EDUCATION AND NEW DEVELOPMENTS 2025

Volume 1

Edited by

Mafalda Carmo

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World Institute for Advanced Research and Science

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2025

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Edited by

Mafalda Carmo

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

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FOREWORD

Dear Colleagues,

This book contains the full text of papers and posters presented at the International Conference on Education and New Developments (END 2025), 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 are delighted to have successfully facilitated connections among academics, scholars, practitioners, and individuals who share a common interest in a field abundant with fresh perspectives, ideas, and knowledge. Our event has attracted a diverse range of contributors and presenters, enriching our understanding of human nature and behavior by showcasing the influence of their unique personal, academic, and cultural backgrounds. This diversity is a testament to the international reach of our conference, fostering multi-disciplinary collaborations and fostering intellectual growth and exchange.

END 2025 received 704 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 oral presentation 264 submissions (38% acceptance rate).

The conference also includes one Keynote presentation by Dr. Diane Boothe, Boise State University, USA. 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 2025, 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 of contributors and presenters who expand our understanding of educational matters by sharing their unique personal, academic, and cultural perspectives. Through their valuable insights and experiences, they enrich our exploration and contribute to the growth of educational discourse in our contemporary world.

This first volume only 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

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KEYNOTE LECTURE

"REIMAGINING CROSS-DISCIPLINARY ACTIVE LEARNING METHODOLOGIES TO ENGAGE EFL STUDENTS"

Dr. Diane Boothe
Director of P-20 Outreach and Professor, Department of Literacy, Language and Culture, College of Education, Boise State University, USA

Abstract

The continued demand and unique learning environment for English as a Foreign Language (EFL) learners is ever changing as educators focus on best practices to promote optimal learning for 21st century students and meet the needs of our complex interdisciplinary globalized world. Central to the demand for revitalizing the classroom experience is to prepare students to enter the evolving workforce. Cutting-edge EFL skills are often tantamount to achieving success in this endeavor and keeping up with the rapid pace of learning. Not only are EFL students expected to demonstrate observable and measurable English skills, but there is a growing interest and stipulation to demonstrate strengths critical to cross-disciplinary fields as well as collaborative active learning methods. This address investigates student-centered instructional methods that focus on the multidimensional perspectives of active learning environments. Experiences from a variety of disciplines will be highlighted including Science, Technology, Engineering and Mathematics (STEM), emphasizing direct EFL preparation to ensure success and promote purposeful collaboration and engaged English learning. Dynamic teaching strategies and methodologies focusing on active, hands-on learning will be discussed. Challenging student-centered activities will be suggested that can be adjusted for a variety of abilities across age groups featuring key transferable English language competencies. Exploration of best practices that build a culture of innovation and prepare students for EFL content areas will be addressed.

Keywords: *Cross-disciplinary, student-centered, interdisciplinary, multidimensional, competencies.*

Biography

Diane Boothe is Professor of Literacy, Language and Culture at Boise State University, and served as Dean of the College of Education from 2005-2014. Prior to coming to Boise State University, she was the Department Chair of Curriculum and Instruction and Professor at the University of West Georgia. She served as a bilingual teacher, and elementary and middle school principal. Diane has worked consistently with multilingual populations to bring about change and support the development of innovative educational programs and policies. She creates collaborative partnerships and fosters positive relationships with the community, schools, and agencies that she serves. She received her Doctor of Public Administration degree from the University of Southern California. Her primary research efforts have been in the areas of English Language Learning, Multilingual Education, Diversity and Comparative Education Systems. She coauthored a book titled In the Eyes of the Beholder: Critical Issues for Diversity in Gifted Education, focusing a chapter on gender and gifted females when identifying the multidimensional perspectives of giftedness. Diane has served in leadership positions as the President of Georgia Teachers of English to Speakers of Other Languages (TESOL), the TESOL International Higher Education Chair, the TESOL International Nominating Committee, and, for ten years, as the editor of the TESOL in Action Journal. She has been selected as the keynote or featured speaker and delivered the plenary session for international and national conferences.

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ORAL PRESENTATIONS

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STUDENTS' SYSTEMATIC REPETITION AS A FRAMEWORK FOR LEARNING ALGEBRA: A CASE STUDY FROM TEACHERS' PROFESSIONAL DEVELOPMENT

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Abstract

The purpose of this study is to examine how students' repetition of arithmetic concepts is organized during the first year of upper secondary school. The theoretical approach is a triangulation of Freudenthal's didactical phenomenology of mathematical structures, Bernstein's repetition -without -repetition and Mezirow's transformative learning theory. The study includes 94 upper secondary school students and their three mathematics teachers. The crucial content for repetition was whole numbers, rational numbers and potencies as prior knowledge for learning algebra-specific content, such as algebraic expressions, equations and problem solving. The study is part of a research project about teachers' professional development in a "research circle." The key components of the methodology are a qualitative analysis of the research questions and theoretical triangulation, which aim to identify significant empirical findings. The results of the study show that limited space is given to conceptual repetition to support students' learning of algebra. Moreover, the current textbook was not a useful source of support for the teachers.

