandemia. Um estudo sobre as percepções dos professores na realidade portuguesa. *Revista Iberoamericana de Educación*, 86(1), 187-204.
- UNESCO (2022). *Reimaginar nossos futuros juntos: um novo contrato social para a Educação*. Unesco.

## GAME FOR DIDACTIC INNOVATION. *CLASSCRAFT* IN ITALIAN SECONDARY SCHOOL

**Andrea Brambilla<sup>1</sup>, Francesca Antonacci<sup>1</sup>, & Stephen E. Moore<sup>2</sup>**

<sup>1</sup>*“Riccardo Massa” Department of Human Sciences for Education,  
Università degli Studi di Milano-Bicocca (Italy)*

<sup>2</sup>*Department of Technology, Georgia School Ningo (China)*

### Abstract

Developing new didactic methodologies in a fast-changing world is increasingly important for teachers. Students are immersed in technological devices outside the school, and engaging them is getting more complicated. *Classcraft* is a gamification platform that transforms class activities into a fantasy game. This study examines gamification and game-based learning features that affect students' marks, engagement, inclusivity, and flow in Italian middle schools. The secondary research question concerns the border till which gamification is positive.

The literature review led to exciting results confirmed by the first part of data collection. “Point system, achievements, quests and challenges, and narrative structures,” “gamified reward mechanics,” “interactive settings,” and “collaborative tasks” contributes to growing of marks, engagement, inclusivity, and flow. This first part of the project was conducted with a third-year middle school classroom in Lombardy during Italian Language, History, and Geography classes. The researcher was also the teacher, who proceeded with a quasi-experimental design. Students completed a pre-test (Likert scale based, 6) and a post-test that included some open-ended questions. Throughout the whole experimentation, the researcher wrote an observation diary. During the second half of the experiment, five significant students were interviewed.

The next phase of the study wants to collect more data from different middle schools in Italy and to use teachers, determinants on results, for discussing them. The design of the second part will follow the one of the beta tests.

**Keywords:** *Game-based learning, gamification, secondary school, Classcraft, augmented reality.*

---

### 1. Introduction

Gamification is becoming a more commonly used practice in the teaching field. As students deal with virtual realities, technological devices, and networks, teachers are finding new strategies to speak a language as close as possible to them. Gamification is «using game design elements in non-game context» (Deterding et al., 2011). It has strictly related to game-based learning, «an approach to encouraging positive affect, engagement, and motivation in learning activities by utilizing game-like features and environments» (Gee, 2003; Sabourin & Lester, 2014), which is the principal didactic theory behind it. This study focuses on a platform called *Classcraft*, which was launched in Canada in 2014 and then spread to many countries worldwide (Sanchez et al., 2017). In January 2022, when the project started going on the field with its first part of data collection (that from now on it is going to be called “beta-test”), *Classcraft* headquarter confirmed the gap that has emerged from the literature review. In Italy, there was no specific research on *Classcraft*.

The study utilizes learners' everyday experiences to determine gamification relevance in the learning process. This paper provides a report of the beta-test, which started with experimenting with platform functioning before addressing its usage on a larger scale during the following phase. It has translated into a preparatory study of *Classcraft* to notice flaws or malfunctions inside platform dynamics, but, even more, in researcher's procedures. This work aims to verify the best *modus operandi*, reflecting on decisions, actions, and other involved people's feedback (especially the ones inside the school context) to deliver to teachers who will be an active part of this project and in other future experiments.

## 2. Study design

The research question that leads the whole study wants to investigate which features of gamification and game-based learning affect students' marks, engagement, inclusivity, and flow in Italian middle schools, with particular attention to *Classcraft*. Following the scheme of SPIDER Tool (Cooke et al., 2012) and confronting study designs collected with this step of literature review, the scheme of beta-test that is going to be explained emerged from Çakıroğlu and Güler's paper (2021). It consists of a quasi-experimental design with a control group, a pre and post-test questionnaire, interviews with significant students after the experiment's first half, and an observation diary during the process.

The researcher who conducted the project and the teacher coincided. He was in his fifth year of teaching, his first time at the public institute "Falcone e Borsellino" in Bellusco (Lombardy, Italy). The sample was a third-year-middle-school class composed of 9 girls and 17 boys. The experimentation started on February 1st, 2022, after compiling the pre-test questionnaire, and ended on May 31st, 2022. In the beginning, a trial week was planned without direct consequences on game dynamics to let students get confident with the platform; it had an important role and will be suggested in future phases to other involved teachers. *Classcraft* concerned 12 hours per week, during Italian Language, History, and Geography classes, for 130 hours.

## 3. Gamification design

The word «features» in the research question is a broad concept. It is helpful to introduce some authors who emerged from the literature review and highlight a few critical components to understand it better. In 1958, Caillois described four principal kinds of game, even if there were still ambiguity around the terms «game» and «to play»: «agon» is physical or intellectual competition; «alea» represents the out-of-control event, randomly determined; «mimicry» is interpreting another role, different from player's one; «ilinx» provoked by the game is the sense of vertigo (Caillois, 2000). These are not exclusive, or rather, classic games are not just one of them, but their combination. Suits defined the verb «to play,» which is still one of the most famous: it is the voluntary attempt to overcome not-necessary obstacles (Suits, 2021). According to this statement, it is possible to point out four components: «prelusory goal» that exists regardless of game rules; «lusory tools» inside game dynamics; «constitutive rules»; «lusory attitude,» or voluntary participation. McGonigal agreed with Suits' definition with an interesting additional element. She confirmed the prelusory goal and lusory attitude, with some slight terminological differences; she identified lusory tools as part of constitutive rules and added the «feedback system» as one of the fundamental components (McGonigal, 2011). More recently, Ramirez and Squire found some design features used in gamification that can be overlapped: «point system, achievements, quests and challenges, and narrative structures» (2014). In conclusion, according to a systematic review, *Classcraft* embodies conditions of optimal gamification learning experiences, which consist of «gamified reward mechanics,» «interactive settings,» and «collaborative tasks» (Zhang et al., 2021). Some of the listed features coincide or overlap others or include more than one, such as constitutive rules; others will be evaluated inside data analysis, like lusory attitude. Later, some key features will be analyzed according to the beta-test gamification design.

**Teams** in *Classcraft* are crucial. Usually, they are mainly related to «agon,» but here, they are thought of as a collaborative game situation («collaborative tasks»). In four months of beta-test, teams changed three times. From February 1st to March 12th, there were five teams, four composed of 5 students and one by 6. The teacher decided on their composition to balance them, according to the didactic attitudes of the pupils. From March 12th to May 2nd, the number of teams became eight: six composed of 3 students and two by 4. Two main reasons conditioned this choice: the importance of balancing continuously between different parts that changed their previous position throughout the game (Antonacci, 2012; 2019) and to empower each student by forcing them to be more involved and to push other pupils, considered able to do it, to become a leader inside their team. From May 2nd - May 31st, teams were reduced from eight to seven: all composed of four students, except for two that consisted of 3. The teacher decided on this last change because they wanted pupils to deal closely with different classmates, especially by who participated more and better understand how to take advantage of game dynamics. It seemed that avoiding the teacher's decision about teams' composition is problematic because it guarantees fairness. In this sense, a possibility for the future could be asking for students' preferences and considering them. «Agon» emerged when teams, bounded together by a strong feeling of collaboration, fought against a common enemy (Bertolo & Mariani, 2020): the game itself. It has not to be too simple; otherwise, the virtuous circle that leads to a flow state cannot happen, and players risk getting bored. To match this requirement, as suggested by De Koven (2020) too, the teacher immediately reduced supply of crystals, which help to activate avatars' powers, to a quarter per day, instead of one per day; moreover, he periodically stopped it, when stocks were



full. «Quests and challenges» are present in *Classcraft* and are one of the principal elements. For the future phase could be interesting to take advantage of:

- «narrative structures» that can be created in quests;
- formative reviews, a quiz with whom to challenge single students or teams;
- quick reviews, a new tool that did not exist when the beta-test was done.

The «Alea» component is represented by **random events**. It happened regularly once per week (mostly on Friday), and on that occasion, differently from usual, the school day started with *Classcraft* on the digital board screen. The teacher prepared twenty unexpected events that students did not know: they could be positive or negative for the whole class or a part of it, or they could cause funny repercussions on class life for that day. Another *Classcraft* feature related to alea is the random picker, which randomly selects a single student or team. The difference between other types of random selection mechanics outside *Classcraft* is that the selected student or team appears on the class board screen.

At the beginning of the experience, every student chose an **avatar** between a guardian, healer, and mage. Guardians protect mates from damage; healers remove damages already suffered, and mages re-energize mates so that they can use their powers. This system of characters, typical of a role-playing game, allowed players to experiment «mimicry» component. The teacher could have chosen for them, but he let pupils decide the best solution together with their first teammates, considering that each team had to include at least one of every avatar. It was revealed to be an excellent custom to reproduce even in future experimentation elsewhere. Each character acquires different **powers** and specializes by leveling up (1000 XP required during beta-test). According to students' words, their usage of them can be counted as «ilinx» because they felt fulfilled and powerful. Powers could be universal, which means familiar with the other avatars from the beginning; specific, which are the ones that characterize avatars; collaborative, which affects the team and individual experience points. The teacher personalizes characters, changing powers that could be modified to create a specific solution for his class. The second part of the experiment could verify if they could work even in other contexts; eventually, it could lead to other good practices about powers.

«Feedback system» is evident in *Classcraft*. It is regulated by **positive behaviors**, which consent to gain experience points and golden pieces, and **negative behaviors**, which cause health-points loss. The goals of behaviors chosen by the teacher were:

- stimulating all students to be more engaged in lesson activities;
- training them to be responsible for themselves, their classmates, and the school;
- reading more books from the list, the teacher proposed.

Two of the most common positive behaviors had been «participating actively in the lesson» and «answer to a difficult question»; one frequent negative behavior had been «homework done partially or badly.» In the beta-test, the teacher assigned bonus and malus on *Classcraft* after the end of lessons. This method does not guarantee immediate feedback because students do not know if their actions will come to a consequence in the game, but it does not oblige the teacher to interrupt his speech any time there is something to note. It is essential not to create a system reward that depends exclusively on marks; otherwise, that would become a copy of the school's evaluation system already in force. Not all the pupils could yearn for the maximum amount of available XP. During the experimentation, according to classroom reality, it is also helpful to change the amount of XP and gold pieces as a reward for good behavior or the life-point loss for bad behavior.

#### 4. Acknowledgment

As a didactic methodology, a teacher can freely experiment *Classcraft* or other gamification platforms with his students. The only requirement is the availability of a digital device by each student, which can be brought to school if the teacher permits it. During the beta-test, the researcher had to ask permission from different levels to collect data. It was fundamental to tell a well-structured proposal and be comforting about the project because behind was a path decided by the university. The aims were to raise students' engagement in disciplines without losing content and reflect on the effects the Covid-19 virus had on engaging in distance learning. *Classcraft* is not the miracle cure for school institutions: today, there is this platform, and in five years or even less, there could be another. It is an attempt to meet pupils' sensibility and to get closer to them to school.

The first step was communicating with the principal and informing the vice-principal and the school coordinator. At the beginning of January, after the principal's positive answer, it was possible to present the project to students' parents, colleagues, and members of the Teaching Staff. Representatives of parents reacted positively as well. In a second moment, the teacher asked the principal for authorization to administer pre-test questionnaires and to acquire students' evaluations in aggregate form. He successfully got his parents' authorization and proceeded with tests. On February 2nd, the teacher invited pupils to a

“solemn oath” in the classroom, through which they promised to accept all the consequences *Classcraft* would imply and all future constitutive rules that would be introduced or changed due to game dynamics. On April 22nd, the principal gave the authorization for the interviews, and four days after, during a reunion with parents, the teacher informed them. Afterward, he asked their permission to all of them, even if only a few of their sons and daughters would be interviewed, through the document indicated by the University Ethics committee. In particular, it was necessary to ask permission for audio recording, which was not done before because the idea was born after the beginning of the beta-test. For future phases, it will be useful to ask preemptively for these parents’ permission.

## 5. Tools for data collection

In this paragraph, tools for beta-test data collection will be analyzed, keeping together the steps, justifications, and emerging considerations. Pre-test questionnaires, evaluations chart, interviews, and post-test questionnaires will be described in this order. They were all selected to answer specifically to the research question, with particular attention to marks, engagement, inclusion, and flow. Secondary research questions came out during the process and were noted in a research diary, together with the teacher’s observations.

The primary goal of the **pre-test questionnaire** for students and parents was to describe the sample to establish a starting point (t-0), which was not just the teacher’s point of view. It consisted of 18 items with multiple choice answers, including the first one that asked about gender; ten of them had a Likert scale structure with 6 levels, to oblige them to take a more defined position. As marks would be already evaluated by another instrument, beyond engagement, inclusion, and flow, there were items on students’ perception of their progress at school in involved disciplines. The pre-test questionnaire was based on validated tools found during the literature review (Mustafa, 2018; Watson, 2018), and it passed a peer-review process of two fellow researchers. It was set that the number of items had to be reduced to 18 and that the questionnaire would be simple yet incisive for thirteen-year-old pupils. A control group represented by another third-year middle school class at the same institute was involved with their parents, thanks to a colleague’s collaboration. The pre-test questionnaire was administered through a Google module. It required access with a Google account (data that had not been collected) to limit to one compilation because it was assigned as homework on January 31st. The beta-test experience made parents’ engagement complex because they are not always easy to reach. Moreover, their perception of children’s school progress is very partial even though sometimes could be interesting. Control group is another operation that implies a waste of energy but has many limitations. Classrooms did not have the same professor and no superimposable characteristics, even though they were in the same institute and were the same age. During the next phase, the enlargement of the sample with related data analysis and data comparison will consider the context’s preliminary description of the experimentation setting to be able to compare data results. This operation will cover the control group role.

Data on **marks** were collected in aggregate form, taking them from school report numbers at the end of the first half of the year, which coincided with the pre-test questionnaire, and at the end of the year, which coincided with the post-test questionnaire. The sample and control group’s evaluations were about Italian Language, History, and Geography, and they were represented by numbers that went from a minimum of 4 to a maximum of 10. The experimentation period would be different in the future, according to the involved teachers’ necessities. They will provide this data following the same mode, photographing starting and final points (pre and post-test), even if it does not coincide with school reports.

On May 6th, five selected students were interviewed by the support teacher they had known for three years in a quiet place outside the classroom during morning school time. These **short interviews** (less than five minutes) were audio recorded. Their goal was to ask five questions different from the ones there would be in the post-test questionnaire to five informants, before the end of the beta test but after half of it. These significant students were not chosen for their learning level or marks but because they represented some interesting profiles who reacted peculiarly to *Classcraft* experimentation. It is an excellent method to collect qualitative data, which can add exciting considerations from students’ points of view. However, replicability conditions are not simple, especially considering the interviewer in charge.

**Post-test questionnaires** were administered on May 31st during the morning-class time. All 18 items of the pre-test questionnaire were re-proposed to compare pre-test and post-test data collected. Open-ended questions about the experience with *Classcraft* and class dynamics during the beta-test were added only to the sample. Giving them time during morning classes guaranteed them to answer primarily open-ended questions well. Future experiences with this platform should last at least two months so that the novelty effect can decrease and disappear. Four months is a period that can lead someone to disaffection towards this environment, especially if it coincides with the end of the school year when students are usually tired. It would be interesting to see the consequences of *Classcraft* after the end of its usage. Through this

beta-test, it was not possible to observe because the school year had finished, and pupils were at the end of their middle-school path. In the subsequent phases, different solutions and timing will be verified to solve some of the secondary questions that emerged during the beta-test, like the border till which gamification has a positive impact.

## 6. Conclusion and future developments

Beta-test was a positive experience, not considering data analysis in itself but dealing with procedures. In these paragraphs, there is a list of practices followed, the reasons behind their choices, and considerations about what will come in the next phase. A proper data analysis of the beta test is necessary to go deeper into the results and compare those data with the others that will be collected during 2023. One of the riskiest fallacies that must be avoided is *post hoc ergo propter hoc* one: distinguishing *Classcraft* consequences from other projects schools have already planned, which may have similar aims for students.

Beta-test design will be substantially repropose in the next phase of data collecting, curing considerations for previously outlined. The second phase of the study wants to collect more data from different middle schools in Italy and to use teachers, determinants on results for discussing them. At the moment, seven teachers in six different institutes have been selected. However, the aim is to enlarge the sample further, guaranteeing the researcher's possibility to follow and support all of them.

## References

- Antonacci, F. (2012). *Puer Ludens: Antimanuale per poeti, funamboli e guerrieri*. Milano: FrancoAngeli.
- Antonacci, F. (2019). *Il cerchio magico. Infanzia, poetica e gioco come ghirlanda dell'educazione*. Milano: FrancoAngeli.
- Bertolo, M., & Mariani, I. (2020). *Game design: Gioco e giocare tra teoria e progetto*, Milano: Pearson.
- Caillois., R. (2000). *I giochi e gli uomini: La maschera e la vertigine*. Dossena, G., & Rovatti, P. A., Guarino, L. (Eds.). Milano: Bompiani.
- Çakıroğlu, U., & Güler, M. (2021). Enhancing statistical literacy skills through real life activities enriched with gamification elements: An experimental study. *E-Learning and Digital Media*, 18 (5), 441-459.
- Cooke, A., & Smith, D., Booth, A. (2012), Beyond PICO: The SPIDER Tool for Qualitative Evidence Synthesis. *Qualitative Health Research*, 22 (10), 1435-43.
- De Koven, B. (2019). *Buon gioco: Giocare bene per vivere bene*. Trento: Erikson.
- Deterding, S., & Dixon, D., Khaled, R., Nacke, L. (2011). From Game Design Elements to Gamefulness: Defining Gamification. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, MindTrek, 11*, 9-15.
- Gee, J. P. (2003). *What Video Games Have to Teach Us About Learning and Literacy*. New York: Palgrave Macmillan.
- McGonigal, J. (2011). *Reality Is Broken. Why Games Make Us Better and How They Can Change the World*. London: Jonathan Cape.
- Mustafa, H. (2018). *Can gamification or Game Based Learning via BYOD increase active engagement in learning activities for student's age 8 - 11 years?*. Retrieved Dec 30th, 2022, from <https://files.classcraft.com/classcraft-assets/research/hm-research-project-aug-2018.pdf>
- Ramirez, D., & Squire, K. (2014). Gamification and Learning. In Walz, S. P., & Deterding S. (Eds.). *The Gameful World: Approaches, Issues, Applications*. Cambridge: MIT Press.
- Sabourin, J. L., & Lester, J. C. (2014). Affect and Engagement in Game-Based Learning Environments. *IEEE Transactions on Affective Computing*, 5 (1), 45-56.
- Sanchez, E., & Young, S., Jouneau-Sion, C. (2017). Classcraft: from Gamification to Ludicization of Classroom Management, *Education and Information Technologies*, 22 (1), 497-513.
- Suits, B. (2021), *La cicala e le formiche: Gioco vita e utopia*, Antonacci, F., & Bertolo, M. (Eds.). Parma: Edizioni Junior.
- Watson, S. (2018). Motivating Computer Science Students Beyond Classwork with Games and Gamification. Retrieved Dec 30th, 2022, from <https://ninercommons.charlotte.edu/islandora/object/etd%3A1266>
- Zhang, Q., Yu, L., Yu, Z. (2021). A Content Analysis and Meta-Analysis on the Effects of Classcraft on Gamification Learning Experiences in terms of Learning Achievement and Motivation, *Education Research International*, 2021, 1-21.

## **BETWEEN EXPECTATIONS AND GENERATIVE UNCERTAINTIES: AN ACTION STUDY IN HIGHER SECONDARY SCHOOL**

**Aet Raudsep**

*Department or Institute of Education, University of Tartu (Estonia)*

### **Abstract**

Uncertainty in education is frequently seen as something that may trigger various defence mechanisms (Jordan, 2015) or lead to feeling confused and lost. Generative uncertainty may be productive (Mint, 2016), enhancing learning and fostering professional growth (Lygo-Baker, 2019).

This paper presents an action study whose main goal was to investigate students' and teacher's uncertainties brought about by re-organization of learning and teaching activities in the form of an intervention in higher secondary school English classes. Students were tasked with creating study aids for their peers and asked to articulate their uncertainties.

In analysing the uncertainties articulated by the students, uncertainty was approached as resulting from a triadic relationship. This relationship is characterized by a situation where the student (1) is responsible for carrying out tasks (2) to the teacher (3). Similarly, teacher is performing their social role as an educator, being responsible for the society (Bardone et al., 2017). Such a relationship may affect teaching situations reflecting the specific uncertainties experienced by students and teacher and the way such uncertainties may foster learning, growth, and educational change.

From the intervention, three types of uncertainties were identified: uncertainties regarding expectations (students were not sure what they were expected to deliver), regarding the content (whether students' work would be of the necessary quality) and regarding the triadic relationship (students' and teacher's focus turning increasingly towards being responsible for the process rather than responding to expectations).

**Keywords:** *Generative uncertainty, higher secondary school, triadic relationship, action study, responsibility.*

---

### **1. Introduction: The role of uncertainty in education**

The occurrence of educational innovation brings out uncertainties related to transformation. Educational innovation forces primarily teachers and students to manage a range of choices, thus creating uncertainties. Such uncertainties are not problems to be overcome but triggers of potentially generative space in learning and teaching.

The concept of uncertainty has been researched in social sciences such as entrepreneurship studies (Garud et al., 2010), environmental studies (Lloyd and Raikhel, 2018), policy research (Dewulf and Biesbroek, 2018), science and technology studies and sociology (Fochler and Sigl, 2018). In educational sciences, uncertainty has been connected with teacher education (Schuck et al, 2018) and the development of "pedagogical phronesis" (Birmingham, 2004).

According to Jordan (2015) uncertainty is a subjective experience akin to doubting, wondering and being unsure of what the future will bring. It is an active situation where the subject must determine a cause of action (Biesta, 2015) in a field where all options are open, and the decision-maker cannot rely on the past experiences and solutions already familiar to them (Arendt, 1970).

Teaching and learning are characterised by chronic uncertainty (Biesta, 2015; Labaree, 2000). No teaching situation will reproduce itself (Sinnema et al., 2017) as teachers and students are dealing with unpredictable and unfamiliar situations (Floden & Clark, 1987). Pedagogical deliberation must adapt itself to "what it finds, responsively, and with respect to complexity" (Kessels & Korthagen, 1996, p 19). Uncertainty is constitutive of learning, since acquiring "something new" is perpetually connected to the situation where the habitual way of perceiving something in the world is dismissed (Bohm, 2004). What students and teachers experience and express when being in a situation that is not determined and still open to further developments, is uncertainty.

Uncertainty in teaching and learning may be productive (Mintz, 2016) and generative, thus favourable to learning for students and professional growth for teachers (Lygo-Baker, 2019) but it

may also be a trigger for various defensive mechanisms (Jordan, 2015) as it may lead to feeling confused and lost. Students' and teacher's uncertainties are interconnected and affect each other, forming a triadic relationship. This relationship is characterized by a situation where the student (1) is responsible for carrying out tasks (2) to the teacher (3). Similarly, teacher is performing their social role as an educator, being responsible for the society (Bardone et al., 2017). Such a relationship may affect teaching situations reflecting the specific uncertainties experienced by students and teacher and the way such uncertainties may foster learning, growth, and educational change. In cases where teachers create learning activities that are straightforward and allow students to achieve the learning outcomes and gain a sense of achievement, it may finally lead to avoidance of more complex and realistic situations, thus leading to "postponement of opportunities" (Hare, 2003). A negative effect of such process can be the rise of overconfidence in students which is connected to how knowledge is delivered, reflecting on teacher's preference of low uncertainty levels (Testa et al., 2020). Schuck and Buchanan (2012) noticed that teacher education programs tend to focus on confidence and self-efficacy, thus undermining the value of doubt and wondering.

## **2. Focus of the article: Students' and their teacher's uncertainties**

The study this article discusses focuses on re-organisation of teaching and learning activities carried out by a higher secondary school's English teacher working in a private school in Estonia. The school was founded in 2000 and currently there are approximately 1000 students aged 7-19. The main aims of the teacher were to give the students a more active role during the study process and move towards a more self-directed form of education thus utilizing the principles of "learning by teaching" (Fiorella & Mayer, 2013). The teacher with the help from a university researcher developed and implemented an intervention which consists of a didactic unit based on the requirements of the curriculum. While implementing the intervention, students gave feedback on their uncertainties and the teacher kept a journal recording hers. The article discusses 1) the students' uncertainties as their role changed because of the re-organization of learning and teaching activities and 2) the teacher's uncertainties as articulated in relation to re-organising her teaching practices. As most of the intervention was carried out during the time of COVID 19 lockdown with the help of digital technologies, the question of whether these are another potential source of uncertainties is also in the background.

## **3. Methodology**

The research was conducted as an embedded case study, characterised by *multiple units of analysis* (Budiyanto et al, 2019; Scholz and Tietje, 2002) with each of them focussing on a different aspect related to the case - an intervention overlapping with a didactic unit. The intervention followed the principles of action research (Baskerville, 1999) as the whole process 1) was committed to change through action; 2) the intervention targeted generating changes in complex social setting; 3) practical and theoretical concerns are connected; and 4) the process was intended to yield reflections. Data was collected and analysed following the principles of co-researching which is based on the involvement of non-professional researchers in a study (Bergold and Thomas, 2012). The co-researcher – the English teacher – was an integral part of the study from the very beginning and provided her comments at every step of the intervention. The role of the co-researcher was to collect data as an observant participant (Moeran, 2009). Students' reflections were collected anonymously, using Google Forms. Asking students to reflect on their uncertainties provided them with an opportunity to contemplate which, according to Jordan (2015) is a resource for learners facing uncertainty. Students' answers were then analysed by the teacher and university researcher and complemented by teacher's reflections. Content analysis was carried out to categorize different types of uncertainties.

## **4. Participants**

Prior to the intervention, the teacher had already experimented with more participatory forms of teaching, asking students to contribute their own materials for grammar, listening and reading tasks and experiment with unfamiliar software when creating presentations. Distance learning enabled the teacher to partly employ the principle of "learning by teaching" with her higher secondary school students. The intervention was carried out with two groups of Year 12 students (aged 18-19, first iteration) and one group of Year 10 students (aged 16-17, second iteration) tasking the student to create a study aid on an area of English (grammar for Year 12 and vocabulary for Year 10) that would support their learning and be used by others studying the same topic. The language groups were divided into smaller teams of 3-4 students and each team was given a different topic. The students were free to choose any means and tools the considered best suitable for understanding the material. They were given the 'end product' – what the

users of their study aid need to know after having used their work. The pattern of the iteration was the same for both groups. During the intervention, the student had the chance to discuss their work either individually or during prescheduled webinars. Students were asked to reflect on their uncertainties at two checkpoints during the intervention: immediately after learning about the task, after finishing their study aid. The students were also asked to reflect on the whole process at the end of the intervention. All data was collected anonymously via Google Forms and the respondents could decide themselves whether they preferred to respond in English or Estonian.

## 5. Results

### 5.1. First Iteration

The first iteration consisted of 24 students belonging to two language groups in their final year of secondary education. Their major uncertainty concerned the study aid as students were not sure what was expected. The uncertainties students mentioned ranged from ‘where to start?’ to ‘What the final outcome should look like?’, to the length and level of details. Students mentioned that the task “had no boundaries”, making them “figure it out” themselves and not being sure what “form” the final product should take. Uncertainties related to the quality of the study aid caused students to wonder whether the study aid would be “understandable for everyone”, “useful”, or “concise” and how the users of the study aid would “cope with the exercise we have provided them with”. As the first iteration tasked the students with creating a study aid for grammar, participants expressed concern about their knowledge. One student pointed out that he/she was not sure how to formulate the study aid. Another respondent indicated that the task was not a straightforward one as “it made me wonder how it would be possible to easily explain a complex subject to as many students as possible since this topic is hard for myself”. After creating the study aid, the uncertainties expressed by students mainly concentrated on how the fellow students would receive their work, whether it would be sufficiently helpful, clear and interesting. At the end of the intervention the students were asked to think back to the process. 20 students from 24 said that they would like to try something similar in the future. The fact that the task was a demanding one, was expressed by the opinions that the task was quite time-consuming, and the respondents would not prefer to do it “with every new theme”. On the other hand, the responses show that students considered the task enriching and broadening their perspective, and instead of consuming the material take a more active role and understand better what being a teacher might be like.

The teacher’s uncertainties revolved round the product. It was a surprise to her that the final products were quite similar to the ones she would create – slides, worksheets, links to online sources, video explanations. The students working with the study aids said that if they had not known these had been made by Year 12 students, they would have thought the materials had come from a grammar book or from the teacher. This caused the teacher to wonder about school making students think “inside the box” and about her own role in fostering such approach. As the teacher chose not to interfere with the design process while being available for questions and clarifications, she wondered if interim discussions with the groups would have helped students become more creative. Since no teams used the opportunity of discussing their work with the teacher, this gave ground to the question of whether students are willing to reflect on what they are doing. None of the teams reported any issues with online collaboration and it was seen as something that supported them when dealing with doubts and considering possibilities. There was one team that reported in connection with dividing the tasks and communication. Although there was nothing to point the other way, the teacher still remained doubtful whether this was actually so or whether other teams chose not to report their problems.

### 5.2. Second Iteration

The second iteration involved 16 students from year 10, a class that had been formed only two months before the intervention took place. The task was adopted to the curriculum and included a vocabulary learning task. The students had to evenly distribute a vocabulary list among themselves, form pairs, create a study aid for and try out study aids created by at least four other pairs. When introducing the task, the teacher this time stressed the need to reconsider the ways they learn vocabulary and come up with something different from what students were used to.

Again, the major source of uncertainty was related to the nature of the task. One of the students pondered what “original and innovative” means “in these days”, implying that it is not something easy to do. The condition was also problematic for another respondent who said that it was not easy “to find a new task type”. Students were worried that another pair coming up with the same kind of task may jeopardize their chance of being innovative. Some students were unclear of what they had to do and had to “read the instructions multiple times to exactly understand what we had to do”. As the students were not able to meet in class because of the COVID 19 restrictions, one of the students remarked that he or

she was lacking the experience of working in pairs online. Another student commented that the students had to “rely on each other and communicate very closely [...]” when choosing the vocabulary for the task. After the task was completed, uncertainties regarding the quality of the study aid arose. The main issues voiced were whether their work was good enough and what would happen next. In the final reflection, students pointed out that the intervention had been something different from “just doing plain exercises” and appreciated the task as being “fun” and “eye-opening”. One respondent pointed out that he/she actually obtained new vocabulary while creating the study aid (“it is like a two in one task”). A critical comment from one of the respondents suggested that everybody should have been given the entire wordlist rather than a predetermined number of words. Although online collaboration had been a major source of uncertainty at the beginning of the intervention, the students valued the chance of collaboration and socialization, the intervention “giving them an excuse to talk to someone new” and supporting the development of class community. Year 10 students reflected that their role had changed from passive consumers to active content creators which required them to find reliable web sources and trying out such digital tools they had not used for creating something before. The responses show students recognizing the difficulties of content creators: “it is not easy to do something interesting and different for students” and developing a new appreciation for teacher’s work. The students also developed their understanding of “good teamwork”, as they “couldn’t rely on a teacher, more on each other”.

While students appreciated the task, one of the teacher’s uncertainties with this class was whether the it was too easy. As the group was a new one to the teacher, she wondered whether the iteration taking place online only might have created an additional barrier that would not have been there had the intervention taken place in class setting. As both Year 10 and Year 12 interventions were carried out as curricular activities, the teacher was uncertain whether students would take the task seriously. Students had to realize that the vocabulary they were working with would eventually be checked in a test. If the task had not been demanding, students might not have taken it seriously. Yet another uncertainty the teacher had was in connection with the “fun” element of the task. Some tasks might have created more delight for the creators rather than the users -e.g. googling for different types of exercises and choosing something absurd. This was reflected in the group’s comment during a webinar after the intervention had ended as word had spread about certain tasks being “pointless” and being subsequently skipped by other students. This enticed the teacher to consider how to preserve what is enjoyable in the task while reinforcing a serious approach to it.

## 6. Discussion and conclusion

In the article uncertainty is perceived as a subjective experience of a situation where issues have not been determined and settled yet and as such are open to different possibilities. In school setting, it is teachers and students who take responsibility for resolving such situations. Although uncertainty can be conducive to learning for students and professional development for teachers it may also be a trigger to various defence mechanisms (Jordan, 2015). Such ambiguity can be productively dealt with within the triadic relationship that students and teacher are involved in.

When looking at the uncertainties the students express, there is a clear difference of those uncertainties related to expectations and the ones that can be seen as generative or productive. The shift from one to another can be seen dependent of triadic relationship. Students expressing concerns regarding the nature of the task can be seen as students focussing on what they thought the teacher might want them to produce. This can be seen as an indicator of students feeling the need to respond to the teacher, although the task was such that neither students nor teacher could know “the answer” beforehand. Such a situation may drive the teacher face her own uncertainties. If these take the form of providing more scaffolding or instructions, the students may be prompted as to what the desired outcome is. When the outcome remains open, the teacher maintains the role of a supervisor who points the students towards an open space and encourages them to continue their inquiry. Students expressing concerns regarding the quality and usefulness of their study aids can be seen to have experienced a shift in their focus away from what teacher might expect to what they could create together. This may also be considered a shift in perspective as the students understood that have a chance to create something that would help their peers. Such uncertainty can be seen as something truly reflecting the ambiguity of the task and might lead students take responsibility for the situation. The year 10 students who were concerned about online collaboration also faced an open situation and took responsibility for it, in due course not only completing the task but also learning to know each other better and strengthening their study community. From the teacher’s perspective, generative uncertainty requires finding a balance between being responsible for the students and providing open space for various interpretations. Whether uncertainties become generative or not depends on how they are managed within the triadic relationship between students and teacher.

## References

- Arendt, H. (1970). *On Violence*. New York: Harcourt, Brace & World INC
- Bardone, E., Burget, M., Saage, K. & Taaler, M. (2017). Making sense of responsible research and innovation in science education through inquiry-based learning. Examples from the field. *Science Education International*, 28(4), 293-304
- Baskerville, R. I. (1999). Investigating Information Systems with Action Research. *Communications of the Association for Information Systems*: Vol. 2, Article 19.
- Bergold, J., & Thomas, S. (2012). Participatory research methods: A methodological approach in motion. *Historical Social Research/Historische Sozialforschung*, 37(4), 191-222.
- Biesta, G. J. (2015). *The Beautiful Risk of Education*. London: Routledge.
- Birmingham, C. (2004). Phronesis: A model for pedagogical reflection. *Journal of Teacher Education*, 55(4), 313-324.
- Bohm, D. (2004). *On Creativity*. New York: Psychology Press.
- Budiyanto, C., Prananto, A., & Tan, F. T. C. (2019). Designing Embedded Case Study Research Approach in Educational Research. *International Journal of Pedagogy and Teacher Education*, 3(1), 1-18.
- Dewulf, A., & Biesbroek, R. (2018). Nine lives of uncertainty in decision-making: strategies for dealing with uncertainty in environmental governance. *Policy and Society*, 37(4), 441-458.
- Fiorella, L., & Mayer, R. E. (2013). The relative benefits of learning by teaching and teaching expectancy. *Contemporary Educational Psychology*, 38(4), 281-288.
- Floden, R. E., & Clark, C. M. (1987). *Preparing teachers for uncertainty*. Retrieved March 2022 from <https://files.eric.ed.gov/fulltext/ED285836.pdf>
- Fochler, M., & Sigl, L. (2018). Anticipatory uncertainty: How academic and industry researchers in the life sciences experience and manage the uncertainties of the research process differently. *Science as Culture*, 27(3), 349-374.
- Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path dependence or path creation? *Journal of Management Studies*, 47(4), 760-774.
- Hare, W. (2003). The ideal of open-mindedness and its place in education. *Journal of Thought*, 38(2), 3-10.
- Jordan, M. E. (2015). Variation in students' propensities for managing uncertainty. *Learning and Individual Differences*, 38, 99-106.
- Kessels, J. P., & Korthagen, F. A. (1996). The relationship between theory and practice: Back to the classics. *Educational Researcher*, 25(3), 17-22.
- Labaree, D. F. (2000). On the nature of teaching and teacher education: Difficult practices that look easy. *Journal of Teacher Education*, 51(3), 228-233.
- Lloyd, S., & Raikhel, E. (2018). "It was there all along": Situated uncertainty and the politics of publication in environmental epigenetics. *BioSocieties*, 13(4), 737-760.
- Lygo-Baker, S. (2019). Valuing Uncertainty. In S. Lygo-Baker, I. M. Kinchin, & N. E. Winstone (Eds.), *Engaging Student Voices in Higher Education*. (pp. 245-259). Palgrave Macmillan: Cham.
- Mintz, J. (2016). Bion and Schön: Psychoanalytic Perspectives on Reflection in Action, *British Journal of Educational Studies*, 64(3), 277-293.
- Moeran, B. (2009). From participant observation to observant participation. In S. Ybema, D. Yanow, H. Wels & F. Kamsteeg (Eds), *Organizational ethnography: Studying the complexity of everyday life* (pp. 139-155). Sage Publications.
- Scholz, R. W., & Tietje, O. (2002). *Embedded Case Study Methods: Integrating Quantitative and Qualitative Knowledge*. London: Sage.
- Schuck, S., & Buchanan, J. (2012). Dead Certainty? The Case for Doubt in Teacher Education. *Australian Journal of Teacher Education* 37(8).
- Schuck, S., Aubusson, P., Burden, K., & Brindley, S. (2018). *Uncertainty in teacher education futures: Scenarios, politics and STEM*. Springer.
- Sinnema, C., Meyer, F., & Aitken, G. (2017). Capturing the complex, situated, and active nature of teaching through inquiry-oriented standards for teaching. *Journal of Teacher Education*, 68(1), 9-27.
- Testa, I., Colantonio, A., Galano, S., Marzoli, I., Trani, F., & di Uccio, U. S. (2020). Effects of instruction on students' overconfidence in introductory quantum mechanics. *Physical Review Physics Education Research*, 16(1), 010143.



## TRANSITIONAL OBJECTS IN EARLY CHILDHOOD: WHAT PARENTS' THINK ABOUT THEIR IMPORTANCE?

**Sanja Tatalović Vorkapić**

*Faculty of Teacher Education, University of Rijeka (Croatia)*

### Abstract

The period of transition and adjustment in a new environment is a very dynamic and challenging phase in the life of every child and also of his/her parents. They have a strong impact on the child's psychological well-being and the strategies the child will later use during times of various adjustments and transitions. Having in mind this significant influence on the child's well-being, it is important to address the quality and manner in which the child will cope with the adjustment in kindergarten in order to provide adequate support and a sense of security. Transition is closely related to transitional objects defined as objects, most often soft toys that are chosen by the child chooses and that are irreplaceable in the new situation because they provide comfort in the separation from the caregiver and security in this situation. The use of transitional objects eases the child's transitions. Previous research has shown that the educational system is aware of their use and their role in the social-emotional functioning of toddlers and preschoolers, which is evident in the practice of kindergartens and schools. However, the question arises as to how parents perceive their importance, which is also the main objective of this study. Therefore, an online survey with 29 questions was conducted among a sample of 100 parents (82 mothers) of preschool children in Croatia. The results of the survey suggest that the attitude of parents is positive, and through their partial agreement, positive experiences with transitional institutions and their great importance in moments of adjustment into the new environment, i.e. kindergarten, are highlighted. Parents emphasized the frequent, everyday use of transitional objects during transitions, as well as their facilitation of the whole process. Based on the survey and its results, the frequent use and variety of transitional objects such as stuffed animals, toy cars, cloths, pacifiers and bottles, and various toys is evident. Because there is a significant lack of empirical research on transition and the importance of transitional objects, the contribution of this article is evident in the context of increasing knowledge and sharing experiences of parents of early childhood and preschool children. With its diversity, it will contribute greatly to the progress of educational practice. The adjustment process itself is a big step in the life of every child and should be treated with a lot of respect and understanding.

**Keywords:** *Children of an early and preschool age, parents, transitions, transitional objects, well-being.*

---

### 1. Introduction

Childhood transitions represent periods in children's lives that are filled with numerous mixed emotions that can affect children's well-being in positive or negative ways, whether we focus on short-term or long-term transition effects (Mashburn, LoCasale-Crouch & Pears, 2018; Pianta & Cox, 1999; Pianta & Kraft-Sayre, 2003; Tatalović Vorkapić, 2019a,b; 2020, 2021a,b; Tatalović Vorkapić & LoCasale-Crouch, 2021). So, it is of utmost importance to explore transition's determinants, i.e., all factors that can facilitate childhood transitions and ensure children's socio-emotional well-being (Rimm-Kaufman & Pianta, 2000). One of those important factors are transitional objects, which are defined as follows: "An object, typically a soft toy, chosen by an infant or child. Irreplaceable, the object is imbued with the child's feelings for and experience of his or her primary caretaker. The child uses the transitional object to aid the transition from primary dependence to independence." (Wilson & Robinson, 2002:861). Winnicott (1953), a British pediatrician and psychoanalyst, studied transitions and transitional objects. He found that children have a strong need to possess a particular object, especially during separation from their attachment figures. Such transitional object has a symbolic function in maintaining continuity of closeness to parents during difficult separation situations. Transitional objects are often cuddly toys such as stuffed animal, as well as blankets or other soft materials that retain the child's familiar smell and provide great comfort (Tatalović Vorkapić, 2021c). They play an important role in the child's psychological development and well-being and are thought to facilitate the individuation process by replacing the primary caregiver and facilitating separation within the developmental stage of autonomy and its conflict with the child's dependency (Mahler, 1972). A study by Bachar and colleagues (1998) found that participants who reported

frequent use of transitional objects and high levels of attachment also had optimal attachment to their mothers and higher levels of well-being. Objects such as toys, pacifiers, and wipes provide children with an additional sense of comfort and security. Such objects represent a connection to children's family and home, and their absence can cause discomfort, anxiety, and sadness in children.

According to a previous study (Tatalović Vorkapić, 2021c) conducted on a sample of 287 pre-service and in-service educators across Croatia, predominantly positive experiences during childhood transition were found. The largest number of initial transitions was from home to kindergarten, where parents or caregivers provided the most support. Soft toys are cited as the most commonly used transitional object, followed by blankets and pillows, then pacifiers and bottles. They are often chosen by children later on as well, and not just in the early days, because they provide comfort, security, and peace of mind as they fall asleep. In addition, of all the sensations, the early childhood educators interviewed cited touch as the most common sensation by which they experience the comfort provided by their transitional object. This rare research in Croatia shows that educators have had different experiences with transitional objects during childhood transition and are aware of their importance to psychological well-being in childhood. In addition, it is necessary to mention another study conducted with the aim of investigating the perspective of children, parents and educators on the organization of the transition from home to kindergarten during the coronavirus pandemic (Tatalović Vorkapić, 2022). Regardless of the major problems that occurred during the pandemic, this research highlighted the particular satisfaction of parents and educators with the cooperation with the kindergarten. Parents, children, and educators pointed out the good (e.g., more time spent outdoors by children, separation from parents already at the beginning of kindergarten, which contributed to greater development of independence) and bad aspects of the organization of the transition (e.g., lack of touch opportunities, wearing face masks, and inability to bring a transitional object to kindergarten) during the pandemic. Even though, most parents emphasize children's successful adjustment in kindergarten, children reported about missing their transitional object in kindergarten. Following the contemporary Ecological-dynamic model of transition (Rimm-Kaufman & Pianta, 2000), the paper emphasizes the great importance of interpersonal relationships in the culture in which a child lives, thus exploring the perspectives of educators and children as well as parents (Early et al., 2001; Einarsdóttir, Perry & Dockett, 2008).

## 2. Research design & objectives

Considering the significance of transitional objects during children's transitions, parents' perceptions of the importance and use of transitional objects for their preschool-aged children were explored through an online survey. In light of previous research, it is expected that parents will show positive perceptions of transition objects in relation to their importance and that they will indicate the frequency and importance of their children's use of various transition objects during transition.

## 3. Methods

### 3.1. Participants

A total of 100 parents of children enrolled in kindergarten in Lovran, Croatia, participated in this study. Among the respondents were 18 fathers and 82 mothers. The average age of the parents was 34 years ( $M=33.6$ ,  $SD=4.52$ ), and the age range was from 24 to 46 years. Parents estimated the duration of their children's adjustment in kindergarten to range from 0 to 10 months, with an average adjustment duration of two months ( $M=1.89$ ,  $SD=1.71$ ). The sample of children studied also included  $N=100$  children (42 girls, 58 boys). The average age of the children was 4 years ( $M=3.81$ ,  $SD=1.36$ ) with a range of 1 to 7 years.

### 3.2. Measures & procedure

For the purpose of this study, an online survey using a Google form was created for parents. The introductory part of the survey included Informed consent and instructions for parents. It consisted of 27 closed-ended questions and three open-ended questions, which can be seen in the Table 1. Because the survey was designed as an integral part of the university science project "*Children's well-being in transition periods: The empirical validation of Ecological-dynamic model*", the approvals of the National Ministry of Science and Education and the Ethics Committee of the Faculty of Social Sciences and Humanities at the University of Rijeka were used for communication with kindergarten directors. After obtaining consent to conduct the study in the kindergartens of Lovran, the invitation to the study was sent to the parents of the registered children. Data collection was anonymous and confidential, and feedback was provided.

## 4. Results & discussion

The collected data were processed at a descriptive level, including basic statistical parameters: Means ( $M$ ) and Standard Deviations ( $SD$ ) of the results, which can be seen in Table 1. On average, there

were no responses where parents did not completely agree with any of the items. Furthermore, parents partially disagreed with three items, namely that their child participates more easily in interactions with other children when they do not have a transitional object, that they do not feel the need to retrieve the transitional object when the child forgets it due to his/her anxiety, and that the child is not upset when one leaves without a transitional object. The "maybe" responses were expressed by parents with a larger number of items, 7. This expressed their divided opinion on the following questions: does their child cry and feel restless and grumpy when they do not have their transitional object with them; whether the transitional object affects their interaction with other children and sharing the transitional object with them; whether the transitional object affects their communication with the child; the role of transitional objects during the pandemic in terms of the impossibility of their adoption and possible impact on the children; and whether transitional objects are also items of clothing that the child brings from home. This shows partial agreement with the previous studies in Croatia (Tatalović Vorkapić, 2022).

Table 1. Descriptive parameters (Means, Standard Deviations) of questionnaire items and in total.

Items	M	SD
My child participates less in interactions with the rest of the educational group when there is no transitional object.	2.30	1.13
Many times we have returned home to get the transitional object and bring it to our son/daughter because it was very sad and/or frustrating without it.	2.33	1.30
When we go somewhere, kindergarten or otherwise, and we forget to bring a transitional object, my child gets very upset.	2.52	1.21
My child cries more when he doesn't have a transitional object with him/her.	2.67	1.27
My child feels bad ((s)he's grumpy, cries, doesn't cooperate) when (s)he doesn't bring his/her transitional object to kindergarten even though (s)he wants to.	2.84	1.21
My child is more open to interactions and prefers to play with peers when (s)he has his/her transition object with him/her in kindergarten.	2.89	1.25
During the pandemic, bringing transitional objects was hard or prohibited altogether, making the transition more difficult.	2.93	1.37
I find it easier to establish and maintain communication with my child when (s)he has his/her transitional object with him/her during transition and adjustment.	3.07	1.29
Transitional objects are very often clothing items that the child brings from home.	3.13	1.18
My child is hesitant to share his/her transitional object with others.	3.27	1.30
When my child entered kindergarten, the adjustment was quick.	3.66	1.25
Soft toys or so-called stuffed animals are very often a transitional object.	3.91	1.07
As a parent, I am very aware of the importance of using a transitional object for my child.	3.93	1.15
Transitional objects are very important for children during the transition and adjustment period.	3.97	1.15
Transitional objects are very often children's favorite toys.	4.04	0.98
During the transition and adjustment period, both educators should be constantly working with the children in the group.	4.06	1.01
Transitional objects are very important for a quality and easier transition and adjustment of the child in the kindergarten.	4.09	1.13
Transitional objects are the greatest comfort for a child when they go to sleep or when they experience a negative emotion (when they are (s)he is sad or miss their parents).	4.10	1.01
Transitional objects are often objects that comfort the child (pacifier, feeding bottle, etc.).	4.12	1.05
The relationship the child has with me (the parent), i.e., the type of bond he or she has developed with me, is critical to the quality of the transition and the child's adjustment in kindergarten.	4.19	0.96
I am satisfied with the quality of my child's adjustment to kindergarten.	4.21	0.94
Good organization of the kindergarten's work is essential for the quality of my child's transition and adjustment to kindergarten.	4.21	1.03
When the child has his/her own transitional object, (s) he calms down faster and feels in an unfamiliar environment.	4.23	0.98
I believe that kindergartens should always allow the child to bring his/ her transitional object to kindergarten.	4.26	1.08
Transitional objects give children a sense of and security in a new, unfamiliar situation.	4.28	0.91
My child is happy and content in kindergarten.	4.46	0.83
For a good transition and adjustment of the child in kindergarten, it is crucial that the early childhood educators get to know each child coming to kindergarten very well.	4.64	0.81
It is very important to achieve a good cooperation with the early childhood educators in the group where my child is enrolled.	4.70	0.70
<b>Total</b>	<b>3.69</b>	<b>0.68</b>

Parents expressed their partial agreement with most of the items, more precisely with 15 of them, and their full agreement with 4 of them, which shows the dominance of positive attitudes towards the importance and influence of transitional objects for their children during the transition and adjustment in kindergarten (Table 1). It was found that parents are aware of the importance of transition objects for their children and have a positive image of their children's transition. Partial agreement also refers to the materials from which transition objects are most often made, as well as the reassuring role of the transition object during the transition. In addition, parents emphasized the importance of good cooperation with the early childhood educators of the educational group in which the child experiences transition, and parents gave the highest score in this category to the statement that their child is happy and satisfied in kindergarten. Looking at the average result of parents' responses to all items, it was found that parents attach importance to transitional objects ( $M=3.69$ ,  $SD=.67$ ), what was expected.

The remaining three statements in the parent survey were processed qualitatively. Regarding the first open-ended question: *Choose which sensation is most associated with the comfort that the transitional object provides to your child*, it was found that most parents chose touch as the sensation that provides the most comfort to their child, followed by sight, smell, and taste, as in previous research (Tatalović Vorkapić, 2021c). The last two open-ended questions were evaluated according to the specified frequencies: *If there were an ideal transitional object, what do you think it would look like? Please describe it;* and *Please list all the transitional objects your child has used so far*. It was found that the ideal transitional object was also a stuffed animal in  $N=27$  cases, followed by wipes and pacifiers and all soft, comfortable, lightweight and easily washable materials, which is a confirmation of previous research. Six parents stated that there is no ideal transitional object, and three of them do not know which object would be an ideal transitional object. Most parents responded that the transitional object in their child's life was a stuffed animal (bear, bunny, unicorn, horse, dog, dolphin, etc.) ( $N=24$ ). 17 parents stated that their child did not have a transitional object. The use of a pacifier as a transitional object ( $N=14$ ) is also not at all surprising, as children at an early age relieve their stress through oral stimulation, thus facilitating separation from the mother, and this type of stimulation is one of the most common (Gulcerce, 1991).

## 5. Conclusions

The purpose of this study was to examine the meaning and use of transitional objects during preschool children's transition and adjustment in kindergarten from the parents' perspective. Using an online survey developed specifically for this study, the purpose was to examine how parents view the importance and use of transition objects for their preschool children. The results of the survey suggest that parents' attitudes are positive, and their partial agreements highlight positive experiences with transitional objects and their great importance in moments of adjustment to a new environment, i.e. kindergarten. Parents emphasized the frequent, daily use of transitional objects during the transition period, as well as their usefulness and facilitation of the whole process, which is consistent with the perception of kindergarten teachers from the previous research. Although this study has the limitation of a relatively small and selected sample, as there are very few studies that focus on transition and the importance of transition objects when children are adjusting into kindergarten or a new environment, the contribution of this study is to expand knowledge and share the experiences of parents of early and preschool-aged children. With its diversity, it will contribute greatly to the advancement of educational practice. The transition is a major step in any child's life and should be taken seriously in terms of quality kindergarten transition practices. Practical implications of this study could be seen in the need for better quality collaboration with parents, informing them about the benefits of transitional objects during their children's transition.

## Acknowledgements

This work has been supported in part by the University of Rijeka under the project number (uniri-drustv-18-11): *"Children's well-being in transition periods: the empirical validation of ecological-dynamic model."* Also, many thanks to Viktorija Kršulj for her support during this research.

## References

- Bachar, E., Canetti, L., Galiee-Weisstub, E., Kaplan-DeNour, A., & Shalev, A. Y. (1998). Childhood vs. Adolescence Transitional Object Attachment, and Its Relation to Mental Health and Parental Bonding. *Child Psychiatry and Human Development*, 28(3), 149-167.
- Early, D. M., Pianta, R. C., Taylor, L. C., & Cox, M. J. (2001). Transition Practices: Findings from a National Survey of Kindergarten Teachers. *Early Childhood Education Journal*, 28(3), 199-206.

- Einarsdóttir, J. Perry, B., & Dockett, S. (2008) Transition to school practices: comparisons from Iceland and Australia, *Early Years*, 28(1), 47-60, doi:10.1080/09575140801924689
- Gulerce, A. (1991). Transitional objects: A reconsideration of the phenomenon. *Journal of Social Behavior & Personality*, 6(6), 187–208.
- Mahler, M.S. (1972). On the first three subphases of the separation-individuation process. *International Journal of psychoanalysis*, 53, 333-338.
- Mashburn, A. J., LoCasale-Crouch, J., & Pears, K. C. (2018). *Kindergarten transition and readiness: Promoting cognitive, social-emotional, and self-regulatory development*. Switzerland: Springer Cham. <https://doi.org/10.1007/978-3-319-90200-5>
- Pianta, R. C., & Cox, M. J. (1999). *The transition to kindergarten*. Baltimore: Paul H. Brookes.
- Pianta, R.C. & Kraft-Sayre, M. (2003). *Successful kindergarten transition*. Baltimore: Paul Brookes Publishing Co.
- Rimm-Kaufman, S. E., & Pianta, R. C. (2000). An ecological perspective on the transition to kindergarten: A theoretical framework to guide empirical research. *Journal of Applied Developmental Psychology*, 21, 491–511.
- Tatalović Vorkapić, S. (2019a). Children's well-being during transition periods in Croatia: The proposal of empirical validation of Ecological-dynamic model. In: L. Gómez Chova, A. López Martínez, I. Candel Torres (Eds.) *INTED2019 Proceedings, 13th International Technology, Education and Development Conference*, 11th-13th March, Valencia, Spain (pp. 265-276).
- Tatalović Vorkapić, S. (2019b). Podrška socijalno-emocionalnoj dobrobiti djece u Hrvatskoj: Prikaz tri znanstveno-stručna projekta (Support for socio-emotional well-being of children in Croatia: Presentation of three scientific projects. In Croatian). In: M. Orel (ed.) *EDUVision 2019 – Sodobni pristopi poučevanja prihajajočih generacij* (pp. 69-83). Ljubljana, Slovenija, EDUvision, Stanislav Jurjevčič s.p.
- Tatalović Vorkapić, S. (2020). *Psihologija privrženosti i prilagodba u dječjem vrtiću – Psihologija dobrobiti djece vol. 1*. (Attachment psychology and adjustment in kindergarten – The Psychology of child well-being, vol. 1. In Croatian). Faculty of Teacher Education, University of Rijeka, Croatia.
- Tatalović Vorkapić, S. (2021a). *Kako bez suza u dječji vrtić i osnovnu školu?: Podrška socijalno-emocionalnoj dobrobiti djece tijekom prijelaza i prilagodbe, Psihologija dobrobiti djece vol. 2*. (How to go to kindergarten and primary school tear-free?: Support for the socio-emotional well-being of children during transition and adaptation, Psychology of child well-being vol. 2. In Croatian). Rijeka: University of Rijeka, Faculty of Teacher Education & City of Rijeka. ISBN: 978-953-7917-32-6 (PDF). <https://urn.nsk.hr/urn:nbn:hr:189:492309>
- Tatalović Vorkapić, S. (2021b). The challenges of children's transition to kindergarten: How early childhood educators perceive their relationship with children during transition? In: L. Gómez Chova, A. López Martínez, I. Candel Torres (Eds.) *INTED2021 Proceedings, 14th International Technology, Education and Development Conference, 8-9. 3. 2021, Valencia, Spain* (pp. 8300-8311).
- Tatalović Vorkapić, S. (2021c). A Retrospective Study on Transitions and Transitional Objects. In: S. Rutar, D. Felda, M. Rodela, N. Krmac, M. Marovič & K. Drljić (Eds.) *Transitions in different social and educational environments* (pp. 15-32). Koper: Založba Univerze na Primorskem, Slovenia.
- Tatalović Vorkapić, S. & LoCasale-Crouch, J. (2021). *Supporting Children's Well-being during Early Childhood Transition to School*. Hershey, PA: IGI Global, USA.
- Tatalović Vorkapić, S. (2022). How to support early educational transitions of children? – An overview of university science project's activities from Croatia. In A. A. Colomeischi (Ed.) *8<sup>th</sup> ENSEC Conference: Social Emotional Learning and Positive Development: Abstract Book* (p.90). European Network for Social and Emotional Competence (ENSEC), Ștefan cel Mare University of Suceava, Suceava, Romania, Learning for Life Society, Suceava, 30.6.-2.7. 2022, Romania.
- Wilson, A., & Robinson, N.M.T. (2002). Transitional Objects and Transitional Phenomena. In M. Hersen & W. H. Sledge (Eds.) *Encyclopedia of Psychotherapy 2*, (pp. 861-866). Amsterdam: Elsevier.
- Winnicott, D.W. (1953). Transitional objects and transitional phenomena. *International Journal of Psycho-Analysis*, 34, 89–97.

## DEVELOPMENT OF CRITICAL THINKING - WISFUL THINKING OR REALITY IN ELEMENTARY SCHOOLS

**Dana Hanesová, & Katarína Vančíková**

*Faculty of Education, Matej Bel University in Banská Bystrica (Slovakia)*

### Abstract

One of the trends in the current curriculum design and goals of teaching methodology at all levels of education is the development of critical thinking as one of the highest priorities of educators. The authors of the article reflect on the extent to which the development of critical thinking is implemented in primary schools as part of the foreign languages teaching (FLT). In some countries of continental Europe, it reflects their long history of transmissive and encyclopedic education and its only very slowly weakening influence on the current training of future specialists. Is the development of critical thinking still just a teacher's wishful thinking or a phrase about cross-cutting competence in the school curriculum? What is the cause of this phenomenon? The article presents the results of a content analysis of current foreign language teaching curricula in the area of critical thinking implementation, and compares them with experiences with development of critical thinking of primary school teachers. The authors bring ideas for the development of critical thinking in the teaching of foreign languages in primary schools.

**Keywords:** *Critical thinking, educational curriculum, development, primary school teachers, teaching foreign languages.*

---

### 1. Introduction: The concept of critical thinking

The term ‘critical thinking’ as a kind of scientific attitude of mind was introduced by John Dewey as early as 1910. According to Dewey, critical thinking should be one of the main educational goals. In 1933, in his revised edition of *How We Think* with the sub-title “A restatement of the relation of reflective thinking to the educative process”, Dewey replaced the use of the words “critical” and “uncritical” in the previous edition with “reflection” or “reflective thinking” (Hitchcock, 2018).

Another important step in the development of the concept of critical thinking in education was the first hierarchy of educational goals for the cognitive domain by B. S. Bloom et al. (1956). This taxonomy distinguished between lower (knowledge, understanding, application) and higher (analysis, synthesis, evaluation) intellectual or critical thinking abilities and skills. In the revised Bloom's Taxonomy, Anderson & Krathwohl said that ‘critical thinking’ and ‘problem solving’ „are widely used and tend to become touchstones of curriculum emphasis” (2001, p. 269-270). According to neuroscientific research, all thinking skills seem to be relatively independent of each other (Kagan, 2005).

From a normative aspect, critical thinking is “the correct assessing of statements” (Ennis, 1962, 83). According to later Ennis's works, “critical thinking is reasonable and reflective thinking focused on deciding what to believe or do” (Ennis, 2015, p. 45). In deciding what to believe or do, we are helped by the employment of a set of critical thinking dispositions and abilities. Critical thinking skills are not subject specific, so they have to be developed across the whole curriculum (Ennis, 2015).

Critical thinking is a concept that is written a lot by individual experts, educational authorities, international organizations, e.g. the OECD, the EU, the UN, the World Bank, but there is no general agreement about what, precisely, it means (Kerr, 2022). For the purposes of this study, by critical thinking we mean “the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning ... as a guide to belief and action” (Scriven & Richard, 1987).

#### 1.1. Historical trajectory and current trends of critical thinking in education

The increasing emphasis on critical thinking is a significant shift in continental European education with a long history of encyclopedic teaching. It is not just about proclaiming the need to teach students to think critically; it emphasizes verifying whether higher cognitive skills have been developed.

In Central and Eastern Europe, the first calls to transform the transmissive approach to educating young people date back to the 1990s, after the fall of the Iron Curtain. In the context of the previous historic development, the personalized and humanistic orientation of teachers in post-communist societies

was a great challenge. This emphasis went hand in hand with the constructivist approach, aimed at developing not only lower but also higher thinking skills. With a sufficient amount of simplification, the 1990s can be described as a shift from teaching facts using indoctrinating, encyclopedic approaches to development of humanistic, constructive and reflective ways of teaching how to think.

With the emergence of democracy in the post-Soviet states, efforts to reform education began to intensify. Teachers were encouraged to focus more on development of students' cognitive and non-cognitive functions than on their learning outcomes. In Slovakia, the Millennium project and the National programme of education (2001) appealed to educators to several important shifts, e.g. from dogmatism to humanization, from uniformity to variability, from reproductive methodology to heuristic one, and from passing on encyclopedic knowledge on the pupils to children's holistic development, including their ability how to learn and critically think. The aim of cognitization in Zelina's KEMSAK model (1996) was to start teaching children to explore, think and solve problems, using various thinking strategies and heuristic methods. Zelina suggested that the higher thinking skills (analysis, evaluation, creativity) should be developed in all school subjects in all age groups. This challenge was also supported by the influence of the constructivist theory of learning in school practice. At the turn of the Millennium, the cognitive-affective-heuristic model began to be used in the teaching of English as a foreign language in Slovakia.

Currently, in the third decade of the 21st century, the development of critical thinking as one of the highest priorities of educators has become one of the inevitable components of the current curriculum and the goal of teaching methodology at all levels of education in many countries. Teachers' tasks need to be expanded to include providing students with both cognitive and non-cognitive skills, including critical thinking (TALIS, 2014, 86). To develop critical thinking, curriculum designers and teachers use Halpern's model (2014) that includes development of not only skills and methods of critical thinking, but also of an attitude, inclination, or willingness to apply these skills, the ability to identify appropriate opportunities for critical thinking and the ability to monitor progress and quality of thinking.

The development of critical thinking skills in foreign language teaching (FLT) is becoming more real with the growing emphasis on CLIL – content and language integrating learning since 1994. CLIL as a constructivist methodology has a real potential to stimulate the development of critical skills because it refers to authentic situations of acquiring knowledge from various subjects through a foreign language. CLIL allows learners to use language as tool of thought rather than only a tool of communication, as it develops higher mental flexibility, including ability of concept-formation, analyzing semantic features in greater detail, ability of reorganizing information etc. (Kovács & Benkó, 2014).

Learners do not learn a language only just to get to know the language, but to find new information in the target language and to think in it. CLIL offers such an educational environment in which students have the chance to use their cognitive abilities and create their own knowledge. They are intellectually challenged to transform information, solve problems, discover meaning through critical and creative thinking. When creating meaning, students mainly use the following thinking skills: analyze, differentiate, organize, sort, compare, contrast, synthesize, guess, evaluate and create. This kind of learning works to develop flexibility in their thinking.

## 1.2. Critical thinking - a wishful dream or a reality in elementary schools?

Although according to TALIS 2014 & 2018, over 80% of teachers self-reported that they help students think critically. and almost 60% 'frequently or always' give students tasks that require students to think critically. However, the truth behind these self-reports is debatable. Some Australian experts doubt whether the self-reports of 2/3 Australian teachers in TALIS 2018 are a real evidence of whether their children are actually learning critical thinking in school; "the understanding of how students actually learn is rarely reflected in school curriculums, teaching practice guides, and student assessment" Henebery (2022). Here data from Slovakia are used as an example. According to TALIS 2014, 90% of Slovak teachers - in contrast to 51.8% of Czech and 15.6% of Japanese - think that they can help students think critically. On the other hand, according to GLOBSEC survey, Slovakia is the most conspiracy-prone in Visegrad (Klingová, 2019). About 20% of TALIS 2018 teachers are not convinced that there is enough research-based evidence about the impact of critical thinking activities (Huber & Kuncel, 2016).

Despite the fact that, for more than a century individual teachers as well as national and transnational organizations (the U.N., the OECD, the E.U., the World Bank) have been enthusiastic about critical thinking as one of the key educational goals, some authors are skeptical about the real fulfilment of this trendy dream. Kerr doubts "the ability of educational activities to have a positive impact on the generic critical thinking skills of learners in English language classes," and adds that "there is so little critical thinking about critical thinking in the world of English language teaching" (2022).

## 2. Research methodology and results: The case of Slovakia

The *aim* of our research was to find out the current state of the development of critical thinking from two perspectives - to what extent it is part of the new educational curricula to what extent it is part of the professional preparation of teachers in higher education in Slovakia. Two *research methods* were used to assess the level of the presence of critical thinking development: qualitative content analysis of the latest educational curricula and its comparison with the results of a quantitative-qualitative survey among primary teachers. Here are some of the *data obtained*:

Slovakia is currently in the midst of launching a curriculum reform called Education for the 21st century. Until now, education in Slovakia has been governed by the State Educational Program, a complex binding document that set out the general goals of education and the key competencies towards which 'basic' education for children 6-15 years old should be directed. It has been valid from 2011. This document includes an emphasis on critical thinking, i.e. the ability to seek, analyze and select information using interdisciplinary knowledge, diverse skills and a critical approach; construct informed decisions based on evidence and changing attitudes in the light of persuasive and valid argument; critically evaluate one's own progress, receive feedback and be aware of opportunities for one's own development; be able to critically evaluate the products of one's own culture and those of other cultures.

The forthcoming reformed curriculum for primary and lower secondary pupils further emphasizes critical thinking and the ability to solve problems as one of the six *global skills*, the development of which must be ensured at all levels of education, within all subjects including foreign languages (Pupala & Fridrichová, 2022). Their graduates should be able to use critical thinking based on knowledge and ethical values (p.17). The section focusing on Language and Communication, which includes educational principles for all linguistic subjects (mother tongue and 2 foreign languages), is devoted to the age-appropriate development of critical thinking. At the age of 12 to 15, the emphasis is on the active use of an increasingly wide range of various texts and multimedia (in addition to the textbooks) with the intention of searching, sorting and critically evaluating the text, its information and sources, as well as on the skills of active and critically listening, reasoning and problem-solving skills.

So as far as curriculum text is concerned, Slovakia has for more than a decade emphasized the development of critical thinking - comparably to its neighboring countries. However, it does answer the question whether creative and critical thinking is really a matter of our schools.

Although there are some ways of assessing partial critical thinking skills, there is no single standardized way across countries that conclusively shows the current level of critical thinking development in a certain school. Nevertheless, as part of the *Learning Makes Sense* project in 2018, we accomplished an in-depth and, as far as the respondents were concerned, extensive survey to find out whether critical thinking was part of school practice. Survey respondents (N=2826) included principals, teachers and students of 399 kindergartens, 434 primary and 212 secondary. The results showed that about 20% of students develop their critical thinking (e.g at secondary level). According to the experience of almost a third of secondary school teachers, students leave primary school with insufficient skills, which indicates insufficiently developed critical and creative thinking. Vančíková et al (2019) also found out that around 80% of teachers still use explanation and discussion as their main teaching methods; explorative methods and EUR strategies are used only by 20% of teachers. The survey authors came to the conclusion that it is more than questionable whether the way children are led in schools meets the requirements for the development of critical thinking. They call for more intensive use of such strategies, with which the school educates critically-minded personalities with their own attitude towards the world.

When comparing both sets of data (from the survey and the curriculum), we can state this: Despite the fact that the state curriculum has long emphasized the development of students' critical thinking, it is still not clear to what extent it is applied in schools. There is not enough research-based evidence for this.

## 3. Discussion and recommendations for developing critical skills in FLT

To teach young learners critical thinking that would develop their autonomy, increase their motivation, and promote their authentic communication has to be faced not as a self-evident capability of most teachers; it is a real challenge – especially for the generation of teachers, whose own education is either marked by indoctrination, or at the very least, based on memorizing facts rather than analysis and problem solving. Among the experts, there are several suggestions on how to respond to it. Some say that there is still a lack of a sufficiently clear definition of critical thinking or that teachers still lack sufficient knowledge and skills about how to develop students' critical thinking (Gedik, 2013). According to Hughes and Dummet (2020), critical thinking in FLT must include rational and reasonable *reflection* on language at three levels: of words and sentences, of text and of the idea. Sweller suggests supporting the learners' innate abilities by "increasing the domain-specific knowledge base" (2022, p.1).

Based on the experience of good practice, here are some recommendations for developing the



critical thinking of FL teachers and students in primary schools:

- Encourage learners to communicate producing spoken or written outputs while continuing a responsible teaching and teacher training about the linguistic phenomena of languages (knowledge of vocabulary and grammatical structures) – This helps them “to think through ideas, to express them, to share knowledge, to give feedback, review ideas, to adapt and refine ideas and to negotiate solutions” (Dale, Van der Es & Tanner, 2011, p. 121).
- Implement neuroscientific findings into FLT - creating a stimulating learning environment enabling positive emotional state of learners (Jensen, 2005). Emotions can stimulate the learner’s brain chemically which will help them to more effectively recalling of knowledge.
- Use productive, open questions and tasks in EFL to contribute to acquiring higher cognitive skills and communicative competence (Gondová, 2011). They help learners to construct their own learning through using their cognitive skills (via comparing, reflecting, finding purpose).
- Teach to formulate argumentation - The argument can be thought of as the message that is being conveyed, whether through speech, writing, performance, or other media. Cottrell suggests that teachers use also the following skills developing critical thinking: identifying other people’s positions, arguments and conclusions, evaluating the evidence for alternative points of view, weighing up opposing arguments and evidence fairly, being able to read between lines, seeing beneath the surface, and identifying false or unjustified assumptions, recognizing techniques used to make certain positions more appealing than others, such as false logic and persuasive devices, reflecting on issues in a structured way, bringing logic and insight to bear, drawing conclusions about whether arguments are valid and justifiable, presenting a point of view in a structured, clear, well-reasoned way that convinces others (Cottrell, 2005).
- Apply novelty and variation in time, space, movement and grouping: energizers; problem solving techniques; presentation of meta-cognitive strategies to improve the memory and information retrieval; visualization (mnemonics, peg words, music, discussion, pictures, mind-maps, graphic organizers, posters); peer teaching, co-operative work, interrupted and repeated solution seeking; episodic strategies (changes in location, circumstances; emotions, movement, novel classroom position (field trips, music, guest speakers, journal writing, projects, peer teaching; quizzes, small group presentations, structured timed tests, real life studies); reflexive strategies (Taylor, 2006).
- Implement scaffolding class activities (discussions, writing, presentations) around critical-thinking tasks. This integration helps to strengthen language knowledge (better use of grammar) and develops not only cognitive, but also communication skills in more complex topics (Snider, 2017).
- Be an example of critical thinker for students (Snider, 2017).

In order to develop unbiased cognition and skills, the person has to get involved not just in straightforward thinking and acting impulsively, but also in a reasonable process of plan preparation, has to be flexible and open-minded, willing to “abandon nonproductive strategies in an attempt to self-correct”; and aware “of the social realities that need to be overcome” (Halpern, 2014, p. 24).

#### **4. Conclusion**

Critical thinking has become not only a fashionable educational trend, but also a mandatory part of state educational curricula and teacher training. School inspectorates have a mandate to check whether teachers at all levels teach critical thinking in everyday professional practice. We think that the first question that foreign language teachers must be able to answer is whether they understand what critical thinking is, whether they can identify it not only in their FLT textbooks, but especially in real life - private, institutional and social. Thus, "explicitly teaching critical thinking skills in a foreign language" will become “one way to strengthen language and cultural knowledge while building students' higher-order thinking skills” (Snider, 2017). A second, equally important question is whether the language teachers are willing to reflect and think critically about their own critical thinking, as well as their own ability to teach critical thinking to their FLT students and subject it to regular scientific inquiry (at least action research).

#### *Acknowledgements*

The contribution is an output of the research project KEGA No. 011UMB-4/2022 called Creation of a web portal for methodological support of foreign language teaching in primary education and also of the research project KEGA No. 008UMB-4/2022 called Education as a gateway to thinking: integration of reading, academic and critical skills as a precondition to intellectual capital of universities and internationalization of education.

## References

- Anderson, L. W., Krathwohl, D. (Eds.) (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.
- Bloom, B., Englehart, M., Furst, E., Hill, W., & Krathwohl, D. (1956). *Taxonomy of educational objectives: The classification of educational goals I: Cognitive domain*. New York: Longmans.
- Cottrell, S. (2005). *Critical Thinking Skills*. New York: Palgrave. Macmillan
- Dale, L., Van der Es, W., & Tanner, R. (2011). *CLIL Skills*. Leiden: Universiteit Leiden.
- Dewey, J. (1991). *How to think*. Buffalo, NY: Prometheus Books.
- Dummett, P., & Hughes, J. (2020). Critical Thinking in ELT: A Working Model for the Classroom. *National Geographic Learning: English Learning*. Retrieved 04 04, 2023, from [https://eltngl.com/search/productOverview.do?N=4294918503+200+89&Ntk=P\\_EPI&Ntt=1138636577213896053320180523201133226&Ntx=mode%2Bmatchallpartial&homePage=false\\_](https://eltngl.com/search/productOverview.do?N=4294918503+200+89&Ntk=P_EPI&Ntt=1138636577213896053320180523201133226&Ntx=mode%2Bmatchallpartial&homePage=false_)
- Ennis, R. H. (1962). A Concept of Critical Thinking: a proposed basis for research in the teaching and evaluation of critical thinking ability. *Harvard Educational Review*, 32(1), 81-111.
- Ennis, R. H. (2015). Critical Thinking: A Streamlined Conception. In M. Davies, & R. Barnett. (Eds.). *The Palgrave Handbook of Critical Thinking in Higher Education* (pp. 31-47). NY: Palgrave Machmillan.
- Gedik, H. (2013). Social studies teacher candidates' critical thinking skills. *Procedia – Social and Behavioral Sciences*, 93, 1020-1024.
- Halpern, D. F. (2014). *Thought and Knowledge: An Introduction to Critical Thinking* (5th edition), Psychology Press.
- Henebery, B. (2022). Schools are teaching critical thinking...but are kids actually learning? *The Educator – Australia*. Retrieved 02 10, 2023 from <https://www.theeducatoronline.com/k12/news/schools-are-teaching-critical-thinking-but-are-kids-actually-learning/279526>.
- Hitchcock, D. (2018). Supplement to Critical Thinking: History. In *Standard Encyclopedia of Philosophy*. Retrieved 12 03, 2023 from <https://plato.stanford.edu/entries/critical-thinking/history.html>.
- Huber, C. R., & Kuncel, N.,R. (2016). Does College Teach Critical Thinking? A Meta-Analysis. *Review of Educational Research*, 86(2), 431-468.
- Jensen, E. (2005). *Teaching with Brain in Mind*. Alexandria: ASCD.
- Kagan, S. (2005). *Rethinking Thinking – Does Bloom's Taxonomy Align with Brain Science?* San Clemente, CA: Kagan Publishing, Kagan Online Magazine.
- Kerr, P. (2022). Doing Critical Thinking to Others. *Adaptive Learning in ELT*. Retrieved 02 10, 2023 from <https://adaptivelearninginelt.wordpress.com/2022/04/19/doing-critical-thinking-to-others/>
- Klingová, K. (2019). *Which Slovaks Believe in Conspiracy Theories?* GLOBSEC. Retrieved 10 03, 2023 <https://www.globsec.org/what-we-do/commentaries/which-slovaks-believe-conspiracy-theories>
- Kovács, J., & Benkó, E. T. (2014). *The World at Their Feet*. Budapest: Eötvös József Könykiadó.
- OECD. (2014). *A Teachers' Guide to TALIS 2013: Teaching and Learning International Survey*. TALIS, OECD Publishing. Retrieved 05 01 2023 from <http://dx.doi.org/10.1787/9789264216075-en>
- OECD. (2019). *A Teachers' Guide to TALIS 2018*. Volume 1. OECD. Retrieved 11 02, 2023 from [https://www.oecd.org/education/talis/TALIS-Teachers-Guide-to-TALIS-2018-Vol-I\\_ENG.pdf](https://www.oecd.org/education/talis/TALIS-Teachers-Guide-to-TALIS-2018-Vol-I_ENG.pdf).
- Pupala, B., & Fridrichová, P. (2022). *Vzdelávanie pre 21. storočie. Východiská zmien v kurikule základného vzdelávania*. Bratislava: MŠVVŠ & ŠPU. Retrieved 10 02, 2023 from <https://vzdelavanie21.sk/wp-content/uploads/2022/06/Vychodiska-zmien-v-kurikule-zakladneho-vzdelavania.pdf>.
- Scriven, M., & Richard P. (1987). *What is Critical thinking*. Retrieved 02 04, 2010 from <https://www.criticalthinking.org/pages/defining-critical-thinking/766>
- Snider, D. (2017). Critical Thinking in the Foreign Language and Culture Curriculum. *Journal of General Education: A Curricular Commons of the Humanities and Sciences*, 66(1-2), 1-16.
- Sweller, J. (2022) *Some Critical Thoughts about Critical and Creative Thinking (Paper 32)*. Sydney: The Centre for Independent Studies Analysis.
- Taylor, K. (2006). Brain Function and Adult Learning: Implications for Practice. In S. Johnson, & K. Taylor (Eds.). *The Neuroscience of Adult Learning* (pp. 71-86). San Francisco: Jossey-Bass.
- Vančíková, K. (2019). Je tvorivé a kritické myslenie témou našich škôl? In K. Vužňáková, & J. Hnatová (Eds.), *Premeny školy a učiteľské vzdelávanie v historickom kontexte* (pp. 499-504). Prešov: PF.
- Zelina, M. (1996). *Stratégie a metódy rozvoja osobnosti dieťaťa*. Bratislava: IRIS.

## ENGLISH IN ALGERIAN PRIMARY SCHOOLS: PROSPECTS AND REALITIES

**Radia Guerza<sup>1</sup>, & Mohammed-Salah Nedjaï<sup>2</sup>**

<sup>1</sup>Dr; <sup>2</sup>Prof.

*Department of English, Batna 2 University (Algeria)*

### Abstract

The teaching of foreign languages in Algeria is a subject that has raised a great deal of controversy. The case of the teaching of English at the primary level is one of the themes that have generated a dilemma. This small scale study tries to debate this decision taken by the government considering scientific and social facts all together with the feasibility of this project. The main objective of this study is to demonstrate whether Algeria is well prepared to successfully teach English to primary school pupils. Therefore, it endeavors to explore the following question: "Does Algeria possess all the required means to teach English at the primary schooling level?". To this end, the study is descriptive in nature, and uses a questionnaire to collect fifty (50) teachers' opinions and perceptions from the English department at Batna 2 University and Batna primary schools. The results obtained indicate that, indeed, the teaching of English at this level sounds rather hasty, for enormous efforts must be invested in the scientific framework to preparing both qualified teachers and suitable programs. A rethinking of the overall policy stands as a must.

**Keywords:** *Teaching English, primary school, prospects, realities.*

---

### 1. Introduction

Over the last decades, the teaching of English gained momentum cross world. According to the Euromonitor International site (2012) and Rezig (2011), English was, in 2012, spoken by 7% of Algerians. Learning this language is also explained by the fact that many Algerians have emigrated to English-speaking countries. The last Algerian education policy calls for the integration of English at the primary school level, whereas this language was taught only at the college. This has created a ceaseless and controversial debate. At the outbreak of the 21<sup>st</sup> century, Algeria has become open to the global world and encouraged the teaching of foreign languages as part of the Algerian educational agenda. Thus, this research endeavors to collect teachers' perceptions towards the integration of English at the primary school, and attempts to showcase whether this policy will prove successful.

### 2. Objectives

The current study aims at highlighting whether Algeria is prepared to successfully teach English to primary school pupils. It discusses the decision taken by the government after considering scientific and social facts all together with the feasibility of the prospected project. It aspires to collect teachers' perceptions of the integration of English at the primary level. More importantly, it intends to explore the different challenges faced by teachers of English after the implementation of the newly devised regulations with respect to the integration of English at the primary schooling level. It seeks to raise awareness among policy makers about teachers' challenges and requirements faced after the implementation of this new reform. Its main purpose is to investigate the following question: "Does Algeria possess all the required means to teach English at the primary schooling level?".

### 3. Literature review

Undoubtedly, English is the 21<sup>st</sup> Century universal language. Two decades ago, Crystal (2003) claims that "more than 350 million people around the world speak English as a first language and more than 430 million speak it as a second language" (p.69). Thence, it is conceived to be the Lingua Franca of

the modern world and the language of science, research and technology. Education in Algeria is free and compulsory for Algerians from the ages of 6 to 15 (Singh, 2016). Language-education policy is core in the government's educational agenda. The Algerian government has taken many decisions to cope with the continuous changes happening in the educational landscape. The Algerian educational system has experienced many controversies over the subject of languages. Henceforth, this study is an attempt to address the issue of integrating English at the primary school from researchers' and teachers' viewpoints.

#### 4. Research methodology design

To address the research question and to consider the research objectives set, this study is descriptive in nature and uses a questionnaire to collect teachers' perceptions from the English department at Batna 2 University and Batna primary schools. Fifty (50) questionnaires were administered, but only a sample of forty (40) responded due to time constraints. Data collected have been processed using Google Form.

The population's characteristics, namely, gender, age, teaching experience, and degree are summarized as follows: This study's population includes 71.8 % Females and 28.2 % Males. The participants' age in this piece of research ranges from 21 to 72. Teachers' age is an important factor in knowing the extent to which these agents are effective in their teaching. It might determine the efficacy of how these teachers may behave towards a vulnerable category of learners. According to Zafer and Aslihan (2012), cited in Ismail, Arshad, and Abas (2018, p. 146), teachers who are at least 41 years old prove more effective classroom managers than teachers who are younger. This seems to accredit the claims and perceptions, towards the integration of English in primary schools, given by the teachers included in this study. Teachers' experience is also pivotal for this study. The majority of participants are well experienced teachers with a mean rate of almost 18 years of teaching experience. As documented by the literature, teachers' ability to impart knowledge contributes significantly on students achievements in schools (Alufohai and Ibhafidon, 2015), cited in Ismail, Arshad, and Abas (2018, p. 146). With respect to teachers' degree, the majority of teachers who participated in this study do hold PhD and Magistère (MAA) degrees with 30% and 25 % respectively.

This means that teachers are well experienced and possess enough background which makes them aware of their profession difficulties. Based on the data obtained from the participants' characteristics, the teachers could be considered to be qualified, experienced, skilled and well trained teachers. Undoubtedly, this positively influences their perceptions and viewpoints. .

#### 5. Results and discussion

Results obtained indicate that, indeed, the teaching of English at this level sounds rather hasty, for enormous efforts must be invested in the scientific framework to prepare both qualified teachers and suitable programs. Results are distributed accordingly.

##### 5.1. What was your initial training before working as a teacher?

When participants were asked what was their initial training before becoming a teacher, they answered as follows (Table 1):

Table 1.

1	University training to teach English
2	Nothing
3	Extensive training at ENS (National School for Teacher Training)
4	Institute of Technology of Education (ITE)

The above table indicates that the majority of participants do have prior training before becoming teachers in highly recognized Algerian institutions like ENS and ITE with the exception of few teachers who did not. This item adds to the previous characteristics about teachers. This might confirm that these teachers have a long experience in dealing with the academic context and the teaching learning enterprise.

### 5.2. Do you accept integrating the teaching of English at primary school?

Figure 1.

Do you accept integrating the Teaching of English at Primary School?

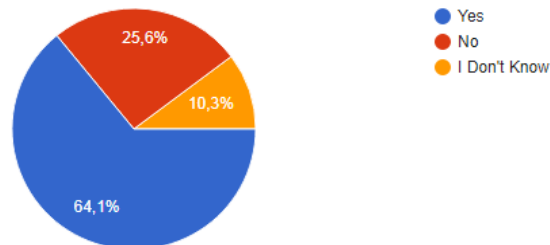


Table 2.

1	English is so important today. It is used everywhere. I believe Algerian school should have used English years ago.
2	It is the language of international communication; particularly, in the domains of business and scientific research
3	It is important for pupils to be familiar with the basics of the language from an early age so that they can keep them firmly in mind.
4	It is quite important in terms of developing in young learners some positive attitudes toward English. Moreover, it is scientifically proven that young learners learn a language quickly.

From Figure 5. and Table 2., it is shown that the majority of teachers of English, with representative rates of 64.1% and 25.6% for “Yes” and “No” respectively, consider that the integration of English at primary school stands mandatory because it, above all, opens horizons for worldwide opportunities.

### 5.3. Do you think the primary school pupils would be overloaded with learning three to four languages at the same time?

Figure 2.

Do you think the primary school pupil would be overloaded with learning three to four languages at the same time?

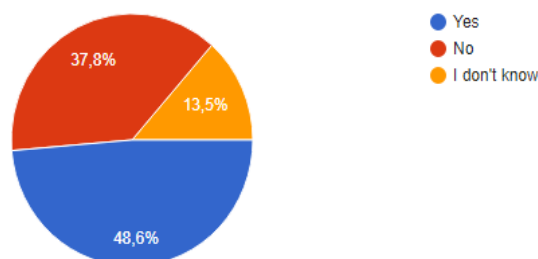


Table 3.

1	Pupils will be reluctant to study so many languages especially in this young age where they think only of playing. Their curriculum is already overloaded. They will get bored.
2	Pupils would be so difficult for them to learn more than one or two languages. In this case, much attention should be given to "how to teach them"
3	The primary school pupil is in the perfect age of language acquisition. Since the Algerian society is already a multilingual society then it is perfectly acceptable to add an overly used language as English to the primary schools curriculum.

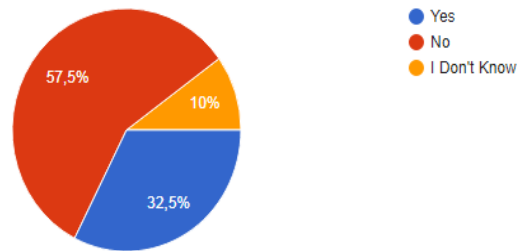
Data obtained confirmed that 48.6% of teachers think affirmatively that pupils at primary school are overloaded as opposed to 37.8% who think the opposite. It seems that those teachers who responded with “No” do not realize that none of these languages is a mother tongue to the exception of Tamazight

which is taught as a local dialect, but not as a unified and codified language cross Algeria. Henceforth, they do not realize that pupils are not in an acquisition situation, for it is a learning activity in contact with the teacher.

**5.4. Do you think that Algeria has the required means for the integration of English at primary school?**

Figure 3.

Do you think that Algeria has the required means for the Integration of English at Primary School?



The chart above (Figure 7) indicates that 57.5% of teachers claim that Algeria does not provide the required means to teach English at primary school as opposed to 32.5% who affirmatively replied by “Yes”. This indicates a disparity in views among teachers. The few ones who believe Algeria has the required means probably think that the teaching of English is limited only to the presence of a teacher and learners, regardless of teachers’ qualifications, learners’ motivation, and other factors at work in a language class.

**5.5. Is Algeria ready to integrate the teaching of English at primary school?**

Figure 4.

Is Algeria ready to integrate the teaching of English at Primary School?

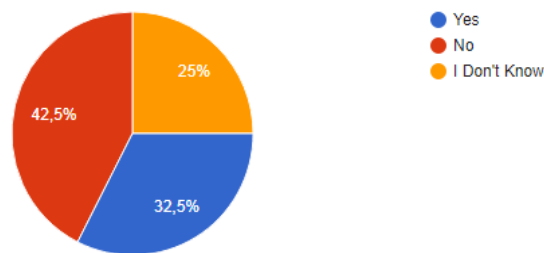


Figure 8. showcases that according to 42.5% of the teachers, Algeria is not ready yet to integrate English in primary school as opposed to 32.5% who claimed the opposite. Probably, those teachers who answered with “yes” are not aware of the factors that interplay in the teaching of a foreign language.

**5.6. What kind of challenges primary teachers of English might face?**

Table 4.

1	Lack of adequate training, lack of appropriate curricular, absence of resources and means, not well prepared to deal pedagogically with young pupils
2	I think the only challenge is the loadedness. That's why Algerian school should make pupils choose one foreign language.
3	The only challenge I guess will be related to the fact that learners might be confused by being overwhelmed by two foreign languages.

The above Table 4. demonstrates that among the prominent challenges that might be faced by teachers of English in primary schools are the lack of adequate training, the lack of appropriate curricular, the absence of resources and means , and teachers' ill-preparation to deal pedagogically with young pupils in overloaded classes and curricular.

## 6. Conclusion

To conclude, this study has demonstrated, with evidence, that the integration of English at primary school is a policy that needs reconsideration because Algeria does not yet possess the human and material resources to cope with the application of this decision. According to teachers, it is a decision that requires a re-thinking and more preparation to implement it successfully and to train global citizens.

## References

- Alufohai, P.J. and Ibhafidon, H.E. (2015). Influence of teachers' age, marital status and gender on students' academic achievement. *Asian Journal of Educational Research*, 3(4), 60-66.
- Crystal, David (2003). *English as a Global Language*. Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo: Cambridge University Press.
- Euromonitor International (April 2012). The Benefits of the English Language for Individuals and Societies: Quantitative Indicators from Algeria, Egypt, Iraq, Jordan, Lebanon, Morocco, Tunisia and Yemen.
- Ismail Rahida Aini Mohd, Arshad Rozita, and Abas Zakaria (2018). Can Teachers' Age and Experience influence Teacher Effectiveness in HOTS? *International Journal of Advanced Studies in Social Science & Innovation (IJASSI)*. Vol. 2, No. (1), 144-158. Retrieved 11 March 2023, from [https://www.researchgate.net/publication/324530340\\_Can\\_Teachers'\\_Age\\_and\\_Experience\\_influence\\_Teacher\\_Effectiveness\\_in\\_HOTS/link/5d6d8b5da6fdcc547d758acc/download](https://www.researchgate.net/publication/324530340_Can_Teachers'_Age_and_Experience_influence_Teacher_Effectiveness_in_HOTS/link/5d6d8b5da6fdcc547d758acc/download)
- Rezig, N. (2011). Teaching English in Algeria and Educational Reforms: An Overview on the Factors Entailing Students Failure in Learning Foreign Languages at University. *Procedia - Social and Behavioral Sciences*, 29, 1327–1333. doi:10.1016/j.sbspro.2011.11.370.
- Singh, K. (2016). *Report of the Special Rapporteur on the right to education*. Retrieved 19 October 2016, from <https://www.ohchr.org/>
- Zafer, Ü., & Aslihan, U. (2012). The impact of years of teaching experience on the classroom management approaches of elementary school teachers. *International Journal of Instruction*, 5(2), e-ISSN: 1308-1470. www.e-iji.net pISSN: 1694-609X. Retrieved 12 March 2023, from <https://files.eric.ed.gov/fulltext/ED533783.pdf>

# LANGUAGE CHALLENGES GRADE 11 LEARNERS ENCOUNTER IN LIFE SCIENCES INSTRUCTIONAL MATERIALS AND ASSESSMENTS

**Godfrey Zwane, & Lydia Mavuru**

*Department of Science and Technology Education, University of Johannesburg (South Africa)*

## Abstract

Language plays a pivotal role in enabling learner acquisition of scientific knowledge and skills. Whilst previous research indicates that proficiency in the language of learning and teaching (LoLT) does not guarantee learners' understanding of concepts taught, the current paper argues that learners who are proficient and fluent in the LoLT have an advantage in the science classrooms. Language affords learners to read the text in learning materials and assessments with understanding. Understandably science (Life Sciences) is a language on its own which is academic and authoritative which every learner grapples with despite fluency in the LoLT, the argument is that the challenge is compounded for those learners whose home languages are different from the LoLT. The current paper therefore sought to explore the language challenges grade 11 learners encounter in the teaching and learning materials and assessments in Life Sciences. In both qualitative and quantitative non-experimental designs, 28 grade 11 Life Sciences learners whose home languages were different from the LoLT, were purposively selected from a school where English is the LoLT. A 4-point Likert scale questionnaire was administered to learners through a google form. It sought learners' biographical information related to their home language and proficiency in English, challenges encountered in instructional materials and assessments, and their views about the use of code switching during the teaching and learning of Life Sciences. Focus group interviews were used to collect qualitative data. Quantitative data was analysed using Statistical Package for the Social Sciences (SPSS) software to obtain descriptive statistics and qualitative data was subjected to content analysis. Most of the learners (75%) indicated that the complexity and specialisation of the scientific language make it difficult for them to understand scientific concepts in the teaching and learning materials such as textbooks, activities, worksheets, and assessments. Whilst many learners pointed out that the use of English as the LoLT limits their acquisition of Life Sciences concepts, only 25% prefers to be taught in their home languages and the majority (72%) appreciated the use of English. They indicated that it places them at an advantage as all assessments are administered in English. Overall, the study found that three quarters of the learners (21 out of the 28) were of the view that code switching made the scientific concepts easier to understand. However, learners from other African countries (18%) who did not speak indigenous languages as homes language, were against code switching. The findings have implications for curriculum policy implementation and instructional materials design.

**Keywords:** *Code switching, language challenges, life sciences, scientific language.*

## 1. Introduction

Language is a fundamental tool in science education and learning science requires learning the language of science (Salloum & BouJaoude, 2020). Most of the rural and township secondary schools in South Africa consider English as the main language of instruction in the classroom (Fang, 2006). Moreover, teaching resources and study materials for science subjects such as Life Sciences are written in English (Seah & Chan, 2020). This is despite the fact that the majority of the learners in rural and township schools are not English first language speakers who lack proficiency and fluency in the English language (Probyn, 2009).

Language plays a pivotal role in enabling learner acquisition of scientific knowledge and skills. Whilst previous research indicates that proficiency in the language of learning and teaching (LoLT) does not guarantee learners' understanding of concepts taught, the current paper argues that learners who are proficient and fluent in the LoLT have an advantage in the science classrooms. Language affords learners to read the text in learning materials and assessments with understanding. Understandably science (Life Sciences included) is a language on its own which is academic and authoritative which every learner grapples with despite their fluency in the LoLT, the argument is that the challenge is compounded for those learners whose home languages are different from the LoLT.



### **1.1. Problem statement**

The 2021 National Senior Certificate Results on School Subjects published by the Department of Basic Education (2022) shows that there has been a decline of 4.8% in the pass rate in grade 12 final Life Sciences examinations i.e. from 2018 (76.3%) to 2021 (71.5%). According to the minister of Basic Education in South Africa, this decrease attests to the subsequent effects of COVID-19 pandemic on learning. COVID-19 pandemic had significantly reduced the physical interaction between teachers and learners as well as putting a considerable limit on the time spent in teaching and learning in the classrooms (Ramathan, 2021). According to Irish and Kang (2017), poor academic performance of learners in science subjects is mainly caused by their lack of understanding of the language used in learning materials and assessment tools. As such, learning science requires learning the language of science and giving correct responses to assessment task questions (Seah & Chan, 2020).

### **1.2. Purpose of study**

The current paper therefore sought to explore the language challenges grade 11 learners encounter in the teaching and learning materials and assessments in Life Sciences. The study sought to answer the questions: 1. What are the language challenges encountered by the grade 11 learners in Life Sciences teaching and learning materials and assessments? 2. How do Life Sciences teachers assist the grade 11 learners in mitigating the language challenges they (learners) encounter in teaching and learning materials and assessments? 3. How does the use of code switching as a teaching strategy contribute to mitigating or causing the challenges that the grade 11 learners encounter in Life Sciences teaching and learning materials and assessments?

## **2. Literature review**

Yore, Bisanz, and Hand (2003) posit that language is a basic aspect of culture, society, and communication. On the other hand, Seah and Chan (2020) argue that language, especially in written form, is an important human characteristic, though its explicit nature and role vary across discourses and purposes. In science education, language plays an integral part in providing insight into the ideas and knowledge of learners, teachers, and scientists and acting as either a bridge that gives learners easy access to science concepts or a barrier that prevents learners from understanding the scientific content (Sutton, 1996).

Accordingly, Probyn (2001) found that teaching and learning through a relatively unfamiliar language contributes to stress and depression among learners and teachers. This is compounded by the scientific language which is distinct in that it encompasses technical terms with specific definitions and gives specific disciplinary meaning to words that may have different usage in the everyday language (Seah & Chan, 2020). Thus, scientific language can pose considerable challenges to learners due to its distinction in linguistic devices and strategies from the languages used in other disciplines and everyday life (Halliday, 2004).

In an investigation, Fang (2006) identified several features of scientific language that could pose challenges to science learning which include: unique use of prepositions; conjunctions and pronouns; ellipses, subordinate clauses; prepositional phrases; abstract nouns; lengthy nouns and complex sentences; interruption construction; and passive voice. Learners also encounter various types of text with unique language features and structures, which have reading requirements that are distinct from requirements in other subjects. These include science-specific procedural recounts, causal explanations, and persuasive discussions (Probyn, 2001).

English, which is the LoLT, is unique in that it is in control of the political, social, economic and educational structures as the language of opportunity and power (Yore, Bisanz, & Hand, 2003). However, most of the secondary schools in rural areas and townships enrol learners who are not first or even second language speakers of English (Grobler, 2018). Rickford (2005) suggests that LoLT policies in the country create 'linguistically structured inequalities or linguistic discrimination', where poor proficiency in the English language results in poor achievement across the curriculum. As such, in a study to investigate teacher use of learners' home languages in science instruction, with a particular focus on the affordances and challenges of using learners' home languages, Mavuru and Ramnarain (2020) found that learners could express themselves "confidently in their home languages" (p. 2472).

## **3. Methodology**

The study was framed within quantitative non-experimental research design and qualitative design (Creswell, 2014). A non-experimental research design focuses on objective measurements and statistical analysis of data gathered through survey designs and questionnaires (Creswell, 2014).

### 3.1. Selection of participants

Using purposive sampling technique (Patton, 2002) one school was selected for the study. The school enrolled learners from neighboring rural and informal settlements where isiZulu and Setswana were the languages spoken at home. Accordingly, the school offers Setswana as Home Language and English is offered as First Additional Language. Nevertheless, English is the LoLT in the school and all formative and summative assessments are administered in English. From the school, 28 grade 11 Life Sciences learners whose home languages were different from the LoLT, were purposively selected for the study.

### 3.2. Data collection and analysis

A 4-point Likert scale questionnaire (McMillan, 2010) was administered to the learners through a google form. The questionnaire consisted of three sections. The first section sought learners' biographical information related to their home language and proficiency in English. The second section sought learners' insights about the language challenges they encounter in Life Sciences teaching and learning materials and assessments. The last section sought learners' views on the role code switching plays in either mitigating or causing the challenges encountered in grade teaching and learning materials and assessments. Quantitative data was analysed using Statistical Package for the Social Sciences (SPSS) software to obtain descriptive statistics. Qualitative data was collected using focus group interviews with learners. and the data was subjected to content analysis (Bowen, 2009). Analysis of the data collected in different sections gave the researchers insight and, more importantly, authenticity on language challenges grade 11 learners encountered in life sciences instructional materials and assessments.

## 4. Findings

The findings are presented in three sections: learners' biographical information; learners' insights about the language challenges encountered in Life Sciences teaching and learning materials; and assessments; and learners' views on the role code switching plays in either mitigating or causing the challenges.

### 4.1. Learners' language profiles

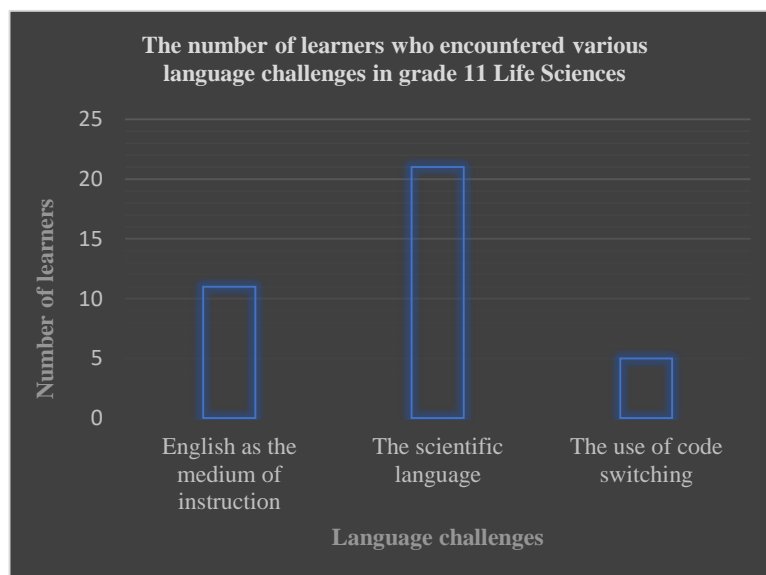
A total number of 28 learners participated in the study with 16 males and 12 females. The results showed that 89% of the participants were South African nationals, and the remainder were Zimbabwean nationals. 71% spoke Setswana, 17.9% IsiZulu, and 11.1% Shona as their home languages to communicate at home. Nevertheless, all these learners used either English only or English and Setswana to communicate among themselves and with the teachers in the Life Sciences classrooms. Though English is the LoLT and the one used in the teaching and learning materials and assessments the school curriculum made learners to study Setswana as a Home Language since grade 8 and English as an Additional language.

### 4.2. Learners' insights about the language challenges encountered

Figure 1 below displays the responses of the grade 11 learners in the selected school on the various identified language challenges in Life Sciences. Learners were instructed to select a language challenge/s that they found to be hindering their quest in understanding the scientific content and/or achieving good grades in Life Sciences. The learners' responses were based on three aspects: English as the medium of instruction; the scientific language; and the use of code switching. Learners were allowed to select more than one challenge depending on their views. Whilst many learners pointed out that the use of English as the LoLT limits their acquisition of Life Sciences concepts, only 25% prefers to be taught in their home languages. The figure shows that 11 learners (39.3%) faced challenges with English as the medium of instruction. English can be considered an unfamiliar language to the sampled learners as they were second or even third English language speakers. The majority (72%) appreciated the use of English in the teaching and learning process. They indicated that it places them at an advantage as all assessments are administered in English.

Most of the learners (75%) indicated that the complexity and specialisation of the scientific language makes it difficult for them to understand scientific concepts in the teaching and learning materials such as textbooks, activities, worksheets, and assessments. Such experiences by learners could be explained by the fact that Life Sciences has technical terms which are not even in English and incorporates many languages such as Greek and Latin, which are equally foreign to learners. In the focus group interviews, most of the learners indicated that they often find it frustrating that some basic English words such as force, cell, energy and photo, to name a few, assume a different meaning from the ordinary English language when used within the science discipline. One learner pointed out that the same words may carry specific meanings in different scientific subjects.

Figure 1. Number of learners who encounter various language challenges in grade 11 Life Sciences.



### 4.3. Learners’ views about code switching in either mitigating or causing challenges

Overall, the study found that three quarters of the learners (21 out of the 28) were of the view that code switching made the scientific concepts easier to understand. However, a small number of learners (18%) indicated that they faced challenges in understanding the subject matter when Life Sciences teachers use code switching between English and indigenous language/s in the classroom. One of the reasons may be that the sampled participants include learners who are originally from another country whose home language is different from any of the South African 11 official languages. Therefore, those learners would naturally not appreciate to be taught sciences via code switching with a language unfamiliar to them.

Table 1 that follows shows the participants’ responses towards using English only as the medium of instruction or code switching between English and Setswana as the media of teaching and communication in the classroom. The results obtained from this section of the questionnaire gives insight on the efficacy of code switching between English and Setswana in the teaching and learning of Life Sciences.

Table 1. Participants’ responses on the languages used to teach.

Item description	Number of learners (%)			
	Strongly agree	Agree	Disagree	Strongly disagree
Being taught Life Sciences in English only is beneficial to me.	29	43	21	7
Use of code switching between English and Setswana in Life Sciences makes it easy for me to understand.	43	32	14	11
Use of code switching between English and Setswana in Life Sciences makes me more confused and stressed.	18	7	54	21

It is evident from table 1 that many learners (72%) agreed and strongly agreed that it was helpful and of an advantage for them to be taught in English only. 75% of the learners showed appreciation of how code switching helped them to understand Life Sciences concepts. In another question to explore learners’ views on the impact of language used in assessment tasks on learners’ performance. More than half of the learners (57%) agreed that being taught in English only increased their chances of succeeding in assessments. More than three quarters of participants (82%) indicated that being taught Life Sciences through code switching (English and Setswana) increases their chances of succeeding in assessment tasks. One learner argued that it is not necessary to write proper English in a science assessment because science has its own language, which if you can understand using code-switching during class discourses, you increase your chances of performing well in assessments.

## 5. Discussions and conclusions

The study sought to explore the language challenges grade 11 learners encounter in the teaching and learning materials and assessments in Life Sciences. An important finding from the study is that both English as a LoLT and scientific language pose daunting challenges for learners whose home languages are different from the LoLT. As such, Yore, Bisanz, and Hand (2003) considered English as the language of opportunity and power since it controls the political, social, economic, and educational structures. On the hand the uniqueness of scientific language, which is subject-specific and encompasses specialised terminologies with specific definitions, has also been described the same in recent studies (e.g. Seah & Chan, 2020). Whilst some learners appreciated the use of code switching in making concepts more comprehensive, other learners did not see it that way. Such a finding disagrees with Rickford (2005) views that code switching has often been perceived as an approach used by weak English language performers to compensate for the language deficiency. Another important issue to note is that whilst code switching enables learners to access concepts, it is difficult for teachers to meet the language demands of learners from diverse linguistic backgrounds. The findings have implications for curriculum policy implementation and instructional materials design.

### References

- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27-40.
- Creswell, J. (2014). *Research design, qualitative, quantitative, and mixed method approach*, 4th ed. Thousand Oaks, California: Sage Publications.
- Fang, Z. H. (2006). The language demands of science reading in middle school. *International Journal of Science Education*, 28(5), 491-520.
- Grobler, R. (2018). Students' perceptions of code-switching in natural sciences classrooms: A South African perspective. *Africa Education Review*, 15(1), 38-51. <https://doi.org/10.1080/18146627.2016.1224593>
- Halliday, M. A. K. (2004). *The language of science*. London: Continuum.
- Irish, T., & Kang, N. H. (2017). Connecting classroom science with everyday life: Teachers' attempts and students' insights. *International Journal of Science and Mathematics Education*, 16, 1227-1245.
- Mavuru, L. & Ramnarain, U. (2020). Language affordances and pedagogical challenges in multilingual grade 9 Natural Sciences classrooms in South Africa. *International Journal of Science Education*, 42(14), 2472-2492. <https://doi.org/10.1080/09500693.2019.1655177>
- McMillan, J. M. (2010). *Research education: Evidence-based inquiry*. Upper Saddle River: Pearson.
- National Senior Certificate: Examination Report (2022). Pretoria: Department of Basic Education.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods*, 3<sup>rd</sup> ed. Thousand Oaks, CA: Sage Publications.
- Probyn, M. (2001). Teachers' voices: Teachers' reflections on learning and teaching through the medium of English as an additional language in South Africa. *International Journal of Bilingual Education and Bilingualism*, 4(4), 249-266.
- Probyn, M. (2009). Smuggling the vernacular into the classroom: conflicts and tensions in classroom code-switching in township/rural schools in South Africa. *International Journal of Bilingualism* 12(2), 123-136.
- Ramrathan, L. (2021). School curriculum in South Africa in the covid-19 context: an opportunity for education for relevance. *Prospects*, 51, 383-392. <https://doi.org/10.1007/s11125-020-09490-1>
- Rickford, J. R. (2005). *Using the vernacular to teach the standard in Ebonics: the urban education debate*. Clevedon: Multilingual Matters.
- Salloum, S., & BouJaoude, S. (2020). Language in teaching and learning science in diverse Lebanese multicultural classrooms: Interactions and perceptives. *International Journal of Science Education*, 42(14), 2331-2363.
- Seah, L. H., & Chan, K. K. H. (2020). A case study of a science teacher's knowledge of students in relation to addressing the language demands of science. *International journal of Science and Mathematics Education*, 19, 267-287.
- Sutton, C. (1996). Beliefs about science and beliefs about language. *International Journal of Science Education*, 18, 1-18.
- Yore, L., Bisanz, G. L., & Hand, B. M. (2003). Examining the literacy component of science literacy: 25 years of language arts and science research. *International Journal of Science Education*, 25, 689-725.

# THE POWER OF HIGHER EDUCATION CURRICULUM IN SHAPING CHARACTER AND PERCEPTION: A SOCIAL CHANGE DIMENSION

**Pulane Adelaide Molomo**

*Dr., Central University of Technology (South Africa)*

## Abstract

This paper explores ways in which a higher education curriculum contributes towards social change by developing certain traits among students including a change in attitude towards the 21<sup>st</sup> century and thereafter using the WIL module as the impetus. The contribution of higher education is realised with the use of Work Integrated Module (WIL) as part of the curriculum in most of university of technology. Through WIL knowledge and skills are put into practice to enable students to look at the world as a unit. The study followed a mixed method approach to gather information wherein interviews including a questionnaire were used to assess how WIL contributes towards social change in enlarging students' horizon by strengthening their character including their future career. Semi-structured interviews were used to gather information about students' perceptions regarding their experiences on how to cope with changes in the world through the transfer of standards, skills, values, and technology acquired in both higher education and at the workplace. Qualitative data were systematically arranged and categorised into common themes. Inversely, quantitative data were analysed statistically. From a total of 50 students, a sample of 30 students, who enrolled for the Work Integrated module was used. The findings showed a change in perception amongst many students. They started looking at the world holistically and were enthusiastic in applying knowledge, technology, and values they have learnt. While their attitude changed, their soft skills improved too. This study concludes that the higher education curriculum through the integration of WIL shape up students' attitude by exposing them towards applying knowledge systematically, adopting technologies, skills, and ethical values that bring change in the society and better ways of solving problems.

**Keywords:** *Curriculum, higher education, social change, students' perceptions, WIL.*

---

## 1. Introduction

The workplace has become a source of knowledge and skills acquisition which students can use to plough back to the society to change some practices that do not yield progress. The contribution of Work Integrated Learning (WIL) in producing students with different competencies plays a huge role in higher education. WIL can set a stage for social change because it does not only command a crucial role in the curriculum design, but it complements the curriculum by developing students who use knowledge objectively to have a holistic view of the world by also tapping into the real-world wisdom and modelling appropriate behaviour. Social change in society may be because of the expediency needed in providing solutions to specific social problems faced in a society. Thus, learning from others' wisdom and experiences in the workplace plays a role in deepening and changing students' perception to enable them to cope with change and to solve problems. WIL can improve students' work readiness and the ability to transfer theoretical knowledge, skills, and technology into the practical implementation to contribute towards influencing change in the society where they live (Freudenberg, Brimble, & Vyvyan, 2010, p. 43).

## 2. Literature review

### 2.1. The benefit of WIL

The cardinal feature of WIL lies in the placement of students in professional environments to bring synergy between knowledge acquired at university with practice and culture of the workplace (Smith & Worsfold, 2015). This implies that the workplace application of technology and a display of professional behaviour and other skills in the performance of daily activities, is recognised as one of the most crucial factors in contributing towards social change to give the society new direction in terms of effectiveness, efficiency, and better standards. Furthermore, the use of advanced technologies that students are exposed

to during WIL placements equips them with new skills that shape them for their future careers (Gribble, Dender, Lawrence, Manning, & Falkmer, 2014). The implication is that changes in technology can contribute towards transforming certain cultural practices for the betterment of the society. The WIL module thus indirectly set a stage for social change by integrating academic learning with workplace learning to help students to connect and derive greater meaning from different knowledge types (Sattler, Wiggers, & Arnold, 2011). The idea is further supported by Sattler et al., (2013) who is of the idea that WIL through its co-extra-curricular nature can influence change and adaptation to new technologies to enhance social norms (Sattler et al., 2013). Furthermore, student employment prospects are enlarged (Smith, Ferns, & Russell, 2014).

## **2.2. WIL's contribution in the development of character**

WIL programmes also place emphasis on critical thinking, creative solutions in solving complex real problems as well as developing students to become leaders and managers who can also initiate change in the digital world (Gannon, Rodrigo, & Santemà, 2016). Similarly, Mutalemwa, Utouh, & Msuya (2020) adds that employers want to see competencies such as initiative, self-awareness, ethical skills, stress tolerance, ability to solve conflicts, a sense of responsibility and active citizenry amongst graduates. The implication thereof is that universities help to shape and prepare responsible citizens who can improve communities. Furthermore, WIL opens possibilities for students to gain situated knowledge, skills, and experience (Orrell, 2018).

## **3. Theoretical framework**

To create a balanced educative experience for students Dewey, one of the progressive educators who believed in practical wisdom to compliment knowledge including attitude, came with the idea of bringing a balance between cognitive and practical knowledge experience (Dewey, 1938). The implication is that students can use the knowledge they have gathered in the classroom to solve real world problems. Dewey's initiative further aimed at bringing an end to the "separation of the ideas of the world from the ideas of the classroom" to develop a fully educative experience through the real world of work (Dewey, 1938). Dewey's work set the stage for constructivist theorists whose philosophy of learning aimed to expose students to the dynamics of the real world by emulating proper behaviour, and re-construct their knowledge to improve' perception and the ability to apply logic in social contexts (Dewey, 1938). This paper is thus underpinned by Dewey's theoretical framework which places an emphasis on recognising a balance between different knowledge types to enable students to develop students' character and to enable them to have a broader view of the world.

## **4. Aim of the study**

The aim was to investigate how Higher Education through WIL expand students' horizon by equipping students with knowledge, skills and technology that can be used for the benefit the society.

### **4.1. Research questions**

- I. To what extent does Higher Education through WIL shape students' character, attitudes, and perception.
- II. Do WIL activities impact on social change?

### **4.2. Research objectives**

- I. To explore the extent to which WIL offer students the opportunities to build character, change attitude and perception towards using knowledge, skills and knowledge acquired in higher education to bring change in the society.
- II. To determine the effect of change among students that translate into their ability to deal with social challenges.

## **5. Methodology**

### **5.1. Research design**

A mixed methods approach was used to collect data. The quantitative, non-experimental responses on how WIL improve student perception and impact on social change through the application of practical knowledge, technologies, and soft skills that are ploughed back to the society. A self-administered questionnaire analysed statistically were used to collect quantitative data, whilst qualitative data were

collected by using a semi structured interview schedule coded manually into themes (Creswell & Clark, 2011; Du Plooy-Cilliers et al., 2014).

## 5.2. Sample and sampling

Both purposive and random sampling were employed. Out of a population of 50 students only a sample of 30 male and female students aged between 20-23 was used wherein 10 were interviewed whilst a questionnaire was distributed to 20 respondents.

## 5.3. Methods

The researcher used a 4-point Likert scale questionnaire and a semi-structured interview schedule to collect data.

## 5.4. Data analysis

Data obtained through a self-administered questionnaire were analysed statistically whilst qualitative data obtained from participants were recorded, transcribed, and analysed systematically from content to codes, patterns and to emerging themes using content analysis (Creswell & Clark, 2011).

## 6. Findings

Responses from a questionnaire were as follows:

- + Statement 1: 100% of respondents strongly agreed that WIL practical experience whereby knowledge, skills and technology including soft skills are put to test that contributes to shape character.
- + Statement 2 98% of respondents strongly agreed that WIL enlarges their horizons and change their perception of the world better, whilst 2% disagreed.
- + Statement 3: 100% of respondents all strongly agreed that Higher Education have power to sytematised knowledge by instilling a sense of objectivity and logic on how to view the world.
- + Statement 4: 90% of the respondents strongly agreed that knowledge and skills acquired from higher education including WIL have an indirect impact in changing traditional practices of society and contribute to the advancement of society. 10% agreed.
- + Statement 5: 90% of the respondents strongly agreed that WIL strengthens soft skills and graduate attributes, whilst 5% agreed and 5% disagreed.
- + Statement 6: 94% of respondents strongly agreed with the statement that through WIL their confidence increased, and it impacted on improved performance in their studies. 4% disagreed.
- + Statement 7: 98% strongly agreed that Higher Education create a foundation for growth, maturity, and shape them to be responsible citizens who can manage and lead. 4% agreed.
- +Statement: 92% of respondents strongly agreed with the statement that higher education qualifications should become mandatory for all citizens for the development of all whilst 8% disagreed.

Themes that emerged from qualitative data:

- Change in attitude, development of other skill and its impact on social change.
- Benefit for students, Higher Education, and Industries
- Personal development, work readiness and social change

### 6.1. Discussion of the findings

**6.1.1. Change in attitude, development of other skills and it impact on social change.** Being given tasks to solve problems students learn more about the importance of teamwork, communication, resilience, and conflict resolution (cf. Gribble, 2014). Participants also indicated that in navigating through complexities their perspective broadened and their attitude in terms of looking at the world. To that effect, WIL makes provision for students to change and to sharpen some of the competencies they already possess. According to (cf. Dewey, 1938) this strengthens and bring a balance between cognitive, practical knowledge, experience, and competencies. This further impact on change in society due to the expediency needed in using appropriate skills and technology to provide solutions to specific social problems (cf. Sattler et al, 2013).

**6.1.2. Benefit to students and higher education.** It has been revealed that WIL create a unit where a university, students and industry interact not only to establish a match between industry needs and educational skills but to capacitate students as members of the society with knowledge, practical skills, and technology. One of the participants indicated that WIL placement made a difference in their lives by learning certain expertise from those with experience that they adopted to bring effectiveness and efficiency on approaching real world problems and how to cope with complexities. WIL also create a relationship between organisations and Universities of Technology (UoTs) to enhance career-oriented education curriculum alignment to the needs of industries and contribute towards improving student employment prospects (Smith, Ferns, & Russell, 2014).

**6.1.3. Personal development, work readiness and social change.** Participants indicated that they learned and gained from real life experiences, and this contributed in improving their performance as they comprehend the relationship between theory and practice. It was also highlighted that through WIL students experience growth, maturity, self-awareness, and confidence including improved human relations that enables them to work with people of different backgrounds and disciplines (cf. Orrell, 2018). Other opportunities that were reported as gains for students are situated knowledge, skills and experience which gives students enables students to participate with ease and become conversant with employability needs resulting to smooth transition from university to career trajectory (cf. Orrell, 2018). Competencies such as interpersonal communication and problem-solving skills were also highlighted as being developed.

The discussion revealed the power of higher education in bringing change in the lives of people which enables them to view the world objectively through the knowledge, skills and competencies that are acquired through the integration of WIL. It has also added some weight towards students' development by not only preparing students for the workplace but highlighted the significance of close ties between universities and industries. For students some of the benefits they gained from WIL placements included the reinforcement of concepts and skills learned in the classroom, obtaining workplace skills, learning different software programs industries that improves student's efficiency. It can be added that WIL has attracted considerable attention as an instrument for enhancing professional practice and developing work-readiness in new graduates by enhancing skills outcomes management, and problem solving. It is thus important that the competency profile of a graduate should not only include discipline specific knowledge, technical skills, workplace generic cognitive skills, but the focus should also be placed on attitudes and behavioural attributes that contribute towards personal development and the ability to cope with changes.

## 7. Conclusion

It can be concluded that WIL is not about putting knowledge into practice, but it relives competencies by putting them to test in real practical situations. The opportunity created by Higher Education for students through WIL creates an opportunity for student to model and relive professional behaviour, ethical practices, communication, teamwork, managing change, using technology, applying logic, managing conflict, and solving problems are skills and others that indirectly impact on change in perception amongst many students. It is thus important that the competency profile of a graduate should not only include discipline specific knowledge, technical skills, workplace generic cognitive skills, but the focus should also be placed on attitudes and behavioural attributes that contribute towards personal development and the ability to cope with change in the real-world context for students to change their lives and that of communities where they live. In addition, the paper contributes to literature about the contribution of Higher Education through WIL towards social change in emulating advanced practices accompanied by technology in the workplace that contribute towards advancing society.

## References

- Creswell, J. W., & Clark, V. L. P. (2014). *Understanding Research: A Consumer's Guide* (2<sup>nd</sup> ed). New York: Pearson.
- Dewey, J. (1938). *Experience and Education*. New York: Macmillan Publishing Company.
- Du Plooy-Cilliers, F., Davis, C. and Bezuidenhout, R. (2014). *Research Matters*. Claremont: Juta and Company.
- Freudenberg, B., M. Brimble, and V. Vyvyan. (2010). The penny drops: Can Work Integrated Learning improve student's learning? *E-Journal of Business Education & Scholarship of Teaching*, 4(1), 42-61.



- Gannon, J., Rodrigo, Z., & Santomà, R. (2016). Learning to work interculturally and virtually: Developing postgraduate hospitality management students across international HE institutions. *International Journal of Management Education*, 14(1), 18-27.
- Gribble, N., Dender, A., Lawrence, E., Manning, K., & Falkmer, T. (2014). International WIL placements: Their influence on student professional development, personal growth, and cultural competence. *Asia-Pacific Journal of Cooperative Education* 15(2), 107-117.
- Mutalemwa, D., Utouh, H., & Msuya, N. (2020). Soft Skills as a Problem and a Purpose for Tanzanian Industry: Views of Graduates. *Economic Insights - Trends & Challenges*, 4, 45-64.
- Orrell, J. (2018, April 29). *Work Integrated Learning: why is it increasing and who benefits? The Conversation*. <https://theconversation.com/work-integrated-learning-why-is-it-increasingand-who-benefits-93642>
- Sattler, P., Wiggers, R., & Arnold, C. (2011). Combining Workplace Training with Postsecondary Education: The Spectrum of Work-Integrated Learning (WIL) Opportunities from Apprenticeship to Experiential Learning. *Canadian Apprenticeship Journal*.
- Smith, C., Ferns, S., & Russell, L. (2014). *The Impact of Work Integrated Learning on Student Work-Readiness. Final Report*. Sydney: Office for Learning and Teaching.
- Smith, C., & Worsfold, K. (2015). Unpacking the learning-work nexus: “Priming” as lever for high-quality learning outcomes in Work-Integrated Learning curricula. *Studies in Higher Education*, 40(1), 22-42.

# UNCOVERING A PRESUMPTIVE LEARNING PROGRESSION ON ELECTRICITY AND MAGNETISM: A CASE STUDY OF MEANINGFUL SCIENCE TEACHING AND LEARNING IN SOUTH AFRICAN HIGH SCHOOLS

**Sakyiwaa Boateng**

*Department of Mathematics and Sciences Education, Walter Sisulu University (South Africa)*

## Abstract

In the subject of science education, debates on topics such as "learning progression," "conceptual transformation," and "meaning making" have a long history, but they remain a vitally significant contemporary issue. Learning progression (LP) is a strategy designed to enhance three components of education: teaching and learning, assessment, and curriculum design. This study focused on building a learning progression of electricity and magnetism concepts that outlines how high school science students develop a more comprehensive grasp of electricity and magnetism concepts after instruction in order to depict a coherent progression of their conception. The constructivism theory and the conceptual change theory served as the theoretical underpinnings for this study. Using a mixed-methods research approach, science teachers and learners from three high schools were purposefully sampled. Interviews, document analysis, and learners' artefacts were used to collect data. The data were coded to characterise teachers' classroom practices and learners' learning experiences in order to ascertain learners' comprehension of the taught big ideas and their application to similar situations. The findings show that learners the high schools can incorporate concepts regarding electricity and magnetism to form a framework for learner understanding of these concepts if they receive appropriate instructional support.

**Keywords:** *Electricity and magnetism, learning progression, physical sciences, science learners, science teachers.*

---

## 1. Introduction

Current research on learners' foundational ideas and practices of a discipline develops over time focuses on how students learn, progress, or change in specific areas of knowledge (Jin, et.al., 2019). Debates around issues such as "learning progression", "conceptual change" or "meaning making", have a long history, but they remain a very important topical issue in the field of education (Brown, Bransford, & Cocking, 1999).

Learning progression (LP) articulates a trajectory of learning and understanding in a domain in the form of levels or steps in learner understanding toward proficiency (Alonzo, & Elby, 2019). In the same disposition, LP has been developed in many areas, including languages (Harden, Witte, & Köhler, 2006), mathematics (Seah, & Horne, 2020) and science (Stevens, Delgado, & Krajcik, 2010). By articulating a trajectory of learning and understanding in a domain, LP provides broad spectrum of ideas on what and how learners are to learn, the varied instructional strategies to be adopted and implemented by the teachers and provide guidelines for the design of learner assessments.

Learning progressions in science are empirically grounded and testable hypotheses about how learners' understanding of scientific concepts and their ability to use and explain these core concepts which are related to scientific practices grow and become more sophisticated over time, with appropriate instruction (NRC, 2007). In a study that was carried out in the United States of America related to learning progressions in high school chemistry (Stevens, Delgado, & Krajcik, 2010), and in Italy (Testa et al., 2019) towards a hypothetical learning progression of scientific explanation, all show the synthesis of a cross-age account of learners' conceptual grasp and development of scientific concepts in the form of a learning progression. In the large number of empirical studies related to concepts on learning progression conducted by researchers over the past decades, the most frequently discussed topics in the field of physics are related to mechanics, dynamics, and energy (Lee, et al., 2017). However, one core concept that learners need to understand in order to be able to explain scientific phenomena in relation to our

technological world is the concept of electricity and magnetism. Research in the field has shown that, most of the learners did not show any significant learning of the basic concepts of electromagnetism even after been exposed to instructions (Michellini, et al., 2007).

Although, the content of the concept of electricity and magnetism are different at all levels of the educational ladder, this does not mean that the conceptual understanding of learners in these concepts would be the same at all levels of teaching. These concepts become more complex in years of learning and teaching, but for most learners they are still far from scientific representations. Most of the studies I reviewed focused on analysing learners' concepts in specific areas, such as the interaction behind the abstract concepts such as electric field, flux, magnetic induction between magnets across all grades, distinctions between the concepts of charge and fields and conceptual difficulties (Li & Singh, 2019). However, few studies provide a more extensive analysis that includes the matter the magnetic material is made of, magnetic fields and how magnetic forces do work (Onorato & De Ambrosis, 2013). These studies explain some of the characteristics of the learners' misconceptions and difficulties of electricity and magnetism, but do not involve the learners' conceptual development and understanding of electricity and magnetism to describe a coherent progression. In addition, few studies appear to have been done to investigate across ages and grades the longitudinal progression of learners' conceptual development and understanding of Electricity and Magnetism.

Against this background, this project intends to develop a LP to describe how high school learners builds more complex understanding of those concepts of electricity and magnetism that support understanding of these concepts to describe a coherent progression of learner conceptions to inform instruction. The following research questions guided the study:

1. How do learners progress in their understanding of electricity and magnetism from grade 10 through grade 12?

## **2. Literature**

### **2.1. Conceptualising learning progression**

Learning progression (LP) is an approach that aims to support three aspects of education: teaching and learning, assessment, and curriculum design. According to Schmidt, Wang, and McKnight (2005) the effectiveness of these three aspects of education may be increased by better coherence, and the LP approach claims to improve coherence by providing frameworks of knowledge and skills called "LP models". These models describe the progression that can be expected of learners through their education. Schmidt et al., (2005) reviewed results of Third International Mathematics and Science Study (TIMSS) and found that countries achieving higher at these international exams have implemented a coherent curriculum framework.

To help develop a coherent framework to guide science education, the South African department of Basic Education adopted and implemented the National Curriculum and Assessment Policy Statements (CAPS) for Physical Sciences for Grades 10 to 12 in 2012. Central to the CAPS curriculum principles is the idea of learner progression, which describes the learning progression of learners in the content and context of each grade to show a progression from simple to complex concepts in physical sciences (DoE, 2011). This means that teachers must adopt strategies for effective teaching and learning, ensuring that learners make meaning as they move from simple information to complex materials in the teaching-learning process while relating one core idea to another in a particular concept. Of paramount is the idea that LP does not focus solely on the end product of understanding of concepts but also illustrates how ideas build upon one another to create new levels of understanding (NRC, 2007). The CAPS document for physical sciences, therefore, incorporates learning progression, which is organised around six core strands to help describe the knowledge and skills learners need to develop whilst promoting knowledge and understanding of the concept and its interrelationships to technology, society and the environment at large (DoE, 2011). In this study, I used such a model of learning from simpler to more sophisticated to develop LP of electricity and magnetism to guide learners to develop a meaningful understanding of these concepts as they progress successfully through schooling.

Table 1. Main concepts that have been included in the learning progression for electricity and magnetism.

<b>Electricity and Magnetism</b>	<b>Grade 10</b>	Magnetism (magnetic field of permanent magnets, poles of permanent magnets, magnetic field lines), Electrostatics (two kinds of charge, the force exerted by charges on each other (descriptive), an attraction between charged and uncharged objects, charge conservation, charge quantization), Electric circuits (emf, potential difference, current, measurement of voltage and current, resistance, resistors in parallel).
	<b>Grade 11</b>	Electrostatics (Coulomb's Law, Electric field), Electromagnetism (Magnetic field associated with current-carrying wires, Faraday's Law), Electric circuits.
	<b>Grade 12</b>	Electric circuits (internal resistance and series-parallel networks), Electrodynamics (electrical machines (generators, motors), alternating current) 12 hours

(Source: Department of Basic Education, CAPS, 2011)

### 3. Research methods

Taking the stances of McCoy (2015) who advocates for the use of mixed research methods, an exploratory research design was followed. A purposeful sampling technique was used to select the participants from grades 10 through grade 12. A total of 210 participants were recruited to take part in this longitudinal study. Data sources were obtained from questionnaires, written responses, interviews, and classroom observation notes.

Data collection commenced in the 3<sup>rd</sup> quarter of 2022, when most schools taught the topics of Electricity and Magnetism. Data was collected in 4 phases. LP was developed incorporating ideas from the big ideas listed in the table below. Details of the LP will be published elsewhere.

Table 2. Big ideas contained in the concepts included in the learning progression for electricity and magnetism.

	<b>Big Ideas</b>	<b>Contents</b>	<b>Knowledge levels</b>
<b>Sub-concepts</b>	Magnetism	Magnetic field of permanent magnet, poles of permanent magnets, attraction and repulsion, magnetic field lines, earth's magnetic field, compass),	All levels of cognitive processes (1, 2, 3, 4 & 5)
	Electrostatics	Two kinds of charge, force exerted by charges on each other (descriptive), attraction between charged and uncharged objects (polarisation), charge conservation, charge quantization), Coulomb's Law, Electric field),	
	Electric circuit	Electric circuits (emf, potential difference current, measurement of voltage and current, resistance, resistors in parallel), Energy, Power), internal resistance and series-parallel networks),	
	Electromagnetism	(Magnetic field associated with current-carrying wires, Faraday's Law),	
	Electrodynamics	Electrical machines (generators, motors), alternating current).	

The researcher believes that students of all grade levels can incorporate concepts from multiple concepts when discussing phenomena. As they advance through the LP, their explanations will become increasingly sophisticated and less scientifically accurate. Learners incorporate new concepts as they progress through the LP to develop increasingly intricate models that characterise the concept of electricity and magnetism.

Using the instruments designed, data was collected. To ensure the reliability and validity of the instruments, all the instruments were given to experts in the field to determine whether the instruments covered the contents intended to cover. The reliability of the instruments was also determined using Cronbach's alpha. All instruments were piloted to increase their reliability. Both numerical and qualitative responses were triangulated to ensure validity. The interview dataset was transcribed and sent out to participants for member checking. Interview data were coded to characterise learners' responses to question items on electricity and magnetism to demonstrate ideas behind their responses. Classroom observations were coded to characterise teachers' teaching practises and learners' experiences using thematic analysis.

## 4. Findings

### 4.1. Teachers' practices and experiences with the LP

The findings show that teachers start their lessons with learning goals and use various teaching methods in their classroom instructions. It was also observed that most classroom instruction was basically a lecture method where learners become passive participants in the teaching-learning process. Sometimes teachers demonstrated activities for learners to grasp the big ideas behind the text. In addition, teachers sometimes relate the lesson to real-life scenarios and capitalise on learners' prior knowledge as they make connections between big ideas on electricity and magnetism. In contrast, teacher content knowledge gaps were also observed in some of the lessons where teachers were unable to represent science content or processes and improper use of teacher questioning, prompting and providing feedback. When the teachers were interviewed, they indicated that electricity and magnetism are challenging concepts for learners to grasp. The reason is that the concepts of electricity and magnetism are exceedingly abstract. Therefore, the learners have trouble comprehending them. In addition, all the teachers appeared to concur that the most challenging aspect of electricity and magnetism is the abstract nature of which they are represented. The teachers were of the view that the learners could not conceptualise abstract concepts such as internal resistance and magnetic flux. One teacher lamented:

*Learners find it difficult to conceptualise the concept of magnetic flux as they presume it to be too abstract. (Mr Ndovela)*

The teachers were of the view that some concepts on electricity and magnetism, specifically electromagnetism lesson, are fascinating to the learners because it has numerous applications in everyday life, including the motor effect, generators, and transformers. However, they acknowledged that these applications are not expressly discussed in class, as the majority of the lesson focuses on quantitative problems, which are challenging for learners. One teacher narrated:

*Learners have anxiety when it comes to the working functioning of motors and generators and find it difficult to answer questions about induced e.m.f. in a coil when a magnet is moved in or out or a nearby coil's current is switched on or off may be cause for concern. (Mr Sistani)*

In contrast, the performance on the remaining test questions dealing with slightly less fundamental concepts or requiring the application of fundamental concepts is less satisfactory.

### 4.2. Learners' learning progressions

Although the researcher did not analyse all data to be included in this paper, the initial dataset indicated learners' ideas and conceptual growth on electricity and magnetism vary.

Learners' responses and artefacts on electricity and magnetism show conceptual growth. In all, most learners were able to give a reasoning behind the question posed to draw big ideas from them. For example; learners were able to explain that when a magnet moves into a coil of wire, a potential difference is induced across the ends of the coil; if the magnet is moving out of the coil, or if the other pole of the magnet is moving into it, the opposite potential difference is induced. Few learners were able to indicate that the changes in the current in one coil of wire can elicit a voltage in a neighbouring coil by inducing a fluctuating magnetic field.

The artefact from the learners shows diagrams they used to indicate a simple transformer, with all its parts and components indicated, with two wire coils wound on an iron core. With the artefact, learners were able to explain that a changing current in one coil of a transformer will induce a changing potential difference across the other transformer coil. However, very few learners were able to explain that a magnet or electromagnet is rotated within a wire coil to induce a voltage across the extremities of the coil in a generator, with understanding. Furthermore, few learners were able to explain the revolution of the magnets as they explained that, during each revolution of the magnet or electromagnet, the induced voltage across the coil of an alternating current generator (and, consequently, the current in an external circuit) changes.

## 5. Conclusion and recommendation

The findings presented suggest that the theory of learning inherent to the LP approach is helpful because it does not reflect the inconsistencies and complexities of the actual process of change that learners go through or how inconsistently they can demonstrate their learning. Hence, the implementation of a theory based on the ladder analogy, replacing other approaches and models of learning, is therefore likely to be counterproductive for learning. This is not to say that no learner progresses or that simplifications cannot be useful in certain contexts (such as when creating a scheme of work from a

curriculum), but that the theory described by "Learning progressions" authors if implemented without additional curriculum and learning consideration, would not result in positive educational outcomes. High school learners can provide relatively sophisticated descriptions of electricity and magnetism according to these findings. Students in high schools can incorporate concepts regarding the concept of electricity and magnetism at the molecular level when given the appropriate instructional support.

### Acknowledgements

The author gratefully acknowledges the financial support provided by the WSU Seed Fund for the completion of this research project.

### References

- Alonzo, A. C., & Elby, A. (2019). Beyond empirical adequacy: Learning progressions as models and their value for teachers. *Cognition and Instruction*, 37(1), 1-37.
- Brown, A. L., Bransford, J., & Cocking, R. R. (1999). *How people learn: Brain, mind, experience, and and School*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/9853>
- Department of Education. [DoE] (2011). *National Curriculum Statement Grades R - 12: Curriculum and Assessment Policy (CAPS) Physical Sciences*. Pretoria.
- Harden, T., Witte, A., & Köhler, D. (2006). *The concept of progression in the teaching and learning of foreign languages*. Peter Lang.
- Jin, H., Mikeska, J. N., Hokayem, H., & Mavronikolas, E. (2019). Toward coherence in curriculum, instruction, and assessment: A review of learning progression literature. *Science Education*, 103(5), 1206-1234.
- Lee, K., Dong, H., Choi, W., Kwon, G., Lee, I., & Kim, Y. J. (2017). Exploring a learning progression for eight core concepts of middle school science using constructed response items in the National Assessment of Educational Achievement (NAEA). *Journal of Science Education*, 41(3), 382-404.
- Li, J., & Singh, C. (2019). Investigating and improving introductory physics students' understanding of electric field and the superposition principle: The case of a continuous charge distribution. *Physical Review Physics Education Research*, 15(1), 010116.
- McCoy, D. L. (2015). Mixed Methods Research. In F. K. Stage, & K. Manning (Eds.), *313 Research in the College Context: Approaches and Methods* (pp. 105-118). London: Routledge
- Michellini, M., Mossenta, A., Testa, I., Viola, R., & Testa, A. (2007). Teaching Electromagnetism: Issues and changes. In *Proceedings of the Girep/EPEC 2007 Conference on Frontiers of Physics Education* (pp. 33-37).
- National Research Council. [NRC] (2007). Generating and evaluating scientific evidence and explanation. In R. Duschl, H. Schweingruber, & A. Shouse (Eds.), *Taking science to school: Learning and teaching science in grades K-8* (pp. 129-167). Washington D.C.: National Academies Press.
- Onorato, P., & De Ambrosis, A. (2013). How can magnetic forces do work? Investigating the problem with students. *Physics Education*, 48(6), 766.
- Schmidt, W. H., Wang, H. C., & McKnight, C. C. (2005). Curriculum coherence: An examination of US mathematics and science content standards from an international perspective. *Journal of curriculum studies*, 37(5), 525-559.
- Seah, R., & Horne, M. (2020). The construction and validation of a geometric reasoning test item to support the development of learning progression. *Mathematics Education Research Journal*, 32, 607-628.
- Stevens, S. Y., Delgado, C., & Krajcik, J. S. (2010). Developing a hypothetical multi-dimensional learning progression for the nature of matter. *Journal of Research in Science Teaching*, 47(6), 687-715.
- Testa, I., Capasso, G., Colantonio, A., Galano, S., Marzoli, I., Scotti di Uccio, U., ... & Zappia, A. (2019). Development and validation of a university students' progression in learning quantum mechanics through exploratory factor analysis and Rasch analysis. *International Journal of Science Education*, 41(3), 388-417.

## REVIEWING THE LITERATURE ON THE INTERPLAY OF CREATIVITY AND CRITICAL THINKING IN EDUCATION

**Maria Gkouzioni, Eirini Kleidara, Zafiria-Sabrina Shehu, Panagiota Koulouri,  
& Lefkothea-Vasiliki Andreou**

*Department of Biological Applications and Technology, University of Ioannina (Greece)*

### Abstract

The significance of creativity in education is very well established in both research and literature. At the same time, a strong interest has emerged in exploring critical thinking and its role in educational settings. Importantly, recent literature has suggested a relationship between these two factors. To this end, we ran Google Scholar searches employing combinations of the keywords “creativity”, “critical thinking” and “education”. The co-occurrence of creativity and education or critical thinking and education in the title of publications returned about 4,270 and 2,010 results respectively. Notably, all three keywords yielded 64 publications. The latter involved mostly case studies, followed by good practices, empirical studies, primary research, theoretical advances, and secondary research. The focus is evenly distributed between teachers and learners. Furthermore, in terms of the learner-focused studies, these mostly concern higher education contexts. A rise is also observed in the interest of the combined examination of creativity and critical thinking in education, with an upward trend of publications in the last decade. Moreover, this body of literature primarily involves the consideration of creativity and critical thinking in a variety of educational scenarios and less the investigation of their interaction. Further tapping on the issue reveals an association between these factors and a possible impact of gender. Nevertheless, this interplay appears rather complex, also affected by several educational elements, such as personal and interpersonal stances, but also technological and methodological goals. Our findings indicate that even though creativity and critical thinking are widely considered as essential 21st century skills, their interaction in education is somewhat understudied in the literature.

**Keywords:** *Creativity, critical thinking, education, teaching and learning.*

---

### 1. Introduction

Cognitive neuroscience research of creativity has provided insights for its application in education (Zhou, 2018). However, those insights have not still found their way into the classroom practices (Fischer, Goswami & Geake, 2010). Similarly, several methods and conceptions of teaching appear to inhibit critical thinking in the classroom, even though critical thinking is regarded as a crucial skill for the education of individuals (Pithers & Soden, 2010). Even more so, there seems to be a gap in literature regarding the relationship between creativity and critical thinking in educational settings (Vincent-Lancrin et al., 2019; Shubina, Kwiatek & Kulakli, 2021). Therefore, the present study aims to identify the implementation of this interaction through the investigation of the relevant educational literature and to clarify whether scientific interest on the topic has increased over recent years.

### 2. Methods

A literature search was conducted, in December 2022, in incognito mode so as not to bias search results by personal browsing preferences. The following databases were used: Google Scholar, Scopus, ERIC and IEEEExplore. A total of 3 constructs was used, one for each round respectively, “creativity AND education” (namely, Construct1; C1), “critical thinking AND education” (namely, C2), and “creativity AND “critical thinking” AND education” (namely, C3), and search was restricted to document title. All results were considered, without any further limitations, also concerning publication year.

Selection criteria were established for the further analysis of the publications returned from the literature search round employing construct C3. Those involved including publications reported in the English language, that are accessible online and include of course all three keywords in the title, while duplicates were removed.

Results were inspected in terms of criteria being met, by three of the researchers and scrutinized by a fourth author.

### 3. Results

Numerical search results for each literature search round and for each database are depicted in Table 1. The great majority of publications derives from the Google Scholar database with Scopus, ERIC, and IEEEXplore following. These results consist mostly of case studies, followed by good practices, empirical studies, and theoretical advances. Focus is distributed evenly between teachers and learners and the learner-focused studies concern mostly the higher education.

Subsequently, the focus of analysis was shifted to the combined C3 results across databases. The application of the selection criteria yielded a number of 26 publications which are listed on Table 2. Information on these publications is organized and presented in Table 2, in terms of publication year, type of study (i.e., theoretical, empirical), study focus (i.e., teachers, learners or both) and educational level (i.e., secondary, tertiary, or not defined/applicable). There is a substantial number of case studies in this body of work. This oeuvre is divided to empirical studies and theoretical advances with empirical studies constituting a marginal majority. Furthermore, the empirical studies comprise mostly qualitative as opposed to quantitative studies. As far as content is concerned, most publications involve the implementation of creativity and/or critical thinking in education and less the interplay of these factors in the educational setting. Some interesting findings include the following observations. First, creativity and critical thinking are inextricably linked to the engagement with social affairs (Rennie, 2022). The two competencies share a two-way relationship (Njonge, 2022) and should be symbiotically integrated in the educational process (Berry, 2022; Shubina & Kulakli, 2019). Students should engage in activities promoting creativity and critical thinking from an early age, for these to be instilled and available to students when they reach higher educational levels (Njonge, 2022). Moreover, as far as the educational process is concerned, creative and critical thinking implementation does not only refer to students or teachers but to both. Implementation of these factors leads to more versatile teaching (Luka & Dukku, 2017) and to students acquiring a more inclusive perception of subjects (Nganga, 2019).

Finally, there seems to be a radical increase of publications in the domain since 2019, suggesting an upward trend in the field. More specifically, literature search results span across the time period of 2011-2022. Importantly, 69% of results were published after 2019 and 58% of results were published after 2020 onwards.

Table 1. Literature search results across databases and constructs used in this study.

Constructs Databases	C1	C2	C3
Google Scholar	4,270	2,010	64
Scopus	1,123	657	6
ERIC	442	334	4
IEEEXplore	41	12	0

Table 2. C3 results combined across databases.

ID	In-line Citation	Year	Type	Focus On	Level
1	(Adeleye, 2018)	2018	Theoretical study	T & L	School setting
2	(Agbowuro & Keswet, 2016)	2016	Theoretical study	T	n/a
3	(Berry, 2022)	2022	Theoretical study	T	n/a
4	(Chaim, 2016)	2016	Empirical study	T	n/a
5	(Cooper, Carpendale, Mansfield & Marangio, 2021)	2021	Empirical study	T	n/a
6	(Hahn, 2022)	2022	Empirical study	L	Tertiary Education
7	(Hebebcı & Usta, 2022)	2022	Empirical study	L	Secondary Education
8	(Lau, 2021)	2021	Empirical study	T   L	n/a   Secondary Education
9	(Leest & Wolbers, 2020)	2020	Empirical study	L	Tertiary Education



10	(Luka & Dukku, 2017)	2017	Theoretical study	T	n/a
11	(McPartland, 2020)	2020	n/a	n/a	n/a
12	(Montana-Hoyos & Leimatre, 2011)	2011	Theoretical & Empirical	L	Tertiary Education
13	(Nganga, 2019)	2019	Empirical study	T	n/a
14	(Njonge, 2022)	2022	Theoretical & Empirical	L	Secondary Education
15	(Okereke & Oladeji, 2020)	2020	Empirical study	L	Tertiary Education
16	(Olanibi, 2019)	2019	Theoretical study	T	n/a
17	(Pepe, 2018)	2018	Empirical study	L	Tertiary Education
18	(Powell, 2021)	2021	Theoretical study	T   L	n/a   School setting
19	(Rennie, 2022)	2022	Theoretical study	L	School setting
20	(Shafat, 2020)	2020	Theoretical study	L	Tertiary Education
21	(Shubina & Kulakli, 2019)	2019	Theoretical & Empirical	L	Tertiary Education
22	(Shubina, Kwiatek & Kulakli, 2021)	2021	Empirical study	L	Tertiary Education
23	(Siri, Del Puente, Martini & Bragazzi, 2017)	2017	Empirical study	T   L	n/a   Tertiary Education
24	(Trolian, 2018)	2018	Theoretical study	L	Tertiary Education
25	(Utama, Sudirman, Widyasari, Savitri & Morika, 2022)	2022	Theoretical & Empirical	L	Tertiary Education
26	(Vincent-Lancrin, 2022)	2022	Theoretical study	T	n/a

\* "T" refers to Teachers and "L" to Learners

#### 4. Discussion

Further tapping on the interplay of creativity and critical thinking reveals an association between these factors and a possible impact of gender (Shubina, Kwiatek & Kulakli, 2021; Shubina & Kulakli, 2019). Nevertheless, this interplay appears rather complex, also affected by several educational elements, such as personal and interpersonal stances, but also technological and methodological goals (Shubina & Kulakli, 2019).

Our findings here indicate: (1) interest in the topic has recently attracted attention with most publications originating from 2019 onwards, (2) the literature focus is on higher education and (3) even though creativity and critical thinking are widely considered as essential 21st century skills (Hebebcı & Usta, 2022), their interaction in education is somewhat understudied and merits further investigation (Berry, 2022; Shubina, Kwiatek & Kulakli, 2021).

#### References

- Adeleye, J. O. (2018). Implications of critical thinking, creativity and information technology on education. *KIU Journal of Social Sciences*, 4(3), 75-81. Retrieved from <https://www.ijhumas.com/ojs/index.php/kiujoss/article/view/365>
- Agbowuro, C., & Keswet, L. A. M. (2016). Critical thinking and creativity in science and technology education for sustainable development. *International Journal of Innovative Research and Advanced Studies (IJIRAS)*, 3(12), 73-78. Retrieved from [https://www.ijiras.com/2016/Vol\\_3-Issue\\_12/paper\\_17.pdf](https://www.ijiras.com/2016/Vol_3-Issue_12/paper_17.pdf)
- Berry, A. (2022). Final commentary: Education in the 21<sup>st</sup> century: STEM, creativity and critical thinking. In A. Berry, C. Bunting, D. Corrigan, R. Gunstone & A. Jones (Eds.), *Education in the 21<sup>st</sup> Century, STEM, Creativity and Critical Thinking* (pp. 177-191). New York, NY: Springer Cham.
- Chaim, O. C. (2016). *Developing competences through individual assessments in an Engineering Education context: creativity and critical thinking* [Master's thesis, University of São Paulo]. Retrieved from <https://www.teses.usp.br/teses/disponiveis/18/18157/tde-17012017-105102/en.php>
- Cooper, R., Carpendale, J., Mansfield, J., & Marangio, K. (2021, June). *Creativity and critical thinking in secondary science pre-service teacher education*. Paper presented at the Australasian Science Education Research Association Annual Conference 2021, Adelaide, South Australia, Australia. Abstract retrieved from <https://asera.org.au/ASERA%2052-Conference%20program.pdf>

- Fischer, K. W., Goswami, U., Geake, J., & The Task Force on the Future of Educational Neuroscience. (2010). The Future of Educational Neuroscience. *Mind, Brain, and Education*, 4(2), 68-80. Retrieved from <https://onlinelibrary.wiley.com/doi/10.1111/j.1751-228X.2010.01086.x>
- Forawi, S. A. (2016). Standard-based science education and critical thinking. *Thinking Skills and Creativity*, 20, 52-62. doi: 10.1016/j.tsc.2016.02.005
- Hahn, S. (2022). *Critical thinking or critical creativity: applying De Bono's six thinking hats to speech-language pathology education and practice* [Master's thesis, University of Louisville]. doi:10.18297/etd/3870
- Hebebcı, M. T., & Usta, E. (2022). The effects of integrated STEM education practices on problem solving skills, scientific creativity, and critical thinking dispositions. *Participatory Educational Research*, 9(6), 358-379. Retrieved from <https://doi.org/10.17275/per.22.143.9.6>
- Lau, C. Y. (2021). A Visual Culture Art Education (VCAE) model for promoting creativity and critical thinking skills in senior art education in Hong Kong. *Australian Art Education*, 42(2), 166-183. Retrieved from <https://search.informit.org/doi/10.3316/informit.528965753485358>
- Leest, B., & Wolbers, M. H. J. (2020). Critical thinking, creativity and study results as predictors of selection for and successful completion of excellence programmes in Dutch higher education institutions. *European Journal of Higher Education*, 11(1), 29-43. doi: 10.1080/21568235.2020.1850310
- Luka, E. P., & Dukku, M. G. (2017). The use of critical thinking and creativity in teacher education in Nigeria. *Journal of Educational Foundations*, 7. Retrieved from <https://www.ajol.info/index.php/jef/article/view/169264>
- McPartland, T. J. (2020). Education and the process of inquiry: Community, creativity, and critical thinking. *Method: Journal of Lonergan Studies*, 11(1), 37-57. Retrieved from <https://doi.org/10.5840/method20201114>
- Montana-Hoyos, C., & Lemaitre, F. (2011). Systems thinking, disciplinarity and critical thinking in relation to creativity within contemporary arts and design education. *Studies in Learning, Evaluation, Innovation and Development*, 8(2), 12-25. Retrieved from [https://www.academia.edu/14318131/\\_2011\\_Systems\\_thinking\\_disciplinarity\\_and\\_critical\\_thinking\\_in\\_relation\\_to\\_creativity\\_within\\_contemporary\\_arts\\_and\\_design\\_education](https://www.academia.edu/14318131/_2011_Systems_thinking_disciplinarity_and_critical_thinking_in_relation_to_creativity_within_contemporary_arts_and_design_education)
- Nganga, L. (2019). Preservice teachers' perceptions and preparedness to teach for global mindedness and social justice using collaboration, critical thinking, creativity and communication (4cs). *Journal of Social Studies Research*, 10(4), 26-57. Retrieved from <https://jsser.org/index.php/jsser/article/view/1262>
- Njonge, T. W. (2022). Situating critical thinking and creativity as enablers of value-based education among secondary school students in Kenya. *Journal of Education and Learning*, 1(1), 1-12. doi:10.51317/jel.v4i1.44
- Okereke, E. C., & Oladeji, A. D. (2020). Perceived influence of social media usage on creativity and critical thinking skills of business education students in colleges of education in southwest Nigeria. *Journal of the Business of Education*, 3(1), 138-144. Retrieved from <https://www.kwasujtbe.com.ng/index.php/JTBKwasu/article/view/51>
- Olanibi, S. A. (2019). Fostering critical thinking and creativity in education using folktale as a teaching strategy in Yoruba traditional early childhood education. *FUDMA Journal of Educational Foundations*, 1(2), 37-44. <http://journal.fudutsinma.edu.ng/index.php/fujef/article/view/1144>
- Pepe, O. (2018). The impact of the creativity levels of the students who study at the school of physical education and sport on their critical thinking dispositions. *World Journal of Education*, 8(5), 185-191. doi:10.5430/wje.v8n5p185
- Pithers, R. T., & Soden, R. (2010). Critical thinking in education: a review. *Educational Research*, 42(3), 237-249. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/001318800440579>
- Powell, E. (2021). Innovative instructional methods integrating 21st-Century competencies in mathematics education: Communication, collaboration, critical thinking, creativity. In H. Dhir (Ed.), *Handbook of Research on Barriers for Teaching 21st-Century Competencies and the Impact of Digitalization* (pp. 234-252). Hershey, PA: IGI Global. Retrieved from <https://doi.org/10.4018/978-1-7998-6967-2.ch013>
- Rennie, L. J. (2022). Stimulating creativity and critical thinking in integrated STEM education: The contribution of out-of-school activities. In A. Berry, C. Bunting, D. Corrigan, R. Gunstone & A. Jones (Eds.), *Education in the 21st Century, STEM, Creativity and Critical Thinking* (pp. 99-117). New York, NY: Springer Cham.

- Shafat, G. (2020). Critical thinking and creativity in engineering education. *Afeka Journal of Engineering and Science*, 2, 73-78. Retrieved from <https://www.afeka.ac.il/media/1600505/%D7%90%D7%A4%D7%A7%D7%942%D7%90%D7%A0%D7%92%D7%9C%D7%99%D7%AA-%D7%90%D7%99%D7%994.pdf#page=73>
- Shubina, I., & Kulakli, A. (2019). Critical thinking, creativity and gender differences for knowledge generation in education. *Literacy Information and Computer Education Journal*, 10(1), 3086-3093. doi: 10.20533/licej.2040.2589.2019.0405
- Shubina, I., Kwiatek, P., & Kulakli, A. (2021). The relationships between critical thinking and creativity among university students in contemporary education: Empirical analysis of gender differences. *The New Educational Review*, 65, 87-98. doi: 10.15804/tner.2021.65.3.07
- Siri, A., Del Puente, G., Martini, M., & Bragazzi, N. L. (2017). Ethnopsychiatry fosters creativity and the adoption of critical and reflexive thinking in higher education students: insights from a qualitative analysis of a preliminary pilot experience at the Faculty of Medicine and Surgery, University of Genoa, Italy. *Advances in Medical Education and Practice*, 2(8), 321-324. doi: 10.2147/AMEP.S114473
- Trolian, T. L. (2018). The neuroscience of learning and development: Enhancing creativity, compassion, critical thinking, and peace in higher education ed. by Marilee J. Bresciani Ludvik (review). *Journal of College Student Development*, 59(6), 779-782. doi: 10.1353/csd.2018.0075
- Utama, I. D., Sudirman, I. D., Widayarsi, R. K., Savitri, M. A., & Morika, D. (2022). Assessing critical thinking skills and creativity skills of higher education students by using ASSURE models. *Journal of Higher Education Theory and Practice*, 22(1), 54-65. Retrieved from <https://www.proquest.com/openview/d1f2fe9768a4191c01418d2a871cdda4/1?pqorigsite=gscholar&cbl=766331>
- Uzunöz, F. S., & Demirhan, G. (2017). The effect of creative drama on critical thinking in preservice physical education teachers. *Thinking Skills and Creativity*, 24, 164-174. doi: 10.1016/j.tsc.2017.02.018
- Vincent-Lancrin, S. (2022). Fostering students' creativity and critical thinking in science education. In A. Berry, C. Bunting, D. Corrigan, R. Gunstone & A. Jones (Eds.), *Education in the 21st Century, STEM, Creativity and Critical Thinking* (pp. 29-47). New York, NY: Springer Cham.
- Vincent-Lancrin, S., González-Sancho, C., Bouckaert, M., de Luca, F., Fernández-Barrerra, M., Jacotin, G., Urgel, J., & Vidal, Q. (2019). *Fostering students' creativity and critical thinking: What it means in school*. [OECD Publishing]. doi: 10.1787/62212c37-en
- Zhou, K. (2018). What cognitive neuroscience tells us about creativity education: A literature review. *Global Education Review*, 5(1), 20-34. Retrieved from <https://ger.mercy.edu/index.php/ger/article/view/367>

# “THAT’S JUST SOMETHING I WAS PLAYING WITH.” MATH TALK AND AVOIDANCE IN AN ART MUSEUM

Nuria Jaumot-Pascual  
TERC (USA)

## Abstract

This paper examines the findings of a project that brought art and math together in the context of an art museum for intergenerational families lead by custodial grandparents. The project brought together intergenerational families to explore the connections between math and art at art museum in the Southeastern U.S. The project consisted of six intergenerational sessions that promoted looking closely at the art through the integration of math into art museum experiences. Project activities integrated art and math content in ways that provided for a learning experience of greater complexity than art or math would alone. The project’s goals were to push families to think mathematically and to help them improve their attitudes and self-confidence toward math. We conducted a final group activity with the grandparents that combined a self-guided gallery tour, a hands-on creative activity, and a photo elicitation focus group. This paper examines how custodial grandparents’ spontaneous talk in the focus group explained how artworks brought together math concepts with art. We also examine the conversational strategies they used to contribute or to avoid math conversations. We found that participants spontaneously used a broad range of mathematical concepts without considering them to be math at the same time that they used strategies for math avoidance when math was explicitly mentioned. Based on these findings, we recommend supporting custodial grandparents’ development of broader understandings of what constitutes math.

**Keywords:** *ArtMath, informal math learning, intergenerational learning, photo elicitation, art museums.*

---

## 1. Introduction

The InterGenerational ArtMath at the Museum (IGAMM) project brought together children, their grandparents, art museum education curators, and researchers to explore the connections between math and art through ArtMath experiences at art museum in the Southeastern U.S. IGAMM consisted of six intergenerational sessions (June to December of 2017) that promoted looking closely at the art through the integration of math into art museum experiences. These experiences spanned different formats of educational activities typical of art museums, such as self-directed tours, guided tours, gallery activities, and classroom activities. The project’s goals were to push grandparents to think mathematically and to help them improve their attitudes and self-confidence toward math. As Ramani, Rowe, Eason, and Leech (2015) showed, caregivers’ engagement in math-related activities and talk at home predicts their children’s advanced math skills. Thus, the goal was for grandparents to also engage in the project’s ArtMath activities and conversations to increase their comfort with them so that they could in turn engage their grandchildren in similar experiences at home. We take Braund and Reiss’ (2019) understanding of the integration of STEM and art at the micro-level as the basis for our work in the IGAMM project. We used “pedagogical practices in science and teaching that can be drawn from the arts” (Braund & Reiss, 2019, p. 225). In ArtMath, understanding of the math content provides for a deeper appreciation of the art and appreciation of the art provides for an opportunity to have a deeper understanding of an artwork’s underlying math.

In this paper, we examine how grandparents’ spontaneous talk in a photo elicitation focus group showed how they expressed ArtMath concepts through their explanations of how artworks (from the galleries and their own) brought together math concepts with art. We also examine the conversational strategies they used to contribute or to avoid ArtMath conversations in a photo elicitation focus group.

## 2. Design

This study involved a combination of quantitative and qualitative methods, including surveys, observations, a photo elicitation focus group, and interviews. In this article we focus on the photo

elicitation focus group with grandparents. The researcher conducted a photo elicitation (Harper, 2002) focus group with the participating grandparents at the art museum. This method involved participants in data collection and analysis by providing them with digital cameras to take pictures that answered to a prompt posed by the researcher, which in this case was: “Take a picture of an artwork that brings together shapes/patterns with art.” Participating grandparents were also asked to use magnetic tiles, pattern blocks, and/or Lucite dots to respond to the following prompt: “Using magnetic tiles and other materials, create something that expresses similar ideas to an artwork in the galleries. Take a picture of yourself while creating or with your creation once it is completed.” Subsequently, participants analyzed photographs of the artwork and of their own creations with the researcher in a focus group. The questions the researcher asked about the pictures involved the description of the images, how the images brought together math with art, and how the images represented their experiences with the program. The focus group was recorded and transcribed verbatim. The project obtained Institutional Review approval.

We used inductive thematic coding (Saldaña, 2015) to create categories from the data. We developed two main categories of codes: (1) content of the participants’ talk, and (2) participants’ responses to the researcher’s prompts for ArtMath content and connections.

### 3. Findings

The findings in this study suggest an interesting dynamic of abundant spontaneous discussion of mathematical ideas such as proportion and perspective from grandparents participating in the focus group, indicating that they integrated some of the ArtMath content they were exposed to in the project. At the same time, they used strategies for math avoidance when the researcher-initiated questions or comments using the word “math” and certain other math terms (e.g., shape names), indicating that math phobia is still prevalent among participants in spite of their integration of art and math content during the project.

#### 3.1. Math vocabulary

Grandparents used math vocabulary in the focus group to describe the art that they took pictures of and that they created 19 times. They used different math vocabulary to describe different types of images. Participants used shape names, sometimes incorrectly (e.g., rectangle, triangle, circle, *octangle* (sic)), and types of lines (e.g., curves, straight line) to describe paintings, sculptures, and their own artwork. In the example in Figure 1, Tallulah used mathematical terms to describe Lee’s creation, such as its symmetry, the shapes used, and position words like underneath and top to describe layers. She also used a familiar image, such as the double-decker bus, to help describe the repetition of layers and the symmetry in the composition. Participants’ use of math vocabulary in their descriptions of their images helped provide an understanding of how they were viewing the artworks to listeners. In Tallulah’s case, her use of language around symmetry and the position of the manipulatives helped listeners grasp the idea of layers that she was trying to convey.

Figure 1. Shapes.

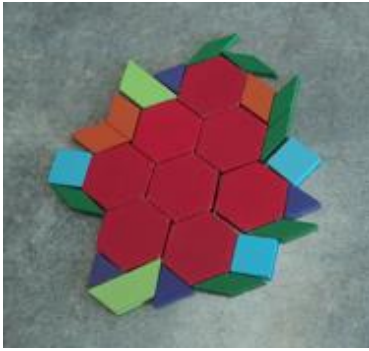


*You were making a symmetry kind of thing, you were very conscious of getting it symmetrical, and everything, I thought. Because it's like a double-decker. I mean, not a double-decker, that's not what I meant. But like the lines have something else underneath it, and then you have the magnetic square. And then you have something else on top of that. So you've got like three [layers] (Tallulah talking about Lee's artwork).*

#### 3.2. Grappling with math concepts

The second math content theme that appeared in the focus group was grappling with math concepts, which we saw 10 times. In these instances, participants’ words indicated that they were trying to understand math concepts that they were using or portraying in their images, such as grasping how figures fit together or using mathematical concepts to understand art. In Figure 2, Pearl tried to understand how shapes could be adjusted to create other shapes.

Figure 2. Ball/Fishing Lure.



*I was trying to do a ball, you know, a round ball with that [hexagon pattern block pieces] but I couldn't get the pieces to fit around like I wanted to. So that's kind of like a fishing lure. And it'll catch all kind of color of fish. Because you know fishes is different colors. So that's my piece (Pearl).*

Pearl was trying to fit hexagons and then other shapes together to make a circle. However, she found that she couldn't fit hexagons together in this way, and consequently decided to change her original plan of creating a ball to creating a fishing lure. This theme allowed us to see in real time how participants were making sense of experiences that integrated art and math and how they thought about the concepts that initially were not obvious to them.

### 3.3. Perspective

In nine occasions, participants described the position in which the art was viewed or described the vantage point it represented. Their words described how looking from different angles provided opportunities to see the same thing differently and how something seemed to transform as the viewpoint changed. In Figure 3, Bonnie described the perspective from which she took the photograph as looking up from underneath the display cases where artworks were displayed. By changing the perspective of the photograph from the typical focus on the art, she changed what was visible in the image and what was worth looking at from the artwork to the display cases.

Figure 3. Squares.



*Bonnie: I like these, too, because I took the picture up under, and you could still see the shapes. They're three-dimensional. They're on the wall, and they're like squares, and this is up underneath it.*

*Nuria: [laugh] You're getting really creative.*

*Bonnie: So, you know, from up underneath, you're still seeing those shapes. Like you can still see that one's a rectangle, and that was more of a square. But they're hanging up there, and they're three-dimensional. This is just from the bottom up.*

### 3.4. Emotionally charged math content

In five instances, participants described (1) their emotional response to an artwork with reference to its spatial arrangement or geometry, or (2) the emotions that they perceived were expressed through the mathematical elements in the artwork. In Figure 4, Lucinda interpreted the mathematical elements of the sculpture, such as shapes and weight, as transmitting emotions of sadness and pain. In her view of this piece, Lucinda interpreted the weight of the shapes and bottles as baggage that the portrayed woman was carrying and that was inflicting pain on her. For Lucinda, the mathematical content of the art contributed to her understanding of the piece.

Figure 4. Lady.



*Lucinda: Well, when I looked at that picture, I see all the different patterns in there. It's like, triangles, there and blocks and rectangles, but they also look like bottles, and all kinds of stuff going on in there. But I also see, when I look at it, I'm seeing like, this lady standing there, and she's got a whole lot of stuff going on. When I look at the bluish green, it seems like she's kind of sad, to me. Yes. And then when you get to the red, it seems like that's a whole lot of pain going on. I mean, I can just see this, she's got a lot of baggage, a lot of stuff. That picture tells a story.*

*Nuria: Hmm. So all the cans and all the bottles and all that stuff, is that her baggage?*

*Lucinda: Yes. It's telling a story, yes. Yes. And you notice that it starts from up here at the top, it starts lighter, and then as you notice it, and keep looking at it, and it gets heavier and heavier, so they keep adding more shapes, bottles, more, you know -- more pain is going on.*

### 3.5. Using a math lens

In five instances participants described artwork as containing mathematical objects (e.g., geometric shapes) when it did not literally do so or described the art using math to make sense of the image.

Figure 5. Bobsledders.



*That is The Bobsledders. If you look, see the green, and you'll see the man who is pushing the back of the bobsled. And you can see another one here at the front, and he -- you have to imagine them being able to fit there in between. There's a four-man bobsled; there's a two-man bobsled. To me, this is the two-man bobsled. And one pushes the front, one pushes the back, and before they get to the timeline, they have to jump in and get ready to go down. Yes, that's the way I see it (Vernon).*

Vernon talked about “you have to imagine them being able to fit.” The viewer does not need to do what Vernon said in order to understand the piece. However, Vernon uses a mathematical lens to explain how he views the role of physical space in the piece and help others understand it.

### 3.6. Absence of math content

There were two focus group participants (Lee and Beulah) who used very few to no math concepts to talk about their photographs. For example, Beulah would talk about the pieces in terms of their beauty, but would not explain what made the pieces beautiful, even when prompted about it, as below:

Figure 6. Plates.



*Nuria: Let's look at other art that you took pictures of. Oh, look at all those plates. How about this one?*

*Beulah: See, those are beautiful, what I can see. I just -- I just cannot see that well.*

*Nuria: Mm-hmm. What do you like about it? Like, it has -- this has like squares, and this one has random dots.*

*Beulah: I like all of them. I wish I had those in my house.*

The beauty of the pieces made Beulah want to own them, but she did not put into words what made her consider them to be beautiful. Like in the quote above, she talked about her poor sight: “I really can’t see the picture of it -- I put my glasses on it and I still can’t see it.”

#### 4. Discussion and conclusions

As our findings show, focus group participants spontaneously discussed a variety of math content, such as proportion, perspective, relationships between 2D and 3D structures, while viewing their photographs. This suggests that participation in the IGAMM program helped them integrate math concepts into their understanding of art. At the same time, some participants chose to disengage when the researcher prompted them with “math” terms.

This article’s findings suggest the need to support caregivers, and particularly grandparents who fulfill caregiving roles, in their understanding of what constitutes important math for the children in their care. Adults, and especially those of older generations, tend to have narrow understandings of what constitutes math based on their school experiences (Pattison et al., 2017) and need to be encouraged to develop broader understandings of it. This would help them be proactive at engaging in mathematical activities and conversations with their grandchildren (Ramani et al., 2015) without feeling the need to avoid mathematical content in their interactions. We recommend further research to corroborate and expand the classification of strategies to avoid math talk by caregiving adults and to find strategies that will promote mathematical conversation without constraining agentic activities that integrate art and math.

#### References

- Braund, M., & Reiss, M. J. (2019). The ‘Great Divide’: How the Arts Contribute to Science and Science Education. *Canadian Journal of Science, Mathematics and Technology Education*, 1-18.
- Harper, D. (2002). Talking about pictures: A case for photo elicitation. *Visual studies*, 17(1), 13-26.
- Pattison, S. A., Rubin, A., & Wright, T. (2017). Math in the Making. Reflections for the field. *CAISE*. <https://www.informalscience.org/news-views/math-making-reflections-field>
- Ramani, G. B., Rowe, M. L., Eason, S. H., & Leech, K. A. (2015). Math talk during informal learning activities in Head Start families. *Cognitive Development*, 35, 15-33.
- Saldaña, J. (2015). *The coding manual for qualitative researchers*. Sage.



## WRITTEN REFLECTION AS A “MOVEMENT” IN A QUALITY SERVICE-LEARNING PROCESS

**Federica Martino**

*University of Palermo (Italy)*

### Abstract

Nowadays, Service Learning (SL) is considered as a form of experiential education. This perspective is based on the recognition and enhancement of experience as an ordering criterion of teaching and learning methods. In these terms, learning offers students the opportunity to experience a deeper understanding of personal competences. Thus, the central element of the SL is the link between personal and interpersonal development with cognitive development and the curricular path.

Investing in authentic conditions of subjectivity and consequently promoting the production of significant knowledge towards research parameters encompass the possibility of collaborating and interacting with a plurality of actors with different interests and perspectives. Besides its strengths the knowledge processes in terms of feasibility and applicability to real community life.

Written reflection is an essential element in a quality SL project, as on the one hand it helps students to connect what they observe and experience within the community, on the other hand, it allows teachers to understand if what they have taught so far manages to go "beyond" the classroom by generating effective strategies and possible significant learning. Thus, writing can be considered as an interesting means which constitutes a useful self-training approach relating to an experience from which to extract significant materials and traces of one's personal learning.

In this research it was aimed to give voice and consistency to the actions and thoughts of the university students who, through Service-Learning activities, have enhanced the narrative training monitoring tool: the logbook. A sample of 153 students, enrolled in the fifth year of the Bachelor of Science in Primary Education (academic year 2021-22), at the University of Palermo, was asked to report in writing all the observations, challenges and achievements, as well as the desired prospects for the future.

Writing, a source of strategic information to be able to identify the progress of experience and skills, is thus considered an engine-training effect for the construction of critical thinking and personal identity. Written reflection is the main pivot for transforming meanings, re-examining them and consolidating them in learning, knowledge of oneself and of the group, and at the same time awareness of one's role as active citizens. Therefore, this study aims at identifying good practices in the face of social commitment, analyzing the development of experiences and promoting a self-directed attitude.

**Keywords:** *Learning experience, learning environments, service learning, written reflection, self-direction.*

---

### 1. Introduction

Today, there are many definitions of Service Learning in the literature, and they find their pedagogical synthesis in learning by doing. Experiential learning looks at being in the situation (acting in the first person) as an authentic method that facilitates the transfer of knowledge and skills from the situation to the internalization of contents.

Service Learning (SL) is configured as an educational strategy based on youth empowerment, more precisely an experiential methodology that focuses attention on a process of community growth (both of the individual and of the group, and thus of the territory to which it belongs) in terms of self-esteem, self-efficacy, self-determination, leading all the protagonists to consciously appropriate their own potential.

Reminding us that experience is recognised as a vital aspect of educational contexts (Schutz & Pekrun, 2007), learning and teaching are practices that activate, and converge, flows of inner (emotion) and outer (expression) experience (Denzin, 2007).

For this reason, the "voice" of students is an indispensable element in Service Learning, because it opens the door to the desire for reflection, participation, decision-making, stimulating them to be more actively involved in community affairs in the future (Morgan & Streb, 2001).

Astin and colleagues (2000) point out that SL experiences generate significant emotional and personal growth in students, and that reflections on their learning are "strongly linked to emotions" (p. 91).

Reflection is the segment that unites Service and Learning, because it guides and helps students connect what they observe and experience, in the community in which they serve, with the content they learn in the classroom. Power (2010) reminds us that it is only possible to make authentic sense of experience through careful reflection. Consequently, the quality of reflection is the greatest challenge for the SL: it determines the implementation of effective structures to guide students, and meaningful strategies to assess learning outcomes (Ash, Clayton & Atkinson, 2005).

It is crucial to give learners the time and space they need to understand, evaluate and master their social, emotional and civic competences, which are gradually activated in the experience. Service Learning to be of 'quality' needs an effort (which we can call commitment) to push (motivate) students beyond basic knowledge and understanding, towards deeper levels of understanding (growth).

So, during the SL there are various activities that can be used to promote reflection, such as writing, thanks to which it is possible to create a new meaning, a new understanding of problems and to ensure a better organization of actions in a continuous work-process of the self. Writing provides material to think about, on which the reflective act can pause, analysing and re-analysing data continuously, in order to think about them in depth; it therefore allows for consistency to be given to actions, thoughts and emotions, making recursivity on them possible (Carson & Domangue, 2013).

Service Learning, going beyond the physical context (the classroom), adopts written reflection as a fundamental vehicle of 'movement'. In parallel, this process allows teachers to understand what students are actually learning, what their expectations and ideas are forming throughout the service about certain situations, people or activities.

Reflective processes are essential to provide feedback to the recipients, they represent a real educational experience. It is in this space that students learn to consider different approaches to problems, weigh the strengths and weaknesses of each possible solution, and carefully make reasoned decisions (Manring, 2012).

Written reflection is the key to good service learning, as it fosters consolidation of learning, introspection and knowledge of self and group, and at the same time awareness of one's role as a citizen. It is through reflection that students become aware of what they are doing and the meaning they want to give to the service experience they are having. Supporting written reflection processes means working for the construction of critical and autonomous thinking, for the maturation of one's personal identity, for the understanding of values such as solidarity (He & Prater, 2014).

Writing thus turns out to be an interesting device, constituting a useful self-formative approach, relating to an experience, bringing out significant materials and traces of one's personal learning.

## 2. Objectives and methodology

The reflections presented in this paper are linked to the Service Learning Project carried out at the University of Palermo with a sample of 150 students enrolled in the fifth year of the Degree Course in Primary Education (academic year 2021-22).

Giving voice to their experiences, actions and thoughts, the challenges they encountered and the results they achieved, and their desired prospects for the future, enhanced the monitoring tool of narrative training: the logbook.

The research aimed at identifying good practices in the face of social engagement, analysing the development of experiences and promoting a self-directed attitude, because written reflection constitutes the main pivot for transforming meanings, re-examining them and consolidating them into learning, self- and group knowledge, and at the same time community awareness.

Writing, as a strategic source of information to be able to identify the progress of experience and skills, has thus been considered a formative engine for the construction of critical thinking and personal identity (Rofle & Freshwater, 2020). Valuing writing to develop reflective skills means promoting expressions of meaning that are rooted in dialogicality, cooperation with others, and the friction that knowledge has with skills.

Reflection, and also writing (an activity that best satisfies the expression of people's inner identity), are indispensable elements for an authentic and meaningful SL experience. There are 6 aims (steps) that accompanied the students, through written reflection, in terms of personal and professional growth.

- STEP 1 - Varying moments of using critical and creative skills, processes that are intrinsically linked;
- STEP 2 - Realising a 'unique' product, a deeply intellectual work that takes the form of a written paper;
- STEP 3 - Promoting expressions of meaning that are rooted in dialogicality, cooperation with others, and the friction that knowledge has with skills;
- STEP 4 - To develop self-determination and self-regulation in learning;
- STEP 5 - To know how to identify the characteristics and components that characterise learning for formative growth;
- STEP 6 - Learning to decide what and how to write, to use the available time effectively, to select known material in order to enrich the paper, to try to apply new strategies, suitable for the success of the task.

### 3. Discussion

Following a reading of the data, it was possible to note how the use of narrative practices led the students to enhance the experience by questioning it, giving it authentic meaning (Table 1). Reflection thus made it possible to focus on achievable objectives through appropriate methodologies, improving the quality of teaching. Experimenting and implementing one's skills, inclinations and acquired knowledge, hypothesizing solutions to a problem through writing skills were all steps that characterized the Service Learning experience.

For 41.3% of the students, writing is the best way to express their identity; "storytelling" involves mastering one's language, being able to communicate one's thoughts to the Other, knowing and acting with attention, curiosity and respect. "*Narrating clarifies thoughts and emotions [...] allows one to rethink and organise thoughts, perceiving oneself as a subject endowed with autonomy and intentionality*".

Therefore, writing results in a harmonious combination of thought, the written word and movement.

Table 1. Enhancing experience by questioning it.

N.	WRITTEN REFLECTION AS...
62	Self-narration
18	Observation of context
54	Exploration of experience
16	Emotional report

The results show that 36% choose to use it to explore the experience, because, in addition to be a means of shaping any idea or personal experience, written reflection is a time to train one's ability to concentrate by defusing attitudes of closure; it therefore represents the key that allows human beings to interface with the society in which they live.

Under the guise of critical and creative thinking, writing 'asks' in what terms one wants to be the protagonist of a story, bringing out interests, ambitions and fears, fostering personal development, improving the linguistic-expressive capacity, renewing the way one perceives the context and perceives oneself in order to relate with one's self and the world (Hunt, 2005).

The reading of the data showed that the experience was characterised by: (1) Perceived impact on social change based on one's own identity; (2) Resilience: exploring internal and external resources as an encouragement to achieve goals; (3) Social responsibility: elements investigated for the interconnection with the Other; (4) Responsiveness to social conditions within the community, and problem solving skills; (5) Perspective taking: valuing oneself and others as possibilities in the making.

From the beginning to the end of all activities, we asked the students to reflect on their own person, to identify which 'relationship' between internal and external factors would be most effective in a Service Learning course (Table 2).

Table 2. Reflection on the most effective relationship.

Relationship: internal and external factors	BEFORE	freq.	AFTER	freq.
Strengths/Opportunities	102	68%	40	26,6%
Strengths/threats	29	19,3%	25	16,6%
Weaknesses/Opportunities	18	12%	73	48,6%
Weaknesses/threats	1	0,6%	12	8%

A substantial change in values can be noted.

After the experience, 49% of the students choose weaknesses-opportunities as the best relationship for good service learning, putting strengths-opportunities in second place (previously at 68%), positive internal factors capable of sustaining an advantageous situation.

Students' reflections show that challenges and insecurities represent a redemption of self-esteem and emotional self-regulation.

Knowing how to seize opportunities from weaknesses proves to be an effective strategy; working on threats (external factors) enables one to act. Strengthening skills means learning to reflect critically on problems and the possibility of change, understood as improvement.

So, while on the one hand Service Learning responds to the need to bring students to learn about the social and environmental reality also in its problematic aspects, "narrating themselves"; on the other hand, with respect to methodological aspects, it is proposed as an innovative didactic, experiential methodology that relies on empowerment and responsibility.

### 3.1. Conclusion

Learning through a cycle of action and reflection offered students the opportunity to experience a deeper understanding of personal skills; indeed, central to the SL is the link between personal and interpersonal development with cognitive development and the curriculum.

Supporting the students' reflective process led to exploring emotional and cognitive aspects, which should not be seen as separate areas, but rather as part of the whole. "Responding" to one's feelings and attitudes during the SL experience means being aware that affective and cognitive components have an impact on behaviour, and that the behavioural dimension of reflection in SL complements the emotional one: thinking with acting. Reflection on this aspect should ensure a perspective of continuity over time. Students need to reflect on who they are during SL activities, but in relation to a retrospective view of their own experience and a hypothetical view of their future behaviour.

By combining service with a reflective framework, the benefits to students, faculty, and the community agencies far exceed those of service or learning offered separately.

Seeing themselves recognised and simultaneously acknowledging their experiential knowledge constitutes a training exercise in which continuity is the crucial element. Completing service activities does not mean finishing the journey, but rather beginning to reflect: it is a process of transformation, a circular process, rich in learning and opportunities, through which young people, and with them the community, continue to grow.

### References

- Ash, S. L., Clayton, P. H., & Atkinson, M. P. (2005). Integrating Reflection and assessment to capture and improve student learning. *Michigan Journal of Community Service Learning, 11*(2), 49-60.
- Astin, A. W., Vogelgesang, L. J., Ikeda, E. K., & Yee, J. A. (2000). *How service learning affects students*. Higher Education. Paper 144. Retrieved from [http://www.gseis.ucla.edu/heri/service\\_learning.html](http://www.gseis.ucla.edu/heri/service_learning.html)
- Carson, R. L., & Domangue, E. A. (2013). The emotional component of service-learning. *Journal of Experiential Education, 36*(2), 139-154.
- Denzin, N. K. (2007). *On understanding emotion* (2nd ed.). New Brunswick, NJ: Transaction Publishers.
- He, Y., & Prater, K. (2014). Writing together, learning together: Teacher development through community service learning. *Teachers and Teaching, 20*(1), 32-44.
- Hunt, R. (2005). Developing emotional competence through service learning. *Annual Review of Nursing Education, Vol. 4, 2006: Innovations in Curriculum, Teaching, and Student and Faculty Development, 251*.
- Manring, S. L. (2012). Tapping and fostering students' emotional intelligence through service-learning experiences. *Journal of Behavioral and Applied Management, 13*(3), 168-185.
- Morgan, W., & Streb, M. (2001). Building citizenship: How student voice in service learning develops civic values. *Social Science Quarterly, 82*, 154-169.
- Power, A. (2010). Community engagement as authentic learning with reflection. *Issues in Educational research, 20*(1), 57-63.
- Rolfe, G., & Freshwater, D. (2020). *Critical reflection in practice: generating knowledge for care*. Bloomsbury Publishing.
- Schutz, P. A., & Pekrun, R. (Eds.). (2007). *Emotion in education*. Boston, MA: Elsevier.

# DRAMATIC PLAY AS A DEVELOPMENTAL MEANS OF PRESCHOOL CHILDREN'S MOTOR CREATIVITY

**Aspasia Panagiotaki, Kalliopi Trouli, & Michalis Linardakis**

*Department of Preschool Education, University of Crete (Greece)*

## Abstract

The purpose of the research was to design, implement and evaluate an experimental program based on dramatic play which aims to develop the motor creativity of preschool children. In particular, we designed a mixed-methods experimental study using the integration technique. The following school year, follow-up research was conducted to check the preservation of the results. Statistical analysis results and qualitative analysis of the data revealed that the experimental program based on dramatic play had a statistically significant improvement in the children's fluency, originality, and imagination of their motor creativity. In addition, the results of the experimental intervention were preserved through time for the factor of imagination, but not for the factor of fluency and originality. The results of our research confirm that activities based on dramatic play are suitable for the development of preschool children's motor creativity, while creativity, movement, and dramatic play seem to be interconnected.

**Keywords:** *Motor creativity, dramatic play, preschool children.*

---

## 1. Introduction

In recent decades there has been a growing research interest in creativity and its integration into formal education worldwide, as it is increasingly seen as the answer to the challenges and unprecedented rhythms of life that technology imposes on us (Corazza, 2016; Dere, 2019; Ozsoy & Ozyer, 2018; Rodríguez-Negro et al., 2020; Selkrig, 2018; Williams et al., 2016). In our work, motor creativity, which is sought to be developed in preschool children, can be defined as an ability to produce multiple and original motor responses to a stimulus (Wyrick, 1968). In other words, children's creative thinking is highly motivated and developed to a large extent by movement (McBride, 1991).

Ourda and her colleagues (2020) propose the development of motor creativity in preschool through activities that stimulate the imagination, help children devise solutions to motor problems, and promote communication between them. Pavlidou (2012) suggests dramatic play (DP) which contains significant motor-expressive challenges as a leading tool for the child's movement education. However, a variety of other programs (such as Physical Education, creative relaxation, creative dance or movement programs as well as an interdisciplinary program with a specific theme) have been implemented in studies focused on improving motor creativity with positive results in motor creativity (Justo, 2008; Ourda et al., 2020; Wang, 2003) or only in motor fluency (Chatoupis, 2013; Cheung, 2010; Richard et al., 2018; Tsapakidou et al., 2001).

In our study, DP is the medium that stimulates the imagination, cultivates the physical expression of the young child, and aims to develop his/her motor creativity.

## 2. Design

We designed a mixed-methods experimental study (quantitative and qualitative) using the integration technique. The experimental research consisted of two equivalent groups (the experimental group and the control group). In the first phase of the research, the initial pre-test of the *Thinking Creatively in Action & Movement test* (Torrance, 1981) was performed in both groups. In the second phase, the experimental program (EP) was implemented by the preschool teachers of the experimental group (EG) after training. To collect data from the processes that emerged during the daily interventions, the preschool teachers/practitioners kept a diary with their personal observations about the processes that took place during these interventions. Finally, at the end of the intervention, in the third phase, the final measurement of motor creativity was carried out with the performance of the same tool, post-test, in order

to evaluate the effectiveness of the EP. At the same time, a semi-structured interview was conducted with the teachers of EG. The fourth and final phase of the research took place the following school year, where the preschoolers in the EG were given motor creativity tests once again to check the preservation of the results of the intervention.

### 3. Objectives

The primary purpose of this research is to investigate the impact of DP on the development of motor creativity, and in particular, to design, implement and evaluate an experimental DP intervention program that will aim to develop motor creativity in preschool children. More specifically, we hypothesize that after the implementation of the intervention, our experimental group is expected to be statistically significantly superior in the factors of motor creativity (fluency, originality, and imagination) compared to the control group.

### 4. Methods

#### 4.1. Participants

The sample consisted of 215 preschool children from 16 public school classes in Greece (102 girls and 113 boys). The participants were randomly placed into one of two groups, the control group (N=109) and the experimental group (N=106). The permission of the Pedagogical Institute of Greece and the parents of the children were requested for the research.

#### 4.2. Intervention

The EP was implemented twice a week for 15 weeks, and each daily intervention lasted 40 minutes. A total of 31 interventions were carried out by the preschool teachers of the experimental group, who were properly trained by the researcher. The applied DP method was developed in six phases, drawing on both international and domestic literature (Avdi & Hadjigeorgiou, 2007; Beauchamp, 1984; Bolton, 1993; Fleming, 1995; Kouretzis, 1991; Mamali & Papadopoulos, 2021; Page, 2008; Way, 1967). The 6 phases that constituted the structural constitution of the DP are: a) activation, b) reproduction, c) stage improvisation, d) relaxation, e) evaluation of achievements, and f) artistic procedure (optionally). The activities that accompanied each intervention emphasized the children's physical expression and motor improvisation.

#### 4.3. Material and measures

For the measurement of children's motor creativity, before and after the EP, Torrance's Thinking Creatively in Action & Movement (TCAM) (1981) tool was used, which measures motor fluency, originality, and imagination at the ages of three to six years old.

The teachers who implemented the experimental program kept a personal diary where they recorded their observations from each DP process. At the end of the experimental program, an individual semi-structured interview was held with the preschool teachers of the experimental group.

### 5. Results

The equality of means of the three factors between the two groups (control and experimental) was examined through independent samples t-tests. Table 1 shows that all three comparisons show no significant difference ( $p>0.1$ ) between the two groups before the intervention. In contrast, all three factors have different mean values after the intervention ( $p<0.01$ , showing a highly statistically significant difference in each one of the three comparisons).

Table 1. Independent samples t-tests for equality of means of the 3 factors between the control and the experimental group, before and after the intervention.

Factors	Groups	Mean (sd)	Test of statistical significance					
			Before the intervention			After the intervention		
			t	Df	p-value	t	df	p-value
Fluency	E.G.pre	90.43 (18.96)	0.29	213	0.77	8.24	212	P<0.01
	C.G.pre	83.66 (19.75)						
	E.G.post	118.93 (29.98)						
	C.G.post	91.23 (17.91)						
Originality	E.G.pre	88.32 (23.23)	0.61	213	0.54	7.40	212	P<0.01
	C.G.pre	86.23 (26.51)						
	E.G.post	117.16 (32.10)						
	C.G.post	90.35 (19.66)						
Imagination	E.G.pre	89 (7.84)	0.83	213	0.41	4.28	212	P<0.01
	C.G.pre	87.65 (14.67)						
	E.G.post	98.89 (13.44)						
	C.G.post	92.03 (9.77)						

From the analysis of the semi-structured interview data, the preschool teachers of the EG stated that they noticed an improvement in the fluency, originality, and imagination of the preschoolers. Specifically, regarding fluency, seven of the eight preschool teachers reported that the preschoolers transferred what they experienced during DP and used it in a variety of ways in their free play in the classroom and outside in the play area. In the individual diaries, higher performance was observed after mid-intervention when the children had become familiar with finding motor solutions.

Regarding the factor of originality, the preschool teachers, observing the evolution of the preschoolers, stated in their interview that they were often surprised by their ideas as, after becoming familiar with the use of their bodies in many different ways, they began to experiment with new original motor combinations. This improvement in the preschoolers' motor originality is also noted in the preschool teachers' diaries, where towards the end of the intervention there is a great increase in their original motor responses.

Finally, regarding imagination, the preschool teachers mentioned in the interview that they noticed a difference in the free play of children. They made up stories using narrative elements from the DP, and over time, the preschoolers immediately activated their imagination to every stimulus suggesting many ideas.

The next school year, in order to test whether the effect of the EG was maintained over time, we used a paired samples t-test between the post-test of the EG and the follow up administration of the test. As shown in Table 2, the scores of the EG on the factors of fluency and originality is statistically significantly different between the post-test and the follow up administration of the test ( $p < 0.05$ ). It appears that the experimental group did not maintain its improvement on these factors. In contrast, the fiction factor means are not statistically significantly different between the post-test and the re-administration of the test ( $p > 0.05$ ). That is, EG appears to have maintained its improvement only on the imagination factor.

Table 2. Experimental group's pair samples t-test on the mean differences of the 3 factors between the post and the follow-up tests.

Factors	Group	Test of statistical significance				
		Mean	Sd	t	df	p-value
Fluency	E.G.post	118.95	31.90	2,73	42	0,01
	E.G. follow-up	102.93	23.43			
Originality	E.G.post	116.88	34.78	2,27	42	0,03
	E.G. follow-up	101.07	28.35			
Imagination	E.G.post	97.37	13.86	0,68	42	0,49
	E.G. follow-up	95.23	14.16			

## 6. Discussion

The results of the present study showed that the EP significantly improved all three factors of motor creativity (fluency, originality, imagination). These results are consistent with previous research that studied motor creativity as a whole or in individual factors (Chatoupis, 2013; Cheung, 2010; Justo, 2008; Ourda et al, 2020; Richard et al., 2018; Tsapakidou et al., 2001; Wang, 2003) and in which creative

movement or creative relaxation or physical education or creative dance/movement programs were implemented.

Checking the maintenance of the EP results over time showed that only the results of imagination, which is the driving force of creativity, remained the same (Duffy, 2006; Zachopoulou et al., 2009). The originality and fluency of the preschoolers declined after six months of abstinence from creative activities. It seems that these two factors are more dependent on the children's sustained practice. Generally, it is argued in the literature that creativity requires experience and knowledge, and is subject to the effects of treatment (see Batey & Furnham, 2006; Ferrari, Cachia, & Punie, 2009; Kostaridou-Euclid, 1989, in Trouli, 2022). It should be noted that in a study by Bournelli & Mountakis (2008), the retention test showed that children's performance remained high in all three factors of motor creativity.

In general, the results from the assessment of the preschoolers' motor creativity immediately after the implementation of the program also showed significant improvement in the factors of fluency and originality. These results align with the statements of the preschool teachers who believe that the EP provided preschoolers with a safe environment to express themselves in diverse, different, and original motor ways. According to their records, preschoolers needed several interventions to free their thinking and gain originality in their movement.

## 7. Conclusions

In general, the results of our research at the end of the EP showed the strong effect of DP as a means of developing fluency, originality, and imagination in preschool children and that the stimulation of children's imagination, a characteristic of this young age, can remain at high levels for a long time after the passage of appropriately designed DP programs. Furthermore, it confirmed that the creative ability of preschoolers, and in particular their fluency and originality of motor creativity needs continuous stimulation and practice to be maintained at high levels. This last finding highlights the need to implement appropriate activities and DP programs in the preschool educational process with continuity and consistency, not just occasionally, in order to enhance young children's motor creativity. As Caf, Kroflic, and Tancig (1997) report, creating through movement puts the person in a process of non-verbal thinking, while encouraging creative movement develops creative thinking directly, and creative behavior indirectly.

## References

- Avdi, A., & Hadjigeorgiou, M. (2007). *Η τέχνη του Δράματος στην εκπαίδευση* [The Art of Drama in Education]. Metaichmio.
- Beauchamp, H. (1984). *Les enfants et le jeu dramatique. Apprivoiser le Theatre*. Bruxelles: A. De Boeck.
- Bolton, G. (1993). Drama in Education and TIE. A comparison. In T. Jackson (Ed.), *Learning through Theatre* (pp. 39-50). Routledge.
- Bournelli, P., & Mountakis, C. (2008). The development of motor creativity in elementary school children and its retention. *Creativity Research Journal*, 20(1), 72-80.
- Caf, B., Kroflic, B., & Tancig, S. (1997). Activation of Hypoactive Children with Creative Movement and Dance in primary school. *The Arts in Psychotherapy*, 24(4), 355-365.
- Chatoupis, C. (2013). Young children's divergent movement ability: A study revisited. *Early Child Development and Care*, 183(1), 92-108. <https://doi.org/10.1080/03004430.2012.655728>
- Cheung, R. H. P. (2010). Designing movement activities to develop children's creativity in early childhood education. *Early Child Development and Care*, 180(3), 377-385. <https://doi.org/10.1080/03004430801931196>
- Corazza, G. (2016). Potential Originality and Effectiveness: The Dynamic Definition of Creativity. *Creativity Research Journal*, 28(3), 258-267. <https://doi.org/10.1080/10400419.2016.1195627>
- Dere, Z. (2019). Investigating the creativity of children in early childhood education institutions. *Universal Journal of Educational Research*, 7(3), 652-658. <https://doi.org/10.13189/ujer.2019.070302>
- Duffy, B. (2006). *Supporting creativity and imagination in the early years*. Open University Press.
- Fleming, M. (1995). *Starting Drama teaching*. David Fulton Publishers.
- Justo, C. (2008). Creative relaxation, motor creativity, self-concept in a sample of children from early childhood education. *Electronic Journal of Research in Educational Psychology*, 6(1), 29-50.
- Kouretzis, L. (1991). *Το θεατρικό παιχνίδι (παιδαγωγική θεωρία, πρακτική και θεατρολογική προσέγγιση)* [Dramatic play (pedagogical theory, practice, and theatrical approach)]. Kastaniotis Publications.



- Mamali, E., & Papadopoulos, S. (2021). Study on the synergy of Theatre Pedagogy and Philosophy for Children: A multi-disciplinary approach. *Epistēmēs Metron Logos*, 6, 7-13. <https://doi.org/10.12681/eml.27614>
- McBride, R. E. (1991). Critical thinking – An overview with implications for physical education. *Journal of Teaching in Physical Education*, 11, 112-125.
- Ourda, D., Mouratidou, A., Gruios, G., & Tsorbatzoudis, H. (2020). Ανάπτυξη και αξιολόγηση μιας παρέμβασης με έμφαση στον υγιεινό τρόπο ζωής στην υποστήριξη της δημιουργικής κίνησης σε νήπια [Development and evaluation of a healthy lifestyle intervention to support creative movement in toddlers]. *Research in Physical Education and Sport*, 18(1), 53-66.
- Ozsoy, N., & Ozyer, S. (2018). Creative drama and example of activity plan in STEM. *European Journal of Education Studies*, 4(4), 213-222. <https://doi.org/10.5281/zenodo.1210590>
- Page, C. (2008). Dramatic play: a meeting of theatre and education. *Education & Theatre*, 9, 67–71.
- Pavlidou, E. (2012). *Κινητική και ρυθμική αγωγή στην προσχολική εκπαίδευση* [Motor and rhythmic education in preschool education]. Zygos
- Richard, V., Lebeau, J. C., Becker, F., Boiangin, N., & Tenenbaum, G. (2018). Developing Cognitive and Motor Creativity in Children Through an Exercise Program Using Nonlinear Pedagogy Principles. *Creativity Research Journal*, 30(4), 391-401. <https://doi.org/10.1080/10400419.2018.1530913>
- Rodríguez-Negro, J., Pesola, A., & Yanci, J. (2020). Effects and retention of different physical exercise programs on children’s cognitive and motor development. *Journal of Educational Research*, 113(6), 431-437. <https://doi.org/10.1080/00220671.2020.1854159>
- Selkrig, M. (2018). Connections teachers make between creativity and arts learning. *Educational Research*, 60(4), 478-493. <https://doi.org/10.1080/00131881.2018.1524715>
- Torrance, P. (1981). *Thinking creatively in action and movement. Administration, scoring, and norms manual*. Scholastic Testing Service, INC. Bensenville, Illinois.
- Trouli, K. (2022). Αναπτύσσοντας την κινητική δημιουργικότητα με τη χρήση πολυμεσικών εφαρμογών στην εκπαιδευτική διαδικασία [Developing motor creativity by using multimedia applications in the educational process]. In P. Anastasiadis & K. Kotsidis (Eds.), *ICT Distance Education and Creativity in the 21st Century School*, (pp. 681-705). [E.D.I.V.E.A.] Department of Primary Education, University of Crete. <https://service.eudoxus.gr/search/#a/id:108802417/0>
- Tsapakidou, A., Zachopoulou, E., & Zographou, M. (2001). Early young children’s behavior during music and movement program. *Journal Oh Human Movement Studies*, 41, 333-345.
- Wang, J. H.-T. (2003). *The effects of a creative movement program on motor creativity of children ages three to five*. Paper presented at the Annual Meeting of the American Alliance for Health, Physical Education, Recreation and Dance (Philadelphia, PA, April 1-5, 2003).
- Way, B. (1967). *Development through Drama*. Longmans.
- Williams, R., Runco, M., & Berlow, E. (2016). Mapping the Themes, Impact, and Cohesion of Creativity Research over the Last 25 Years. *Creativity Research Journal*, 28(4), 385-394. <https://doi.org/10.1080/10400419.2016.1230358>
- Wyrick, W. (1968). The development of a test of motor creativity. *Research Quarterly*, 39, 756-765.
- Zachopoulou, E., Makri, A., & Pollatou, E. (2009). Evaluation of children’s creativity: Psychometric properties of Torrance’s “Thinking Creatively in Action and Movement” test. *Early Child Development and Care*, 179(3), 317-328. <https://doi.org/10.1080/03004430601078669>

# IMPLEMENTATION OF MATLAB GUIDE TEMPLATES FOR CHEMICAL ENGINEERING STUDENTS TO SOLVE COMPLEX MATERIAL AND ENERGY BALANCES

Ivan Dominguez-Candela, Salvador Cayetano Cardona, Maria Fernanda López-Pérez, Jaime Lora, & Vicent Fombuena

*Departamento de Ingeniería Química y Nuclear (DIQN), Universitat Politècnica de València (UPV), Escuela Politècnica Superior de Alcoy (Spain)*

## Abstract

Chemical engineering involves activities that require specific skills, such as analyzing, calculating and simulating real problems to develop the profession adequately. During the training stage, students of the Chemical Engineering Degree must transform real problems into mathematical equations that respond to the demands of a system. As a result, a complex system of algebraic equations is involved, which students must be capable of solving and getting numerical solutions. In order to facilitate the resolution, a mathematical software called Matlab is employed.

In this regard, Matlab is a powerful tool widely used in engineering, but it is not very intuitive for users. The programming window is simple, and students should program in an empty editor using Matlab functions with a certain complexity. Moreover, the introduction of the proper Matlab functions and the mathematical equations and restrictions of real problems based on material and energy balances requires time that is not available in the classroom. To overcome these disadvantages, students from Chemical Engineering Degree are provided with Matlab templates. This guide allows students to solve material and energy balances using a specific methodology to obtain a mathematical solution.

These Matlab templates consist of two files: the first one, called *template.mlx* is developed using the *Live Script* mode. This mode allows solving the low interaction and possible customization of the Matlab programming environment. In this language, it is possible to include equations, comments and even images that allow a better understanding of the students. The second file is called *steady\_state\_balances\_solver.m*. This file works as a “black box” and contains the “solve functions” needed to solve all equations introduced by students in the *template.mlx*.

Therefore, in addition to providing a way to solve complex algebraic equations in a more student-friendly programming environment, the use of templates gives students a better understanding of solving material and energy balances. Anonymous surveys were done by students to determine the degree of satisfaction and to determine possible improvements and solve the weaknesses of the new methodology proposed.

**Keywords:** *Matlab, guide template, chemical engineering, student-friendly, material and energy balances.*

## 1. Introduction

Chemical Engineer requires specific skills which involve analyzing, calculating and simulating real problems. In this field, one of the most essential tools is the use of material and energy balance. In most problems studied, mass and energy are always involved, as in reactors with chemical reactions. The employment of these balances in a steady state, which is obtained after analyzing the system, results in complex mathematical equations with a high number of both equations and unknown variables (Carbonell Alcaina et al., 2021). In this sense, mathematical software is highly recommended since the manual calculation is time-consuming and can lead to possible miscalculations.

Regarding mathematical software, Matlab is one of the most powerful and widely used in the field of engineering, allowing any mathematical problem to be adequately solved. Nevertheless, this software uses programming code to carry out any mathematical resolution thus is a requirement for every user who wants to use it. In this sense, chemical engineering students are beginners in programming code, and one of the challenges is to resolve materials and energy balances to face real problems. Therefore, how can they solve these complex algebraic equations with poor programming skills? One of the proposals is to guide students and provided tools to ease this mathematical calculation (Cardona et al.,

2021). Then, the question is: what tools can teachers provide to reduce this drawback in solving material and energy balances, considering that calculation is needed in chemical engineering?

The main objective of this study is provided to students a methodology in order to solve mathematically complex material and energy balance. The study does not focus on modeling skills, but on solving these algebraic equations to overcome the deficiency in students' programming skills. Therefore, the authors have developed Matlab files capable of solving these equations without the programming knowledge for the student. Furthermore, anonymous surveys have been developed in order to know the students' opinions and future improvements of the proposed methodology.

## 2. Methodology

As a first stage of this research, Matlab templates provided to chemical engineering students are described. Two Matlab files have been developed by chemical engineer teachers of Campus of Alcoy in order to solve complex algebraic systems that involve material and energy balances in a steady state. These files are called `template.mlx` and `steady_state_balance_solver.mlx`.

First, the algebraic equations modeling the system studied by students are introduced into `template.mlx` file. This file is divided into 6 main points, that is, 4 points for material balance and 2 points for energy balance. In Figure 1a) can be shown the template of Matlab that is provided to students, which allows the organization of the information introduced in this file. In addition, using the Matlab live version allows the students to add images, equations and comments that let them understand in a better way the system they are focused on. In Figure 1b) is shown an example of possible customizing of the file, giving freedom to the students to a better understanding of the problem. This step requires filling the file with the information previously explained in class.

Figure 1. Image of `Template.mlx` file: a) material and energy balances template provided to students; b) proposal for customization of the template file by the student.

a)

### Mass and energy balances template

$$C_2H_6 + H_2 \rightarrow C_2H_4 + CH_4 \quad (R_1)$$

$$2 C_2H_6 + H_2 \rightarrow C_2H_{10} + 2 CH_4 \quad (R_2)$$

Write the equations following this example: `eq(1)=F1==3`; Write ; always at the end of the equations

**Chemical reaction**

**Scheme of process**

**Questions:**

- Degrees of freedom analysis of BM and BE together.
- Balances of Matter and (4 points) Energy balances to determine the heat (Q) exchanged between stream 3 and 9, as well as the outlet temperature of stream 9 (T9S).
- Matlab resolution of all variables.

**Specified variables material balance**

`eq(1)=;`

**Additional relations material balance**

`eq(3)=;`

**Independent equations material balance**

VC1

`eq(5)=;`

**Summation of the mole or mass fractions for each stream**

`eq(9)=;`

**Specified variables energy balance**

`eq(11)=T0==25;`

`eq(13)=;`

`eq(15)=;`

`eq(17)=;`

`eq(19)=;`

`eq(21)=eq(29)=F3*(x(3)*hd3e+x(3)*ho3e+x(3)*hn3e)-F3*(x(3)*hd3s+x(3)*ho3s+x(3)*hn3s)-q=0;`

`eq(23)=;`

b)

### Mass and energy balances template

$$C_2H_6 + H_2 \rightarrow C_2H_4 + CH_4 \quad (R_1)$$

$$2 C_2H_6 + H_2 \rightarrow C_2H_{10} + 2 CH_4 \quad (R_2)$$

Take into account all the independent material balance equations, the specified variables, the additional relations and the summation of the mole or mass fractions for each stream. Also take into account the energy balance equations.

Write the equations following this example: `eq(1)=F1==3`; Write ; always at the end of the equations

**Chemical reaction**

**Scheme of process**

**Questions:**

- Degrees of freedom analysis of BM and BE together.
- Balances of Matter and (4 points) Energy balances to determine the heat (Q) exchanged between stream 3 and 9, as well as the outlet temperature of stream 9 (T9S).
- Matlab resolution of all variables.

**Specified variables material balance**

`eq(1)=;`

**Additional relations material balance**

`eq(3)=;`

**Independent equations material balance**

VC1

`eq(5)=;`

**Summation of the mole or mass fractions for each stream**

`eq(9)=;`

**Specified variables energy balance**

The next stage is to use the second file “*steady\_state\_balances\_solver.m*”. It works as a “black box”; thus students do not require to introduce any additional information. This file contains the solve function needed to solve all equations introduced previously by students into *Template.mlx*. Once the file has been executed in the software, a sentence asks the student for the name of the Matlab to be solved. The sentence specifies how to add the file name, which is without quotes and adding the extension (.mlx). An example of this sentence is shown below, where the file name that users (students) should add is written in red.

**Steady-state balance file name (with extension and without quotes): example.mlx**

The next information that “*steady\_state\_balances\_solver.m*” file requires is the type of solution desired by users. In this sense, the student can choose between two options, that is, (1) numerical solutions and (2) analytical solutions. In general, a numerical solution is chosen as is exposed below.

**Which type of solution do you prefer, numerical (1) or analytical (2)?: 1**

Finally, the file solves the problem by giving mathematical solutions to the variables. In the next step, student has to interpret the solution from an engineering point of view.

To evaluate the usefulness of the methodology explained previously, a survey was conducted on the second-year students, since it is the first time they have used them. The anonymous survey was carried out during the first semester of 2022-2023, collecting 65 surveys. The satisfaction survey is detailed in Figure 3, in which questions have been divided into 4 main aspects. In terms of possible answers, 5 options were offered to students from totally agree up to an option for students that had a poor implication in the subject (option: I have not used them).

Figure 2. Satisfactory survey provided to chemical engineering students.

MARK THE CORRESPONDING BOX WITH A X		Answers				
1. Usefulness Matlab guide files	1.1. Of the following didactic materials used in the course, how do you consider its level of ease of use?	VERY EASY	EASY	DIFICULT	VERY DIFICULT	I HAVE NOT USED THEM
	1.2. Of the following teaching materials used in the subject, how do you consider their usefulness?	VERY USEFUL	USEFUL	LITTLE USEFUL	NOTHING USEFUL	I HAVE NOT USED THEM
2. Adequacy of the guides to the resolution	2.1. Regarding the use of the Matlab template and the Steady State “solver”, do you consider its use appropriate for solving material and energy balances?	VERY APPROPRIATE	APPROPRIATE	LITTLE APPROPRIATE	NOTHING APPROPRIATE	I HAVE NOT USED THEM
	2.2. Do you consider that the Matlab template and the Steady State “solver” help to understand material and energy balance problems?	TOTALLY AGREE	AGREE	LITTLE AGREE	NOTHING AGREE	I HAVE NOT USED THEM
3. Performance of the teacher in the implementation	3.1. Do you think the teacher has correctly explained the approach to the material and energy balance problems?					
	3.2. Do you think the teacher has correctly explained the use of Matlab templates and the Steady State “solver” for solving matter and energy balances?					
4. Student opinion	4.1. Do you think that Matlab Live improved the way of understanding the material and energy balance problems?					
	4.2. Regarding the Matlab template and the Steady State “solver”, would you recommend its use to other classmates or even in other subjects?					
	4.3. After using the Matlab template and the Steady State “solver” in the course, what is the general level of satisfaction with the solving of matter and energy balances?	VERY SATISFACTORY	SATISFACTORY		UNSATISFACTORY	NOT SATISFACTORY

### 3. Results

The level of satisfaction with the methodology developed was obtained from studies surveys. The results are summarized in 4 main points following the survey structure (Figure 2).

The first main point aims to evaluate the usefulness of Matlab guides from the student’s point of view. The authors have split this point into two questions: (1) the level of ease of use for files provided by teachers and (2) the usefulness of files in solving complex algebraic equations, which results are in Figure 3a.

Regarding the first question (1.1), students have considered the level of ease use of Matlab files as “very easy or easy” by 79%, being then the vast majority. It is an interesting and unexpected answer since students usually prefer different software, as can be Excel for its easiness. The main reason for it is the lack of skills in code programming on the part of students and the poor graphic environment of Matlab software, making it difficult to use. Nevertheless, according to these results, the guiding methodology seems to decrease more than 2/3 part of students' difficulty in solving these complex algebraic equations. The remaining students (18%) still consider using it “Difficult or very difficult”, whereas 3% confirm they have never used them. The authors should point out that this 3% is concordant with students who miss the subject. In the case of the second question (1.2), the usefulness of this methodology for students is quite evident with more than 90% of surveys with a “very useful or useful” selection. At least, for this first stage, students seem aware of the difficulty of resolving this problem without this software, since these files lead to making automatic the calculation of variables that are involved in the material and energy balance.

In the second point, the questions were aimed to find out if students considered appropriate the adequacy of the templates to solve and understand the material and energy balances (Figure 3b).

Considering the question about whether it is appropriate to use these templates for solving (question 2.1), it showed that 75% of students considered it “very appropriate” and 15% “appropriate”. Regarding the question related to the understanding of the problems raised using the templates (question 2.2), the results obtained indicate that students “totally agree” in 36% and “agree” in 37%, whereas 18% “little agree”. These results are a little expected because Matlab software and specifically the templates provided work as a “black box” resolving equations without any interpretation, giving the students the final interpretation. Although that teachers were concerned about this point, the results indicated that almost 75% of students considered that the template helped to understand the problems, which confirms the effectiveness of this methodology.

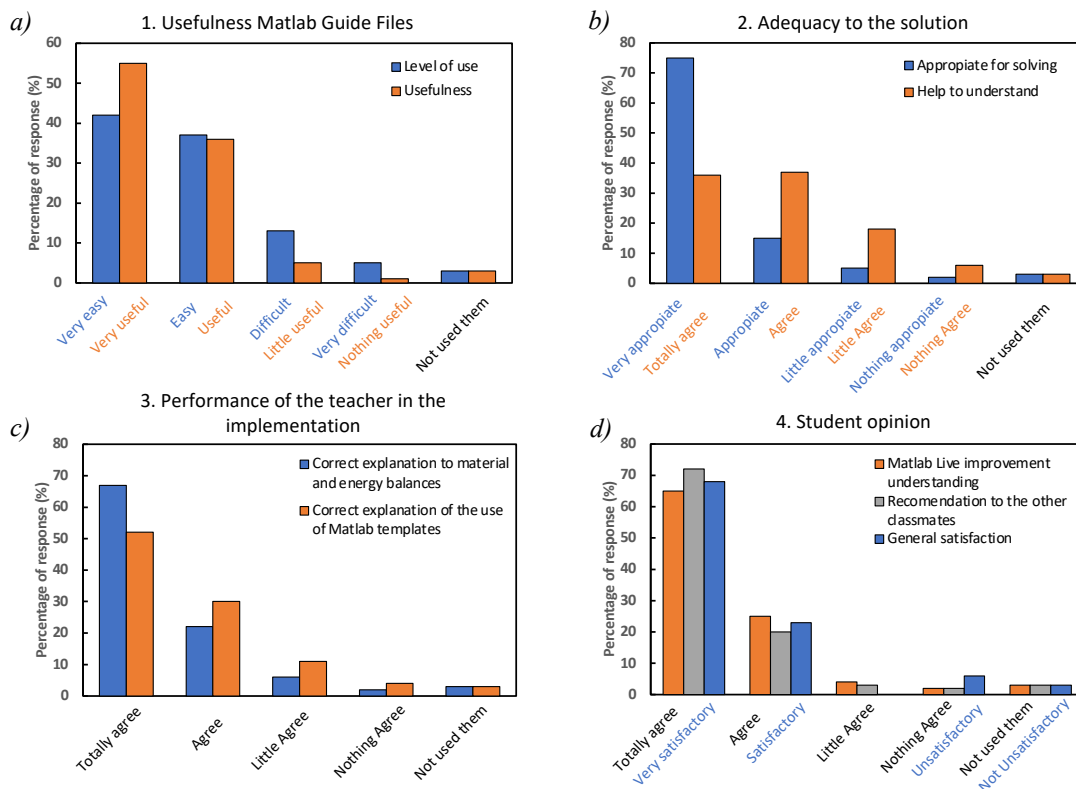
About the third point, it was a key aspect to ask students about teachers' performance to implement the methodology described above. The results are summarized in Figure 3c.

In this point, two main aspects should be taken into account for the successful implementation of the methodology. The first question concerns the teachers' correct explanation of material and energy balance problems (question 3.1). The 89% of the students surveyed answered both “totally agree” and “agree”, being a good approach for teachers and promoting student's understanding of what is happening in the system under study. In this question, less than 10% “little agree” or “nothing agree”, which is quite low compared to the others. The second question was considered to determine if the procedure for using Matlab templates (question 3.2) was explained adequately by the teacher, since it is one of the central aspects of this methodology. The results showed the same trend as the explanation of the equations (question 3.1), reaching 82% with “totally agree” and “agree” from students. Considering the results obtained, the teacher's role is adequate to solve material and energy balances using the Matlab templates as a resolution method.

To conclude this study, the student opinion is also evaluated in order to determine possible future improvements of the methodology exposed. In this last point, we were intrigued by the use of the new Matlab Live version, the possible recommendation of these templates to other students, and about the general satisfaction of the proposed methodology. These results are shown in Figure 3d.

The first question (4.1) was asked to determine whether customizing the template by students could improve the understanding of the problem, making the resolution more student-friendly. According to the results, students “totally agree” and “agree” in almost 90%. These results indicate that students feel more comfortable in software with a better graphic environment. In addition, the ability to add images of the problem statement, as well as to customize the format without the need to add % to be able to write in the software, can turn the template into a complete document to study for the exam improving the understanding of material and energy balances. Concerning to the second question (4.2), 92% of students would recommend using these templates to other students to solve these types of problems. This was somehow expected, considering the results obtained in the previous questions. Finally, the general satisfaction of students was requested (question 4.3). Based on the results, it was observed that this methodology seems to be satisfactory for 91% of students, whereas 6% are unsatisfactory. This highlights the methodology proposed by teachers in solving material and energy balances.

Figure 3. Results obtained in questions about: a) usefulness of Matlab guide files; b) adequacy to the solution; c) performance of the teacher in the implementation; d) student opinion.



#### 4. Conclusions

As summary of our study, the use of Matlab guide template to solve complex algebraic equations of material and energy balance has been successfully implemented. Based on the research results, chemical engineering students considered very easy/easy the level of use and very useful/useful the Matlab templates provided. Besides, students assume that this methodology is appropriate for solving material and energy balances, helping to understand the problems under study according to 73% of students, as well as teacher performance is correct and highly valued using the templates. In general, students totally agree that the implementation of Matlab Live template improved the understanding of problems under study as well as found a very positive general satisfaction with a value of 91%.

Therefore, it is possible to conclude that the implementation of this methodology to solve material and energy balance was successfully accepted by more than 85% of students. These results highlight the usefulness of these templates to overcome the general disadvantage of students in solving complex equations.

#### References

- Carbonell Alcaina, C., Cardona, S. C., Dominguez-Candela, I., Fombuena, V., López-Pérez, M. F., & Lora-García, J. (2021). How to guide chemical engineering students in the solution of complex engineering problems. In *INTED2021 Proceedings* (pp. 9442-9450). <https://doi.org/10.21125/inted.2021.1977>
- Cardona, S. C., Albesa, L., Pla, M., & Boix, M. (2020). Cómo guiar a los alumnos en la simulación de modelos matemáticos complejos en Ingeniería Química. *Modelling in Science Education and Learning*, 13(1), 37-44.

## MEASURING INQUIRY ABILITIES OF YOUNG LEARNERS USING A PERFORMANCE-BASED ASSESSMENT

**Cinthya Kayser<sup>1</sup>, Mafor Penn<sup>1</sup>, Umesh Ramnarain<sup>2</sup>, & Hsin Kai Wu<sup>2,3</sup>**

<sup>1</sup>*Department of Childhood Education, University of Johannesburg (South Africa)*

<sup>2</sup>*Department of Science and Technology Education, University of Johannesburg (South Africa)*

<sup>3</sup>*Graduate Institute of Science Education, National Taiwan Normal University (Taiwan)*

### Abstract

Scientific inquiry abilities and the nature of scientific inquiry (NOSI) are critical in building a scientifically literate citizenry. However, little information is available regarding the inquiry abilities of young learners between the ages of 5-7 years, though it is widely agreed that children are born inquirers. Among the reasons why inquiry abilities in young children are not explored is the need for reliable research instruments to measure these abilities. Most existing research excludes the measurement of young learners' inquiry abilities but tends to report more on the inquiry abilities of middle and high school learners. This study aims to adapt an existing performance-based assessment (PBA) and apply it in measuring the inquiry abilities of young learners aged 5 to 7 years in the South African context. The study aims to report on learners' innate abilities that develop naturally without formal instruction at kindergarten (grade R) and early primary to inform early science interventions. Three Afrikaans schools were conveniently selected as samples. Afrikaans is one of eleven official languages spoken in South Africa, and with no existing literature on Afrikaans learners' inquiry abilities in the foundation phase, a gap was explored. Data for the study was qualitatively gathered from 120 foundation phase learners (pre-schoolers to third graders) through an orally presented Performance-based Assessment of Kindergarteners' Scientific Inquiry Abilities (PAKSIA). Audio-recorded oral assessments were transcribed and translated into English. Transcripts were then scored using an adapted rubric to generate numerical scores on learners' performance. The numerical data were then analysed to provide descriptive statistics of participants' inquiry abilities. Of the four inquiry abilities assessed, high scores were realised in the experimentation and observation abilities. The results suggested that young learners have innate abilities to engage in inquiry activities. A multisensory and "play" approach to the adapted PAKSIA supported learners' engagement with tasks using their senses. Younger learners aged 5 and 6 struggled with more abstract questions, such as predicting or measuring without a measuring instrument. However, learners aged 7 displayed adequate abilities to predict, plan, design, investigate and communicate their results. The PAKSIA is a baseline assessment for educators to identify what inquiry abilities need more implicit nurturing and development. Some implications and recommendations for foundation phase learning are also made herein.

**Keywords:** *Inquiry abilities, performance-based assessment, foundation phase, scientific literacy.*

---

### 1. Introduction and background

One of the fundamental goals of science education is to help learners become scientifically literate and be able to contribute to and make informed societal decisions (National Research Council [NRC], 2000). As scientific literacy became essential to communities worldwide, scientific inquiry abilities became more relevant in the 21st century. The development of inquiry abilities can be viewed as a vehicle to promote scientific literacy within education sectors. Scientific inquiry abilities are skills to investigate and explore the natural world (Deboer, 2006). Learners who engage in inquiry display their ability to explore, question, plan, investigate, predict, provide accurate interpretations of findings, and communicate. These essential competencies assist people in participating productively within scientifically literate societies (Kuo et al., 2015). The study of inquiry abilities is familiar and has been going on for many years since the early 19th century (Deboer, 2006). However, focusing on measuring the scientific inquiry abilities of young learners is recent and needs further investigation. This study aimed to adapt an existing performance-based assessment (PBA) and apply it in measuring the inquiry

abilities of young learners aged 5 to 7 years in the South African context by answering the following research question:

Which scientific inquiry abilities are prominent in young learners ages 5-7?

To answer this research question, the following objectives were set:

- Administer an adapted PBA (the PAKSIA) to the selected group of learners.
- Score and analyse the PAKSIA for inquiry ability clusters.
- Report any observed differences and trends in young learners' inquiry abilities.

Six inquiry abilities were assessed: exploring, questioning, predicting, planning, designing, investigating, and communicating.

## 2. Literature review

Studies that developed instruments to measure young learners' scientific inquiry abilities have focussed on developing measurements with a holistic approach (Koerber & Osterhaus, 2019; Marian & Jackson, 2017). This may be because young learners do not receive formal science education at a young age but rather a broad exposure to science and the natural world. Some studies speculate about the abilities of young learners to conduct/engage in inquiry. However, results by Koerber & Osterhaus (2019) contradict these statements somewhat. Measuring the inquiry abilities of young learners using a performance-based assessment can be a useful tool to evaluate their scientific inquiry abilities. Performance-based assessments allow students to demonstrate their understanding of a particular concept or skill by completing a task or solving a problem (cite). It is challenging to assess young learners with traditional methods such as paper-and-pencil tests since they cannot read or write well or merely oral tests since their verbal can be limited. The PAKSIA instrument validated and proposed by (cited) was adapted to the South African context. Resources relevant to the participants were used, and questions were altered to fit the context. Although scientific inquiry abilities are interwoven within the basic education curriculum in South Africa, a gap exists with reliable research instruments to measure inquiry ability skills in young learners from kindergarten (grade R) to third grade in the Foundation phase. Furthermore, there is no assessment for inquiry abilities suitable for Afrikaans learners in South Africa.

In South Africa, the National Curriculum Statement (NCS) for Grades R-12 reflects the value of inquiry in the curriculum, aiming to produce "learners that can collect, analyse, organise and critically evaluate information" (Department of Basic Education [DBE], 2011, p. 5). The South African Foundation phase curriculum emphasises the importance of inquiry abilities. However, very few assessments of inquiry abilities have been constructed, and there are no explicit guidelines or policies regarding the measurements teachers can use to measure inquiry abilities. The unavailability of reliable research instruments to measure these abilities is why inquiry abilities in young children are not explored. Most existing research excludes the measurement of young learners' inquiry abilities. Still, it tends to report more on the inquiry abilities of middle and high school learners, which is why this study was timely. Some research reported findings of young learners displaying inquiry abilities from a young age (Chen, Wu & Hsin, 2022).

## 3. Methods

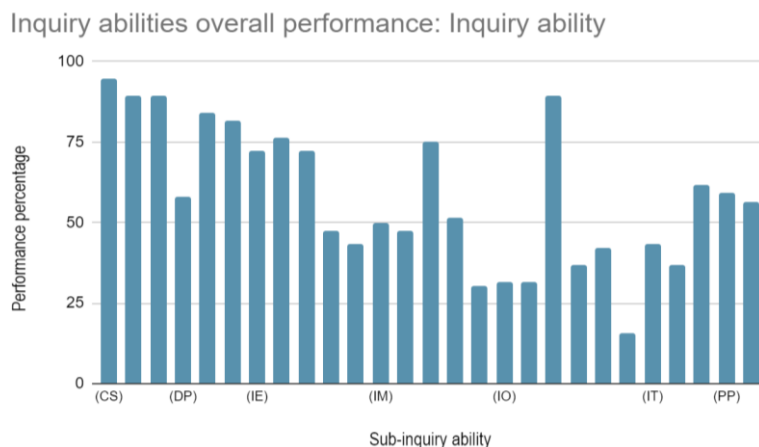
A descriptive qualitative research methodology was employed to determine the validity of the PAKSIA and the inquiry abilities of Grade RR (equivalent to pre-kindergarten) to Grade 1 learners. Data were collected from 40 learners (pre-schoolers and foundation phase learners) through a hands-on and orally presented Performance-based Assessment of Kindergarteners' Scientific Inquiry Abilities (PAKSIA). The oral assessments were conducted individually and with the first author and some trained peer teachers. The recordings obtained from the assessment were transcribed and back translated from Afrikaans to English for analysis and scoring. The transcripts were then scored using an adapted rubric to generate numerical scores on learners' performance. The numerical data were then analysed using MS Excel for baseline descriptive statistics on young learners' inquiry abilities.

## 4. Data analysis and results

Questioning and exploring tasks were further excluded from the six inquiry abilities assessed due to time constraints. Four inquiry abilities and their sub-abilities were assessed according to the Children Inquiry Ability Framework (Chen et al., 2022): *predicting* (Make predictions- PP), *planning* (Make a plan- DP), *investigating* (Making systematic observations- IO), (Employing tools- IT), (Measuring- IM), (Experimenting- IE) and *communicating* (Sharing- CS). Of the 120 participants, data obtained from 40 participant learners were scored and analysed to obtain the following descriptive results for this baseline report.



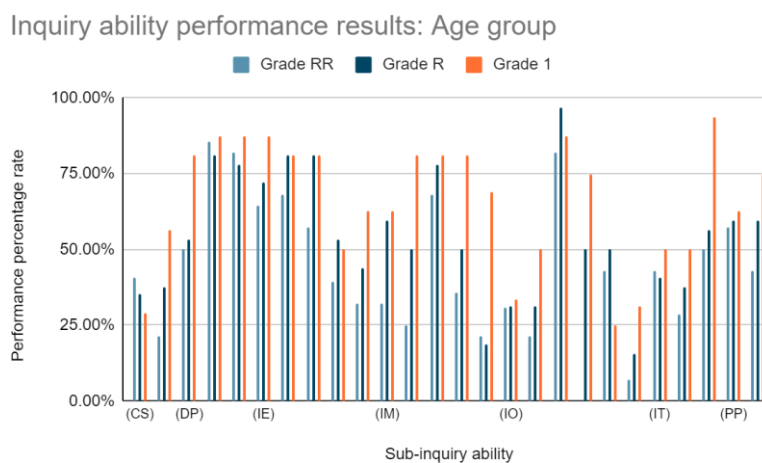
Figure 1. Overall observation of inquiry abilities.



As seen in Figure 1, high inquiry ability scores were realised in sharing (CS), with averages ranging from 89%, 89% and 74% on three questions in the PBA. Experimenting (IE) abilities followed with averages of 76%, 72% and 72% and predicting (PP) abilities in general, with performance averages of 59% and 56%. Learners performed poorly in measuring (IM), making systematic observations (IO), and employing equipment and tools (IT). Most systematic observation questions required abstract or higher-level thinking, and the results were generally poor (IO, 15%, 31%, 36%, 42%). Results were overall consistent in predicting abilities (PP, 59%, 56%).

Learners engaged actively with the presented objects to answer the questions. Evidently, some learners displayed flexible thinking when they adapted their incorrect answers after engaging with the materials. When choosing and predicting certain experiments, learners only choose the materials that fit their description or prediction of the outcome. Many learners did not display a complete innate understanding of dependent and independent variables. Some learners chose materials impulsively. They would state, for example, that they have the same car at home or like the colour blue, which is why they chose certain objects to experiment with. However, this was not the case for all the participants. It was evident that learners relate unknown situations with personal experiences to make sense of the problem. Misconceptions of science became clear in the data as learners predicted and chose suitable objects to experiment with. Some young learners, for example, chose all the small blocks in an experiment where the objects that would float should be selected. Learners predicted and explained that all the small objects would float because they are lighter than the larger blocks. A few learners changed their predictions as soon as they picked the objects up and could feel some were heavy and the metal blocks were cold. Although questioning was not assessed in the PBA, it was evident that learners used their senses and ask questions to further their understanding of the problem at hand. Figure 2 below shows the variation in inquiry abilities of the different age groups.

Figure 2. Differences in age group inquiry abilities.



From Figure 2, younger learners aged 5 struggled with questions that required developed language skills and abstract thinking, such as sharing (CS, 40%), measuring (IM, 35%), and making

systematic observations (IO, 42%). However, learners aged 6 displayed adequate abilities to predict (PP, 59%), plan (DP, 81%) and investigate (IE, 81%). Older learners in grade 1 performed better with most of the inquiry abilities than younger learners in Grades RR and Grade R: (CS, 56%) (DP, 87%) (IE, 87) (IM, 81%) (IO, 87%) (IT, 93%) (PP, 75%). Communicating and sharing results (CS, 40%, 25%, 29%) with measurement (IM, 21%, 18%, 68%) were some of the more difficult abilities to access on average. Standardised measurements are only introduced in late grade 1 and formally in grade 2. Most learners display inquiry abilities to some degree and show that young learners are born inquirers with innate abilities. Learners changed their answers on multiple occasions when they used their senses, such as touch, to feel the weight of the instruments during a comparison.

## 5. Discussions and conclusion

Although abilities vary across age groups, young learners display innate abilities to be inquirers with few interventions received from formal education. It is evident from the data that measuring activities with standardised items and activities that require more abstract thinking and communication skills is difficult for most young learners. Using their senses to make sense of their environment, young learners can use inquiry abilities to solve problems. A multisensory and “play” approach supported young learners to engage in fun ways with tasks and to access answers while using their senses. The performance-based assessment allowed learners in Grades RR, R and 1 to engage in low-anxiety activities and showcase the most suitable skills to solve problems. The adapted PAKSIA performance-based assessment was a useful diagnostic tool for measuring young learners’ inquiry abilities and can provide valuable insights into diagnostic assessments for scientific inquiry skills. The study is limited by the size of the participants. More in terms of a larger-scale inquiry is yet to be done to provide deeper insights into young learners’ inquiry abilities in the South African context.

## References

- Chen, Y.-C., Wu, H.-K., & Hsin, C.-T. (2022). A systematic review of assessments for young children’s scientific and engineering practices. *Research in Science & Technological Education*. <https://doi.org/10.1080/02635143.2022.2121693>
- Deboer, G. E. (2006). Historical perspectives on inquiry teaching in schools. In L. B. Flick, & N. G. Lederman (Eds.), *Scientific Inquiry and Nature of Science. Science & Technology Education Library, vol 25* (pp. 17-35). Springer, Dordrecht. [https://doi.org/10.1007/978-1-4020-5814-1\\_2](https://doi.org/10.1007/978-1-4020-5814-1_2)
- Department of Basic Education [DBE]. (2011). *National Curriculum Statement (NCS): Curriculum Assessment Policy Statement (Grades R-3), Natural Sciences*. Pretoria: Government printing works.
- Koerber, S., & Osterhaus, C. (2019). Individual differences in early scientific thinking: Assessment, cognitive influences, and their relevance for science learning. *Journal of Cognition and Development, 20*(4), 510-533.
- Kuo, C. Y., Wu, H. K., Jen, T. H., & Hsu, Y. S. (2015). Development and validation of a multimedia-based assessment of scientific inquiry abilities. *International Journal of Science Education, 37*(14), 2326-2357. <https://doi.org/10.1080/09500693.2015.1078521>
- Marian, H., & Jackson, C. (2017). Inquiry-based learning: a framework for assessing science in the early years. *Early Child Development and Care, 187*(2), 221-232. <https://doi.org/10.1080/03004430.2016.1237563>
- National Research Council [NRC]. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. Washington, DC: National Academy Press. <http://www.nap.edu/catalog/9596.html>



The background features a vertical gradient from purple on the left to orange on the right. A network of white lines connects various circular nodes, some of which are highlighted with a glowing effect. Scattered throughout are small white icons: a globe, a cloud, a Wi-Fi symbol, and a four-pointed starburst.

# **WORKSHOPS**



## **TEACHING AND SERVING STUDENTS OF HIDDEN AND APPARENT DIVERSITY: THIRD CULTURE KIDS AND CROSS CULTURE KIDS**

**Patricia A. Stokke**

*Edd, MA, BS, West Valley College (USA)*

### **Abstract**

Increasingly students live mobile lives, whether they move across countries or travel daily across borders or cities. The outcomes of these unique experiences may result in challenges with a sense of belonging and interruptions in academic progression. Consequently, educators have a responsibility to understand the complexity and interrelatedness of learning, education, and culture (Hofstede, 2001) and adapt accordingly to support student success. If every “experience has a formative effect on the constitution of the human being” (END, 2023) and we accept that education is one of those experiences, it is necessary to recognize and address the influence of cultural experiences on student educational outcomes.

This paper discusses the need for educators to identify and understand students who are living in transitions between their parents’ home and host countries and cultures. These individuals referred to as Third Culture Kids (TCKs) have similar challenges as students of other cross cultural life experiences. Such as those from less dominant cultures living in their passport country or children of immigrants, referred to as Cross Culture Kids (CCKs).

The terms hidden diversity, TCKs, and CCKs are defined below. The challenges facing these student populations, including their needs and strengths that emerge from their unique cross cultural and transitional growing up experiences are presented. Teaching and serving students of hidden and apparent diversity is based on research in the fields of cross-culture and third culture kids, global transitions, cultural diversity, cross-cultural and international education.

incluKit©, a game from diversophy®, that engages educators and staff to explore dealing with diverse cultures in education will be introduced and critical incidents will be presented in a gamified manner to be discussed in small groups during the workshop.

**Keywords:** *Diversity, culture, education, third culture kids, transitions.*

---

### **1. Introduction**

The unique experience of students living mobile lives, whether globally because of parents’ transnational careers or traveling daily across borders or cities, often results in challenges of belonging and academic progression. Consequently, educators have a responsibility to understand the complexity of these experiences and their impact on educational success. There can be a tendency to accept one’s own way as the way, creating blinders to differences in approaches to teaching and serving students. Understanding and learning how to effectively approach diverse worldviews and schemas are vital to supporting positive student outcomes.

The purpose of this paper and workshop is to support educators to better understand, serve, and educate students from a variety of cultural backgrounds, including cultural experiences that are hidden and mobile. Hidden diversity as defined by Van Reken and Bethel is a “diversity of experience that shapes a person’s life and worldview but is not readily apparent on the outside, unlike the usual diversity markers such as race, ethnicity, nationality...” (Van Reken, Pollock, & Pollock, 2009, p. 60). Hidden diversity is used as a descriptor because cultural identities often are unrecognized or unacknowledged by the individuals themselves or others. Hidden because their cultural identities or backgrounds are not seen either because the individual does not “look” like what others expect them to look like, or because their life experiences have cross cultural influences not readily apparent to others. These cross-cultural experiences may influence students’ ways of thinking about, approaching, and interacting with their environments, which can be different than students, faculty, and staff from monocultural and culturally dominant backgrounds.

How then do educators and student service professionals teach and serve these students effectively? First, they need to identify and understand these students’ third culture or cross culture

experiences. Second, they need to learn about the needs and potential strengths of TCKs and CCKs. Finally, they need to develop the knowledge and skills necessary to better teach and serve students of hidden and apparent diversity.

## **2. Objectives**

- a) Define hidden diversity, third culture kids, and cross culture kids.
- b) Identify the needs and potential strengths of culturally diverse students.
- c) Practice constructive approaches to teaching and serving students of hidden diversity.

## **3. Discussion**

### **3.1. Delineating Third Culture Kids and Cross Culture Kids**

Third Culture Kids (TCKs) are defined as individuals, who live or have lived outside their parents' culture or home country during their formative years, with the expectation of returning to the parents' home country (Pollock & Van Reken, 2009). These individuals' appearances and behaviors do not necessarily match the expectations of others. An example is a Caucasian student returning to a dominant White country and culture after living as an expatriate in an African or Asian country where she looked different from the people of the host country. While growing up in this "foreign culture" she may have absorbed several cultural identities and practices, but upon return to her "home" country she is expected to reintegrate as part of the dominant culture. She looks like she fits in with White culture but does not feel or behave as expected by her peers in the home country. This may result in challenges with identity and belonging, resulting in identity confusion, unresolved grief, and loss (Sichel, 2018). Additionally, she may be overlooked and misunderstood by educators due to assumptions and expectations that she is familiar with the educational system (Yang-Handy, 2019).

Cross Culture Kids (CCKs), the umbrella term that encompasses TCKs, consists of individuals from diverse cultural experiences. For example, students who travel across town from culturally diverse neighborhoods to college campuses in monoculturally dominant areas of cities, or students who immigrated with parents to new countries. CCKs daily study in new cultures but go home to parents' cultures at the end of each day, meaning these students live between two cultural worlds while trying to fit into both. Other categories of CCKs may be from families of mixed race or color, multiple cultures, or both (Pollock & Van Reken, 2009). These are all examples of multifaceted complex cultural experiences impacting student identity development and schema that in turn may affect student learning.

### **3.2. TCK, CCK, global nomad challenges and strengths**

Considering the neuroscience behind culture and education may give insight into why education may be challenging for students with multicultural and cross-cultural backgrounds. There is an increasing body of knowledge indicating a connection between the brain and culture (Hammond, 2015; Han & Humphreys, 2016; Park & Huang, 2010). If culture influences the way one thinks, then it would follow that culture influences how we learn. For example, Western culture typically approaches thinking and learning from a linear approach, whereas Indigenous and Eastern cultural worldviews are often from a holistic perspective that is nonlinear. This difference can make it challenging for students from these groups to learn in a Western educational environment.

The power dynamic between student and instructor may also be affected by culture. Power distance (Hofstede, 2001) may influence their relationships with authority figures and comfort levels for questioning and challenging their instructors.

A strength with a flip side for TCKs is the tendency to be cultural chameleons. The desire and ability to adapt to new circumstances, developed during transitions out of the need to fit into new environments, may keep them from seeking help. This characteristic can also make it difficult for faculty and staff to recognize a TCK's need for support.

Acknowledging that transitions between cultures can cause cognitive overload, due to continual adjustments, cultural switching, loss, and cultural shock, will aid faculty and staff in developing the empathy necessary to support TCKs and CCKs learning.

### **3.3. Adapting to teaching and serving students of hidden diversity**

Culture has been compared to the air around us (Hofstede, 2009), we are so familiar with it, we accept it without thinking about it until something affects that air. Educators often are steeped in what it means to educate based on their own culture without understanding how their cultural references impact their teaching and interactions with students. Therefore, the first step to becoming a culturally responsive educator is to accept and understand oneself as a cultural being by reflecting on one's own culture and

cultural experiences (Chavez & Longerbeam, 2016; Hammond, 2015; Marshall, 2002). Gaining an understanding of the air they live in by identifying their cultural references before facing cultural conflicts, shapes reference points about instructional schemas for faculty and staff (Hammond, 2015, p. 56).

Faculty and staff can explore their cultural self by asking themselves self-reflective questions such as, was I the first in my family to attend college? If not, who did? Who were the heroes and anti-heroes in my family? As a child, did I call adults by their first names? Related questions about education and school background will lead to discovery of beliefs and schemas about time, collective or individual studies, viewpoints about cultural groups, countries, or educational systems. Other reflective questions may include, what approach and schema do I teach from? How can I adapt my approach to students, whether from Indigenous, Eastern, or Western educational backgrounds? Do I make assumptions about their identities? Do I notice and acknowledge my students' cultural backgrounds?

Educators can explore questions such as those mentioned above in a personal reflection journal or discuss cultural situations with colleagues to explore their cultural selves. Activities in workshops that explore cross cultural critical incidents in small groups can be facilitated in a discussion format or in a gamified fashion using a game of cultural competence such as incluKit© from diversophy® (Simons, n.d.).

Other strategies to encourage direction and confidence include building upon TCK's and CCK's strengths by acknowledging and developing their potential for connecting across differences and leadership capabilities (Stokke, 2013).

#### 4. Conclusions

If “Our own culture is to us like the air we breathe and another culture is like water – and it takes special skills to be able to survive in both...” (Hofstede, 2009, p. 18), then educators need to acknowledge the unique struggle and strength of students in cultural transitions and address the challenge of living and surviving in multiple cultures. First, by understanding their own cultural selves and second by adapting their teaching schemas to become culturally responsive educators and support the learning of TCKs and CCKs.

#### References

- Chavez, A. F., & Longerbeam, S. D. (2016). *Teaching Across Cultural Strengths*. Sterling, VA, USA: Stylus Publishing, LLC.
- END. (2023). International Conference on Education and New Developments. <https://end-educationconference.org/>
- Hammond, Z. (2015). *Culturally Responsive Teaching and The Brain*. Thousand Oaks, CA, USA: Corwin.
- Han, S., & Humphreys, G. (2016). Self-construal: A cultural framework for brain function. *Current Opinion in Psychology*, 8, 10-14. <https://www.sciencedirect.com/science/article/pii/S2352250X15002390>
- Hofstede, G. H. (2001). *Culture's consequences: Comparing values, behaviours, institutions, and organizations across nations* (2nd ed., pp. 1-77). CA, USA: Sage Publications.
- Hofstede, G. J. (2009). Research on cultures: how to use it in training? *European Journal of Cross-Cultural Competence and Management*, 1(1), 14-21.
- Marshall, P. L. (2002). *Cultural Diversity in Our Schools*. Belmont, CA, USA: Wadsworth/Thomson Learning.
- Park, D. C. & Huang, C. M. (2010). Culture Wires the Brain: A Cognitive Neuroscience Perspective. *Perspectives on psychological science: A journal of the Association for Psychological Science*, 5(4), 391-400. <https://doi.org/10.1177/1745691610374591>
- Pollock, D. C., Van Reken, R. E., & Pollock, M. V. (2009). *Third culture kids: Growing up among worlds*. London, UK: Nicholas Brealey Publishing.
- Sichel, N. (2018, March 30). *The Trouble with Third Culture Kids*. Children Mental Health Network. <https://www.cmhnetwork.org/news/the-trouble-with-third-culture-kids/>
- Simons, G. (n.d.). incluKit© from diversophy® game of cultural competence.
- Stokke, P. (2013). *Adult Third Culture Kids: Potential global leaders with global mindset* [Doctoral dissertation, Drexel University]. ProQuest Dissertations Publishing, 3599503.
- Yang-Handy, A. (2019, Fall). How Schools Can Better Support Third Culture Kids. *Independent School*. <https://www.nais.org/magazine/independent-school/fall-2019/third-culture-kids-and-how-schools-can-better-support-them/>



## GEOQUEST TROPOMAG DIGITAL ADVENTURE PATH: WHEN SCIENCE IS A GAME

**Giovanna Lucia Piangiamore<sup>1</sup>, Sabina Maraffi<sup>2</sup>, Francesco Maria Sacerdoti<sup>3</sup>,  
& TROPOMAG WP3 Team\***

<sup>1</sup>*Istituto Nazionale di Geofisica e Vulcanologia (INGV) RM 2- Lerici (Italy)*

<sup>2</sup>*MIUR - Ministero della Pubblica Istruzione, Rome (Italy)*

<sup>3</sup>*Università degli Studi "Federico II", Naples (Italy)*

### Abstract

Game is a powerful educational tool able to involve students and keep their attention high, promoting cognitive development, discoveries, reasoning, and thinking. It is also an effective active form of learning which consolidates the acquired knowledge and carries out an authentic assessment through reality tasks and immediate feedback typical of the use of the digital games. Our *gamy-learning* experimentation focuses on new methods and practices of science communication, with the aim to face the challenge of educating about natural risks and climate change. The goal is to facilitate the automatic choice of good practices, by stimulating mind, intuition and logic in the perspective of team building in school-based civic education. The proper application of technological tools is a valuable aid for conscious communication for the next generation. A *Computer Supported Collaborative Learning Education* is experienced, in order to test the efficacy of our *GeoQuest TROPOMAG* digital adventure, and pave the ground for the implementation of the storytelling in an integrated table game. Our climate change role-playing videogame explores phenomena related to the possible effects of changes in the Earth's magnetic field on the atmosphere. The virtual adventure path is played on smartphones and follows alternative paths chosen by the players to develop the storytelling. As a result, students play not only "just for fun", but also to actively participate in their learning process and acquisition of new knowledge, skills and competences in environmental issues.

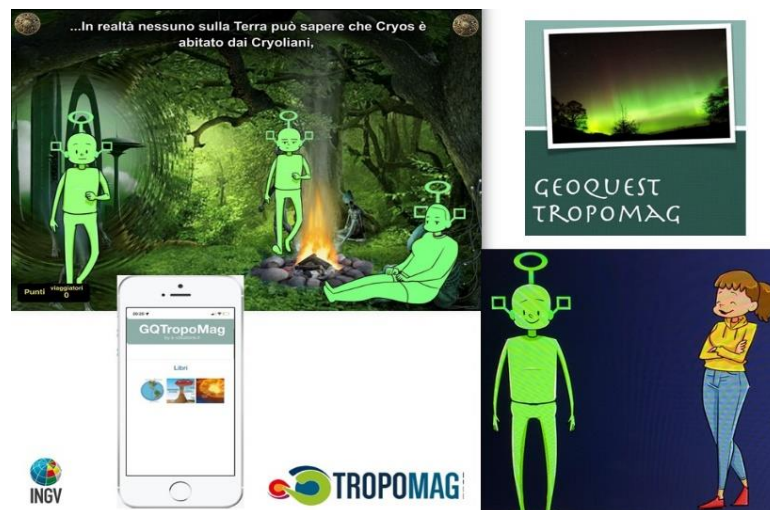
**Keywords:** *Gamification, digital game based learning, computer supported collaborative learning education, educational competition, climate change.*

---

### 1. Introduction

The education guidelines by the EU Commission are in line with the world's leading educational instances: innovative teaching, Information and Communication Technology (ICT), hands-on and lab activities. In this frame, gaming should be considered a key element (Maraffi et al., 2017), encouraging students to spend more time studying, be more engaged and, as a result, learn more (Chapman & Rich, 2017). This new way of learning offers new opportunities to use collaborative tools, allowing the students to co-construct knowledge efficiently (González-González et al., 2016). *Digital Game Based Learning (DGBL)* increases student motivation to pursue Geoscience learning (Maraffi & Sacerdoti, 2017). Students are familiar with games and we propose the *GeoQuest TROPOMAG* serious game (Fig. 1) to engage them, in an amusing way, promoting teamwork and the *Content and Language Integrated Learning (CLIL)* approach (Maraffi & Sacerdoti, 2016a, 2016b). *TROPOMAG - Influence of geomagnetic storms on the TROPOsphere dynamics: Can the Earth's MAGnetic field be considered a proxy of climate changes?* is an on-going project investigating the possible effects of changes of the Earth's magnetic field on the atmosphere and weather conditions. The main outreach product at the end of the first year is the virtual adventure game developed from the pre-existing *EvoQuest* educational digital game series (<http://www.evoquest.eu/>). *EvoQuest* is a specific software engine to realize *Computer Class Digital Role* adventure games. The TV science format SuperQuark described *EvoQuest* as an interesting learning game for students (<https://www.raisplay.it/video/2019/12/Superquark-piu-II-Gioco-ee159d7e-b39f-497a-9911-cb269728425c.html>). The main goal of our Earth Science *Class Role Playing Game* is building a sustainable system to educate future citizens to respect the natural environment and Nature in response to an increasing disaster risk caused by rapid urbanization, environmental degradation and climate change (Piangiamore & Maramai, 2022; Piangiamore, 2019).

Figure 1. *GeoQuest TROPOMAG* digital adventure game.



## 2. Game design and adventure creation

To create an adventure based on *TROPOMAG* project's main scientific topics for students playing with smartphone or tablet, we used a well-tested educational technique based on the *EvoQuest Computer Role Playing Game* (Maraffi & Sacerdoti, 2018a). The new adventure begins with a storytelling that immerses players in an environmental emergency, as well as other topics covered in the project. The overall game ideas have been collected and organized, applying gamification concepts, focusing on the roles of the students in the game. Finally, we defined the characters and the adventure path, writing the text and inserting images, video, and GIFs. The *TROPOMAG GeoQuest* adventure, ready to be played, was devoted to test the games in classes of different grades and in special venues, proving to be a user-friendly teaching tool, which also allows students to learn a subject and a second language at the same time (CLIL). It's available in both Italian and in English and it can be translated in other languages.

## 3. Objectives

*TROPOMAG* WP3 (Work Package 3 - Scientific Outreach) focuses on the need, for the Society in general and for modern educational system, to embrace a holistic Earth system Science approach, and to provide an effective view on climate change and its consequences. Playing our digital team adventure, teachers discover an innovative *learning-by-playing* tool to spread environmental education at school. *TROPOMAG GeoQuest* is a new way to approach multidisciplinary learning about *TROPOMAG* topics: Artificial satellites, Earth's atmosphere, Geomagnetic storms, Geomagnetism, Global Navigation Satellite System (GNSS), Ionosphere, Polar aurorae, Pollution from volcanoes, Solar radiation, Solar system, Solar wind, Sun, Troposphere and Precipitable Water Vapor. The flow of the adventure computer game engages students from Middle Schools (ISCDE 2) and High Schools (ISCDE 3) through audio, images, and videos on the adventure path they are on.

## 4. Methods

We developed the implementation of the interactive learning strategies, technology and effectiveness of an already existing successful digital serious game (*EvoQuest* widely tested in several European countries) for schools. *GeoQuest TROPOMAG* is an original scientific outreach product that features a new adventure path based on project's scientific topics using the same game techniques. The structure of the digital game is interactive (players interact with the game through an "automatic responder"), cooperative (players cooperate each other to win, since game is projected on any screen, through a PC), and based on a learning *flipped classroom* approach. Players can select specific topics and choose whether to deepen them by videos and lab activities for effective clarification. Students receive immediate feedback on their responses and benefit from individual insights on their device as compensatory or deepening tools. The game, designed for players aged 12-18, includes some tricks to adapt the target to the age and players' characteristics. These activities have been carried out always with very positive feedback on several occasions at school and in special venues, such as the *Futuro Remoto 2022* science festival in Naples, in collaboration with the Regional School Office USR Molise.

## 5. Discussion and conclusions

Traditional approaches and engagement in teaching and learning will be replaced by innovative, unconventional forms of knowledge transfer. The Scientific Education Outreach activity we conduct meets the modern school's need of new methods for communicating Science through digital play. We adopt the *gamification* logic such as competition, virtual goods, real-time feedback, storytelling, points, rankings, and levels, to develop "*emotional intelligence*" and *soft skills*. At the end of our ongoing research, a modern and valid *gamy-learning* tool for environmental educational purposes will be realized: the goal is to sensitize players on the issues of natural disasters prevention. The immediate meaningful feedback requires a challenge that is well suited to skill level and it represents an argument in favour of personalised learning (Mayo, 2009). To play the *GeoQuest TROPOMAG* computer game adventure students collaborate and discuss their ideas and possible solutions. This insignificant learning experience in which the *reflective learning* assists students in problem solving and adopting sustainable behavior to win. The next step is to create a new table game that is integrated with the computer game in order to provide a better and more enjoyable game experience while also improving the didactic results. Fun, play, goals, competition make *GeoQuest TROPOMAG* experience at school an involving educational virtual adventure, useful to convey the values of solidarity and commitment to the defense of a common good (our planet Earth).

**\*TROPOMAG WP 3 Team:** Valentina Bruno<sup>4</sup>, Iginò Coco<sup>5</sup>, Sofia De Gregorio<sup>6</sup>, Paola De Michelis<sup>5</sup>, Anita Grezio<sup>7</sup>, Paolo Madonia<sup>6</sup>, Alessandra Maramai<sup>8</sup>, Michael Pezzopane<sup>5</sup>, Roberta Tozzi<sup>5</sup>, & Simone Vecchi<sup>5</sup>

<sup>4</sup>INGV OE Catania (Italy), <sup>5</sup>INGV RM 2- Rome (Italy), <sup>6</sup>INGV Palermo (Italy), <sup>7</sup>INGV Bologna (Italy),

<sup>8</sup>INGV RM 1- Rome (Italy)

## References

- Chapman, J. R., & Rich, P. (2017). Identifying Motivational Styles in Educational Gamification. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 1318-1327). <http://hdl.handle.net/10125/41310>
- González González, C. S., Collazos, C. A., Guerrero L. A., & Moreno, M. (2016). Game-based learning environments: designing the collaborative learning process. *Acta Scientia*, 18(4), 12-28.
- Maraffi, S., & Sacerdoti, F. M. (2018). *GeoQuest Project implementation and experimentation of a computer classroom role playing game: final results*. In 6th Mediterranean Interdisciplinary Forum on Social Sciences and Humanities, MIFS 2018.
- Maraffi, S., & Sacerdoti, F.M. (2017). "Learning on Gaming" Improves Science Learning in a STEAM Interdisciplinary Approach. *Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering*, 6(3), 155-165. doi:10.17265/2162-5298/2017.03.007
- Maraffi, S., Sacerdoti, F.M., & Paris, E. (2017). Learning on Gaming: A new DGBL approach to Improve Education Outcomes. *US-China Education Review*, 7(9), 421-432.
- Maraffi, S., & Sacerdoti, F.M. (2016a). GeoQuest Project. Computer class Role Playing Game as innovative teaching methodology to foster STEAM education. *Journal of Environmental Science and Engineering*, 5(10), 495-511. <http://dx.doi.org/10.21125/iceri.2016.0039>
- Maraffi, S., & Sacerdoti, F. M. (2016b). *GeoQuest a Computer Classroom Role Playing Engine to Teach Earth Science in an Interdisciplinary way*. In Proceedings of 9th Annual International Conference of Education, Research and Innovation (pp. 6119-6127).
- Mayo, M. (2009). Video games: A route to large-scale STEM education? *Science*, 323, 79-82. <http://dx.doi.org/10.1126/science.1166900>.
- Piangiamore, G. L., & Maramai, A. (2022). Gaming and Resilience: Teaching by Playing Together — Online Educational Competition at School during the Pandemic. *Applied Science*, 12(23). <https://doi.org/10.3390/app122311931>
- Piangiamore, G. L. (2019). Metodologie didattiche innovative di educazione dei rischi naturali nei progetti per le scuole del territorio spezzino. In F. De Pascale, P. Farabollini, & F. R. Lugerì (Eds), *PRISMA - Economia, Società, Lavoro: Comunicare il rischio, il rischio di comunicare - IRES Marche* (pp. 113-133). Franco Angeli Ed. <http://hdl.handle.net/2122/13016>

# THE APPLICATION OF CRITICAL THINKING IN LITERATURE EDUCATION

**Gepco de Jong**

*Centre for the Arts in Society, Leiden University (The Netherlands)*

## Abstract

**Purpose:** The workshop 'conscious critical thinking' provides insight into the concept of critical thinking and the importance of this basic skill for literature education at secondary schools.

**Background:** The student who reads a text formulates a judgment: immediately and instinctively. By using the academic skill of critical thinking in the lesson, the teacher can make the student think more deeply about his own judgment and the meaning of a literary work. The workshop focuses on the primary response when reading a literary text: participants experience the influence of this primary reaction on the reasoned final judgment on a literary text.

**Key Points:** Critical thinking is an extremely useful tool that allows the teacher to strengthen the students in three areas: knowledge about literary conventions, the application of critical thinking as an academic skill and the understanding of the individual thought process.

**Procedure:** After a general introduction, the participants are asked to read a short text and to give a first reaction in specific places in the text using keywords. These responses are then compared with the results of an intervention in students from the upper classes of secondary education. The ensuing discussion focuses on the general tendency in these responses and the influence that the primary reading experiences can have on the further thought process.

**Description participants:** The workshop is aimed at researchers as well as language teachers with a maximum number of 25 participants.

**Keywords:** *Critical thinking, literature, secondary education.*

---

## 1. Introduction

In the novel *Poubelle*, author Pieter Waterdrinker describes a scene on Independence Square in Kiev: *'On the stage in Independence Square, a handsome singer was singing the Ukrainian national anthem, in a sea of blue-yellow flags that slowly swayed. The crowd formed a giant magnet; never before had he felt a tension that seemed to repel and attract him violently at the same time. Nervously, it was said that they were trapped on three sides by military units'* (Waterdrinker, 2018, p. 270).

The literary description of the situation on Independence Square automatically evokes a reaction from the reader. This could include an expression of disapproval, indignation or compassion, or perhaps even a sense of recognition, but that the scene elicits a response is inevitable. The question is, however, on what basis do these various reactions come about: are they the result of a profound, substantiated reasoning or a first impression; an unconscious feeling?

In his research into thinking skills and decision-making Psychologist Kahneman (2011) makes a distinction between intuitive and reflective thinking systems. Kahneman's ideas provide a preliminary answer to this question: intuitive thinking is automatic based on unconscious, uncritical associations and does not assume any choices. Such an association leaves no room for doubt, is based on previous experiences or obvious solutions. The doubt and falsification of this intuitive thinking comes into effect through the active use of the second thought system: conscious, reflective thinking. What could these two systems of thinking mean for the reader's reaction to the fragment from *Poubelle*?

Conscious critical thinking could be seen as a form of thinking that allows readers to reflect on their own bias, which has been evoked by the automatic intuitive thinking system. Making the thinking steps explicit is then crucial for critical thinking and forms the direct motivation for adding the word 'conscious' to 'critical thinking'. It would therefore be worthwhile to develop a teaching model that gives critical thinking a more central place in literature education (Meijerink, 2009; Guth, 2016; Hernot, 2019).

On the basis of an extensive literature study, a conceptual model has been constructed, which will be refined in the various phases of the research. The workshop of the END Conference provides insight into the first thinking step of the subject-teaching model: the creation of the primary response. The description of design, objectives, methods, discussion and conclusion are therefore mainly aimed at clarifying this first step in the process of critical thinking.

## 2. Design

Educational Design Research (EDR) is at the heart of the methodological approach. EDR is in line with the thinking steps in critical thinking, because it is based on analysis, design and evaluation. The research phases have an iterative character, with which hypotheses and conjectures are always validated and refined (McKenney, Reeves & Nieveen, 2014). The research is carried out at the Sint Odulphuslyceum in Tilburg with pupils aged 16 to 18 years, from the highest classes of preparatory scientific education (vwo). The research phases will be described in four chapters: theory and background, a model for critical thinking in literature education, critical thinking in the classroom and finally critical thinking and the student.

## 3. Objectives

The aim of the *total research* is the construction of a subject-taught model of conscious critical thinking (CCT model), with which the teacher can achieve three goals:

- a the students gain insight into the process of conscious critical thinking at a cognitive and metacognitive level through which they first acquire knowledge about the thought process as an instrument, then learn the skills to be able to use this knowledge and finally develop the attitude to actually use critical thinking;
- b the students gain insight into the literary techniques and the formal and referential meaning of literature at a cognitive and metacognitive level;
- c the critical thinking used in the study of literary texts is transferable to situations where citizenship skills are called upon. The students can take a reasoned position in the social debate, taking into account different views and arguments.

The purpose of the *first intervention* is to provide insight into the nature of the reaction from pupils: what do the pupils pay attention to when they read a text for the first time? The categorization of these responses is the starting point for the second phase in the CCT model: the literature-substantive, normative-substantive and reflective thinking steps. If it turns out that the students focus on only a few, specific aspects in the primary response, then critical thinking should be the means to broaden the thinking about the text and make the student aware of the fact that initially only a few focus points supported the certain idea.

## 4. Methods

The intervention was divided into two parts: a pilot phase and a main phase. In the pilot phase only a limited number of respondents (N=4) took part in the intended intervention in order to check the reliability and validity. In the main phase, the intervention was deployed in the three highest classes of secondary education (N=45).

For the main phase of the intervention, three classes from the highest years of secondary education had been chosen. The students read the first twenty pages of a recent Dutch novel. This interaction between reader and text was not preceded by a textual introduction or an explanation of the intention of the intervention in order to exclude any form of influence. The pupils were only informed of the procedure at the start of the intervention. While reading, the students comment on the text with one or more keywords. This comment took place after every four pages and at the end of the text fragment. The students had the opportunity to write down keywords apart from these fixed points.

In order to match as much as possible with the way the students communicate in informal situations, the participants noted their comments in WhatsApp. Not only the avoidance of a school situation was a consideration, but also the more informal nature should help to ensure that the keywords were noted as intuitively as possible, without the research situation giving rise to reasoned thinking steps.

On the basis of the noted keywords the domain determination place of the primary reactions was conducted by a bottom-up encoding. A total of 45 pupils participated in the intervention and 365 responses were recorded: 120 from 6 vwo (16 pupils), 166 from 5 vwo (15 pupils) and 79 from 4 vwo (14 pupils).

## 5. Discussion

The intervention shows that students mainly express themselves in inner textual reactions. No fewer than 318 keywords relate to aspects that are within the boundaries of the text, while only 47 responses focus on thoughts and ideas that are extratextual in nature. Furthermore, it is striking that the inner textual reactions mainly relate to the content of the text: 42 percent of these reactions comment on the course of the story and 30 percent on the characters. The reactions focused on the form of the text, language use and structure, lag far behind the substantive aspects. Although the extratextual reactions were few in number, it is remarkable that they are mainly concerned with the individual reading consciousness: knowing how the text influences the reader and what effect this has on the reading experience.

The result of the intervention leads to a different categorization than the distinction that comparable research by Cornelissen (2016) makes in the categories 'experience, interpretation, judgment and narrative understanding'. The intervention shows a difference in inner and outer textual domains, followed by a split within the text into form (language, structure) and content (story progression, characters) and outside the text a division into individual and contextual domains. Perhaps this difference is a result of the fact that Cornelissen focuses on primary education, while the intervention took place in the highest classes of secondary education.

## 6. Conclusions

Now that it has been established that students are primarily concerned with the story course and the characters, it is important to focus the second phase in the CCT model, the thought process, on the translation of this strongly substantive text experience into a richer, contextual and metacognitive deepening. The planned literature-content, normative-substantive and reflective thinking steps should offer sufficient opportunities to concretize this deepening. Awareness, the reasoned formulation of one's own judgment and the further development of citizenship are key concepts.

## References

- Cornelissen, G. (2016). *Maar als je erover nadenkt...: Een jaar literatuuronderwijs in groepen 7 en 8 van de basisschool* (Vol. 27). Utrecht: Eburon Uitgeverij BV.
- Facione, P. A. (2011). Critical thinking: What it is and why it counts. *Insight assessment*, 2007(1), 1-23. Retrieved December 30th, 2022, from [https://www.researchgate.net/publication/251303244\\_Critical\\_Thinking\\_What\\_It\\_Is\\_and\\_Why\\_It\\_Counts](https://www.researchgate.net/publication/251303244_Critical_Thinking_What_It_Is_and_Why_It_Counts)
- Kahneman, D. (2011), *Thinking, Fast and Slow*, New York: Farrar, Straus and Giroux.
- McKenney, S., & Reeves, T. C. (2014). Educational design research. In *Handbook of research on educational communications and technology* (pp. 131-140). New York, NY: Springer.
- Waterdrinker, P. (2018) *Poubelle* (p. 270) Amsterdam: Nijgh & Van Ditmar.

## CRITICAL REFLEXIVITY AS A TOOL FOR ADDRESSING INEQUITIES IN EDUCATION AND BEYOND

**Eden Rivera, Langan Courtney, & Heidi Bloom**

*International Education Policy, College of Education, University of Maryland (USA)*

### Abstract

Society, perhaps more than ever, is open to disrupting racist, colonial, and oppressive policies and systems. Engaging critical reflexivity (CR) in education spaces is one potential way to move this work forward. CR is “an ‘unsettling’ of the basic assumptions, discourse, and practices used in describing reality” (Pollner, 1991, p. 370). It involves examining assumptions underlying our actions and examining how these assumptions and related actions influence meaning and contribute to creating, sustaining, and/or transforming “realities” and ourselves (Cunliffe, 2020, p. 3). CR can expose contradictions, uncertainties, and possibilities within ourselves and in relation to the world around us (Cunliffe, 2020) while also enhancing our ability to explore positionality and power dynamics.

The purpose of this workshop is to engage with CR as an intervention to deconstruct the existing power hierarchies in one’s work environment, education, and knowledge base. CR is a potential tool to help educators foster inclusive, equitable, and safe learning environments for their students. This session will provide a safe space to engage with CR and to work toward addressing the disconnect between “talk” and “application” in education, with an aim of bridging the gap between theory and practice.

**Keywords:** *Critical reflexivity, education, positionality, social justice.*

---

### 1. Introduction

Educators, like anyone, have inherent biases that shape their approach to life. These biases can have far-reaching implications, not only on the lives of their students but also for society as a whole. Critical reflexivity (CR) is a practice of examining assumptions, biases, and inequalities that underlie our thoughts and actions. CR is a powerful tool that requires a rigorous examination of one’s identities and privileges and how social, cultural, and historical influences have shaped these. A key aim of CR is to challenge existing power relations and to contribute to dismantling systems and institutions that perpetuate inequities. Therefore, incorporating CR into educational spaces can enable educators to examine their biases and challenge existing educational inequities—as well as support students to do the same. Actively engaging in CR holds the potential to foster a more equitable and inclusive educational environment that supports positive societal transformation. The objectives of this workshop are twofold: firstly, to provide participants with an understanding of the key tenets of CR, and secondly, to provide participants with the opportunity to explore CR in relation to their individual contexts.

### 2. Literature review

From the humanities and social sciences - especially education - to business and STEM fields, this increased attention on reflexivity mirrors the ongoing social justice movements and critical awareness that has dominated these times (Cunliffe, 2020). The significance of reflexivity in academia and practice can be traced back to earlier discussions on reflection. Stemming from John Dewey’s (1997) reflexive practice to Donald Schön’s (1992) theory on reflection, then Melvin Pollner’s (1991) radical reflexivity and Ann Cunliffe’s (2004) critical reflexivity; the evolution of reflexivity, with roots in reflection, has progressed to incorporate more critical components.

Dewey defined reflection as “active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it and the further conclusions to which it tends” and recalls earlier philosophers and enlightened thinkers who began to focus on the individual and the self in relation to the world (Dewey 1997, p. 6). Taking inspiration from Dewey, Donald Schön’s work theorized reflection in two parts: “in action [...] reflection that occurs whilst a problem is being addressed” with ‘on action’ which “takes place after an event” occurs and the way in which it is processed and understood

(Stingu, 2012, p. 617). Both Dewey and Schön are credited as setting a foundation for reflection and reflexive practices.

Shifting from reflection to reflexivity, Pollner made a call to those in ethnomethodology to revive the practice of radical reflexivity to promote “unsettling [...] an insecurity regarding the basic assumptions, discourse and practices used in describing reality” (1991, p. 370). Pollner’s work highlighted the need for critical reflexivity to further complicate the discourse around reflexivity. Expanding on Pollner’s work, Cunliffe has continued to push for critical reflexivity as a practice in various sectors, including education. Cunliffe’s (2020) article provides a concise guide for practitioners on how to utilize critical reflexivity, including approaches to developing critically reflexive activities for students. Influenced by Paulo Freire’s critical pedagogy, which emphasizes the importance of critical reflexivity in education, Cunliffe (2004) attempts to tie Freire’s ideas “with social constructionist conceptions of reality” to foster “critical thinkers” and “moral practitioners” (pp. 409-410). Like Pollner, Cunliffe highlights why CR is necessary to challenge our assumptions by exposing restrictions as well as probabilities; checking our biases to break out of traditional forms of thinking and doing; expanding our understanding and acceptance of various perspectives that disrupt the antiquated forms of knowledge production (2020, p. 408). Engaging in this work can promote students, practitioners, and educators alike to take ownership of their privilege and positionality as it relates to their work and society.

Over the years, concerns, and critiques about the limitations of self-reflection and reflexive practices in general have been discussed; opening the door for more critical application. Reflection, as a whole, has been seen as “too big, too vague, and too general for everyday application” (Korthagen & Wubbels, 1995, p. 53 as cited in Stingu, 2012, p. 619). Stingu and other scholars have cautioned against overusing reflection or reflective practices especially in teacher training, where there is a likelihood that individuals may not have the capacity to decenter themselves in the process to fully commit to critically analyze their assumptions and biases (Brockbank & McGill, 1998 as cited in Stingu, 2012 p. 610). Lastly, Olmos-Vega et al. (2023) noted that reflexivity can be seen as narcissistic, as privilege, and as a never-ending process, which provides further evidence for a strong need for a more critical perspective (p. 248).

Furthermore, while much scholarship highlights the potential benefits of *critical reflexivity* specifically, there are concerns and critiques with this practice. Two areas of critique are particularly relevant to this conference workshop. The first is the difficulty of bridging theory and practice. Patricia Alexander (2017) underscores that despite the many benefits of reflexive practices, there is considerable confusion and ambiguity surrounding definitions, strategies for implementation, and criteria for evaluating effectiveness. The second critique, which has been shared by various scholars and thinkers, posits that CR as a concept and practice is a western construct that both reflects and promotes western cultural perspectives. This critique questions the relevance and applicability of CR in non-western contexts, the extent to which CR prioritizes individualism vs. collectivism, and the extent to which CR instills additional norms and values that are western-centric in nature.

### **3. Critical reflexivity as a tool for transformation**

Critical reflexivity in educational settings has the capacity to encourage individual and societal change, as it promotes action-oriented critical thinking and introspection. It involves examining assumptions underlying our actions and examining how these assumptions and related actions influence meaning and contribute to creating, sustaining, and/or transforming “realities” and ourselves (Cunliffe, 2020). CR can expose contradictions, uncertainties, and possibilities within ourselves and the broader world (ibid, 2020) while also enhancing our ability to deeply explore positionality and related power dynamics (Alcott, 1988; Maher & Tetreault, 1993; Hooks, 1981). Specifically, CR can support: a) increased self-awareness and deeper understanding of one’s positionality through rigorous examination of one’s identities and related privileges and marginalizations in the context of the larger social, cultural, and historical forces that shape them; b) challenging of power structures through an intentional examination of power relations between individuals and within society at large, and c) a deep focus on systems aimed at examining, challenging, and potentially transforming—or dismantling—systems and institutions that perpetuate injustice and inequity in various ways.

CR alone cannot galvanize broad societal transformation, but it can be a vital aspect of this work in certain contexts. Through engaging in an intentional process to ‘unsettle’ our ways of thinking, question our assumptions and ways of knowing and being, and examine systems more deeply, we can contribute to individual and collective transformational efforts on multiple fronts.



#### 4. Engaging with critical reflexivity and workshop format

CR involves actively questioning and challenging biases and inequitable practices. Below are a few examples of how to apply CR to educational contexts:

1. Examine course materials: Engaging CR to examine course materials and syllabi can ensure classes incorporate diverse perspectives and do not reinforce inequitable power structures or reproduce harmful stereotypes.
2. Reflect on teaching practices: Educators can use CR to: a) better understand potentially harmful language or facilitation styles; b) examine their approach to summative and formative student assessments, creating more equitable practices in measuring student learning; c) support students' capacities to develop their own CR practices through an explicit focus on the benefits of engaging CR as well as the inclusion of regular opportunities for students to actively engage in CR in their academic journey.
3. Challenge policies that uphold inequities: CR can be a tool to delve into a critical analysis of policies that allow inequities to persist and identify approaches to challenging these policies.
4. Engage in antiracist work: Through the ongoing engagement of critical reflexivity, educators can identify and counter inherent biases, working toward being anti-racist.

This workshop will begin with a brief presentation that outlines the key approaches to CR in education. The presenters will then provide case studies that highlight the practical application of CR in real-world situations. These examples will be used to stimulate discussion and encourage participants to identify ways they can adapt these approaches to their own contexts. The workshop's main focus is an interactive portion, during which participants will collaborate with their peers and explore how they can further apply CR in their own lives and professional contexts.

#### 5. Conclusions

In Conclusion, critical reflexivity is a powerful tool that can support educators to examine their biases and challenge existing educational inequities. While not without limitations or shortcomings, it can provide opportunities to challenge assumptions, expose inequities, understand multiple perspectives, and ultimately work toward positive societal transformation. By effectively and consistently engaging with CR, educators can take responsibility for their privilege and positionality, better identify and critically examine inequitable educational policies and practices, and work toward dismantling them. CR focuses social justice work through an essential combination of inward and outward focus, with the goal of action.

#### References

- Alcott, L. (1988). Cultural feminism versus post-structuralism: The identity crisis in feminist theory. *Signs*, 13(3), 405-436.
- Alexander, P. (2017). Reflection and reflexivity in practice vs. in theory: Challenges of conceptualization, complexity, and competence. *Educational Psychologist*, 52(4), 307-314.
- Cunliffe, A. L. (2004). On becoming a critically reflexive practitioner. *Journal of Management Education*, 28(4), 407-426.
- Cunliffe, A. L. (2020). Reflexivity in teaching and researching organizational studies. *RAE - Revista de Administração de Empresas (Journal of Business Management)*, 28(4), 64-69.
- Dewey, J. (1997). *How We Think*. Mineola, N.Y. Dover Publications.
- Hooks, B. (1981). *Ain't I a Woman: Black women and feminism* (12th print). Boston, MA: South End Press.
- Maher, F. A., & Tetreault, M. K. (1993). Frames of Positionality: Constructing Meaningful Dialogues About Gender and Race. *Anthropological Quarterly*, 66(3), 118-126.
- Misawa, M. (2010). Queer Race Pedagogy for Educators in Higher Education: Dealing with Power Dynamics and Positionality of LGBTQ Students of Color. *The International Journal of Critical Pedagogy*, 3(1), 26-35.
- Olmos-Vega, F. M., Stalmeijer, R. E., Varpio, L., & Kahlke, R. (2023). A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. *Medical Teacher*, 45(3), 241-251.
- Pollner, M. (1991). Left of Ethnomethodology: The Rise and Decline of Radical Reflexivity. *American Sociological Review*, 56(3), 370-380.
- Schön, D. A. (1992). *The Reflective Practitioner: How professionals think in action*. London. Routledge.
- Stíngu, M. M. (2012). Reflexive practice in teacher education: facts and trends. *Procedia - Social and Behavioral Sciences*, 33, 617-621.

## AUTHOR INDEX

Adeyinka, B.	231	Clements, K.	563
Aina, A. Y.	231, 320	Conboy, A. F.	275
Aldinah, S.	258	Concannon, B.	350
Anđić, D.	480	Corr, C.	251, 408
Andreou, L.-V.	628	Corral, M. J.	543
Antonacci, F.	588	Correia, R.	144
Auli Giraldo, M.	181	Courtney, L.	668
Autukevičienė, B.	310	D'Angelo, I.	300
Babić, A.	106	Dan, A.	49
Badenhorst, J.	290	de Jong, G.	665
Baek, E.-O.	375	de Oliveira Jayme, B.	385
Banihashem, S.	125	de Salles, J. F.	431
Bastos, A. M.	583	Dědičová, M.	325
Benceze, R.	34, 44	Del Bianco, N.	300
Beyer, L.	416	den Brok, P.	125
Bezdicikova, Z.	262	Deneault, J.	437
Bhebbe, S.	66	Dias, S.	440
Biemans, H.	125	Dlamini, T.	578
Bin, M. W.	443	Dominguez-Candela, I.	647
Blanco-López, A.	467	Dragičević, H. P.	106
Blašković Glaleković, J.	241	Dubé, F.	446
Bloom, H.	668	Ehlers, L.	489
Boateng, S.	623	Eichler, R.	62
Böhm-Fischer, A.	416	Esmail, S.	350
Borges, E. P. K.	431	Espada, M.	81
Brajčić, M.	206	Fafner, G.	393
Brambilla, A.	588	Fan, H.	413
Brasil, C. F.	186	Feng, T.	375
Brebera, P.	262	Fernández, D.	221
Broder, N.	39	Ferreira, C. A.	583
Cacheda, F.	221	Fojcik, M.	335
Calhoun, D.	201	Fojcik, M. K.	335
Capellini, S. A.	186, 300, 499	Fombuena, V.	647
Cardona, S. C.	647	Fox, K. R.	120
Carneiro, V.	221	Frivaldsky, M.	425
Cavasino, G.	553	García Ramos, R.	201
Čepić, R.	480	García-Mínguez, P.	543
Červenková, B.	365	García-Ruiz, C.	467
Chen, D.	405	Gareau, M.	446
Chen, H.-Y.	419	Geduld, B.	489
Chen, T.-F.	419	Giacconi, C.	300
Chiang, C.	172	Gingras, M.	422
Chrappán, M.	34, 44	Giroto Junior, G.	280
Clancy, K.	275	Gkamas, V.	236

Gkouzioni, M.	628	Lanoix, S.	446
Gómez-Baldenegro, F.	271	Lategahn, J.	226
González, I.	494	Lau, P. K.	462
Graham, M.	20	Lavoie, N.	437
Graham, B.	457	Lazou, A.	452
Guerza, R.	608	Leppänen, N.	246
Guevara-Pezoa, F.	548	Letuka, M.	139, 253
Guo, Q. E.	375	Lewin, T.	258
Guo, X.	413	Li, Z.	413
Hanesová, D.	603	Linardakis, M.	642
Haralanova, V.	393	Liu, J.	413
Hargrove, T. Y.	120	López, A. B.	558
Herden, O.	295	López-Pérez, M. F.	647
Herold, J.-F.	181	López-Vizcaíno, M.	221
Hiiemäe-Metsar, K.	475	Lora, J.	647
Hollenkamp, K.	251	Louw, J. M.	538
Ikonen, S.	246	Lupián-Cobos, T.	467
Jagals, D.	13	Luque-Jiménez, J.	467
Jappie, N.	76	Macsotay, T.	543
Jaumot-Pascual, N.	633	Makgopa, K.	163
Jeynes, W.	59	Mangwegape, B. K.	168
Jia, L.	375	Maraffi, S.	662
Jonasson, K.	399	Marci-Boehncke, G.	211, 226
Joseph, D.	410	Marin, J.	437
Kalaitzi, C.	568	Marín, V.	494, 558
Kärbla, T.	18	Martino, F.	638
Karlsson, N.	3, 196	Martins, M. A.	300
Kärnä, E.	246	Mavuru, L.	71, 86, 523, 613
Katrencik, I.	396	McGivern, K.	153
Kayser, C.	652	Medina, E.	96
Kazeni, M.	163	Meyer, M.	134
Kellich, R.	216	Mezak, J.	428
Kerges-Alcantara, G.	499	Mijić, I. P.	267
Khoshaba, S.	393	Moazami-Goodarzi, A.	402
Kilborn, W.	3, 196	Mokhothu, K. G.	472, 514, 533
Klčo, P.	305	Mollo, P.	111, 139, 168, 533
Kleidara, E.	628	Molomo, P. A.	618
Knight, B.	360	Monkevičienė, O.	310
Koltermann, G.	431	Moore, S.	588
Koňarik, R.	434	Mozelius, P.	191
Koulouri, P.	628	Muotka, J.	402
Krzywacki, H.	330	Mushaikwa, N.	91
Kuo, L.-H.	149, 172	Mushayikwa, E.	91
Kurihara, L.	280	Nachshon, N.	8
Kuščević, D.	206	Ndleleni, P.	533
Lan, C.-W.	380	Nedjai, M.-S.	608

Němejc, K.	101	Sajaniemi, N.	402
Niekerk, A.	76	Sampedro, B. E.	558
Nolka, E.	355	Sánchez Cuevas, M.	130
Noroozi, O.	125	SanMiguel, I.	543
Nováková, N.	528	Santos, M.	440
Novaković, S.	241	Schinck-Mikel, A.	96
Nurkka, P.	370	Schlebusch, G.	66
Ogegbo, A. A.	231	Schlebusch, L.	66
Ojasalo, K.	370	Scollo, L. B.	186
Panagiotaki, A.	642	Shaked, N.	158
Pappa, D.	563	Shapir, B.	258
Paritzky, D.	62	Shehu, Z.-S.	628
Paulding, K.	96	Sheng, M. J.	443
Pawlowski, J.	563	Sheoratan, S.	457
Peens, S.	518	Šimko, J.	434
Pejić Papak, P.	428	Simon, E.	49
Penn, M.	504, 652	Sjödén, B.	399
Phindane, P.	54	Skočić Mihić, S.	480
Piangiamore, G. L.	662	Smolić Batelić, A.	480
Pihlainen, K.	246	Sofianopoulou, C.	355
Ping, D. Y.	443	Solná, G.	365
Plšičík, R.	305	Sotiriou, S.	563
Pojarliev, A.	340	Spyridis, G.	452
Poutiainen, A.	330	Stephen, M.	91
Pražnica, M.	305, 434	Stokke, P. A.	659
Quintero, B.	494	Suárez, E.	543
Radebe, N.	91	Suero Montero, C.	246
Rainio, A. P.	315	Sun, Y.	413
Ramírez-Romero, J. L.	271	Szigeti, M.	29
Rammile, D.	290	Tapala, T. T.	485
Ramnarain, U.	578, 652	Tatalović Vorkapić, S.	480, 598
Ran, M.	443	Teng, D.	419
Rath, M.	211	Thomas, D.	251
Raudsaar, M.	475	Tkotzyk, R.	226
Raudsep, A.	593	Tomljenović, Z.	241
Reche, E.	494	Topelberg, N.	115
Remesal, A.	543	Tosi, R.	385
Ribau, I.	285	Trouli, K.	642
Rigou, M.	236	Tsai, P.-H.	149, 172
Rivera, E.	668	Tseng, H.	25
Rodan-Doron, R.	62	Tu, K.-M.	172
Rom, A.	8	Uibu, K.	18, 475
Roney, K.	120	Vančiková, K.	603
Rusch, M.	211	Vega, E.	558
Sacerdoti, F. M.	662	Ventura, J.	115
Sahar-Inbar, L.	158	Vezzani, V.	573

Vicherková, D.	528
Vitytė, B.	310
Vujić, L.	428
Walker, M.	457
Wattad, G.	405
Wilson, N.	523
Witt, M.	360
WP3 Team, T.	662
Wu, H. K.	652
Yáñez-Monje, V.	509
Yang, T.	413
Yeh, T.	172
Yergeau, E.	422
You, L.	149
Zarra-Nezhad, M.	402
Zařková, T. S.	449
Zatrochova, M.	396
Zhang, D.	177
Zsiray, B.	345
Zwane, G.	613