Keywords: *Systematic repetition, prior knowledge and algebra, knowledge transfer from primary to upper secondary school.*

1. Introduction

Students' development of knowledge from the senior year of primary school to secondary school is perceived as problematic and challenging (Jindal-Snape, Symonds, Hannah & Barlow, 2021). One reason for this is that students often come from different learning environments, bringing with them different levels of knowledge and different perceptions of mathematics (Symonds & Galton, 2014). Moreover, during primary school, students often learn mathematics in different ways, using different methods and relying on the rote learning of formulas. At the same time, secondary school activities are mostly dominated by lower-level cognitive learning, rote knowledge, and numeracy (Carmichael, 2015). This may cause problems when students learn algebra which, in turn, might have consequences for their further studies in mathematics. To resolve this, it is necessary to activate and systematize students' previous learning through optimal repetition. According to Brinkmann (2012), repetition is a teaching strategy that aims to actualize the knowledge that the students already have or have had in the past.

2. Background

Before introducing new teaching content, it is important to ensure that students have adequate prior knowledge to assimilate new mathematical concepts or methods. For some students it may be enough to recapitulate and systematize what they have already learned and understood in their previous learning of mathematics (Kania, Fitriani, & Bonyah, 2023). For other students, the knowledge gap and discrepancy between prior knowledge and new knowledge that must be assimilated is sometimes extensive and require a new approach to teaching that comprises two interwoven parts: a core of prior knowledge and new knowledge. Helping students to continuously gain access to current mathematical concepts and methods is crucial for teaching in a democratic classroom (Stemhagen & Henney, 2021).

It is not sufficient for students to work with mathematical tasks they have never understood. A study of students' learning of operations with rational numbers in grades 7–9 showed major deficiencies in grade 7 regarding operations with rational numbers (Baldemir, Tutak, Nayiroglu, & Suzen, 2023). Moreover, several research studies illustrate that students face challenges in learning rational numbers

(Avcu, 2024). Several of these challenges were still present in grade 9, where most students had poor knowledge of fractions, related concepts and also lacked conceptual knowledge. Instead, they relied on formulas they were unable to manage and often got mixed up (Joutsenlahti & Perkkilä, 2024). This meant that students had limited opportunities for knowledge transfer from primary to secondary school and consequently had difficulties developing new conceptual mathematical knowledge. In other words, continuous repetition in the form of teachers' intervention in the teaching process is required in order to coordinate the students' ability to assimilate previous knowledge and a framework for new knowledge. Knowledge transfer, specifically from primary school to upper secondary school and from arithmetic to algebra, is still the subject of research (Matiti, 2022).

The purpose of this study is to examine how students' repetition of arithmetic is organized in teaching during the first year of upper secondary school. More specifically, the study seeks to address the following research questions:

RQ1: How do teachers plan and implement the repetition of arithmetic concepts?

RQ2: How do teachers assess students' prior knowledge and what support do they get from the current textbook? The study is a part of a research project about teachers' professional development in a "research circle."

3. Theoretical conceptual framework

The theoretical conceptual framework consists of triangulation of Freudenthal's (1973; 1983) didactical phenomenology of mathematical structures, Bernstein's (1996) repetition -without -repetition, and Mezirow's (2012) transformative learning theory. The triangulation is used for the conceptualization of systematic repetition in teaching and for responding to research questions RQ1 and RQ2 through the analysis of the collected data for the current research.

The importance of understanding mathematical concepts and their conceptual meaning and context is described by Freudenthal (1983). According to a fundamental didactical phenomenological analysis of mathematical concepts and structures, it is possible to define mathematics as a science and understand how to use and apply mathematics, not least in teaching. Understanding the phenomenology of "mathematical structures, knowledge of mathematics and its applications" through didactical phenomenology provides knowledge for instruction and how to follow up students' cognitive development and growth. According to Freudenthal (1983), mathematics cannot be taught without continuity of students' learning and activating their previous experience of mathematics. At the same time, mathematical instruction needs to include realistic mathematical activities (Freudenthal, 1991; Gravemeijer, 1994) that include pre-requisites and conditions for students learning mathematics in terms of possibilities and limitations. A crucial aspect of Freundenthal (1983) in terms of teaching practice is that learning is an individual process, and a student's achievements need to be analyzed in relation to the individual development and progression of knowledge rather than the outcomes of a curriculum.

The significant impact of algebra is a result of the conceptual expansion of the arithmetic and "intuitive" methods that are mostly used by students. Teaching elementary arithmetic as numbers and their operations is key to practicing algebra using algebraic rules methods (Freudenthal, 1973). At the same time, mastering algebra is on another level of knowledge and requires new learning of algebraic methods because "traditional methods from elementary arithmetic" is not enough. According to Freudenthal (1973) arithmetic and algebra are fundamentally different because arithmetic is "intuitive and close to reality or at least it should be so" (p. 287). However, algebra is abstract and grounded in "formal-symbolic methods". To minimize the conceptual difference between arithmetic and algebraic methods it is important to introduce and apply algebraic methods at an early stage when students are introduced to algebraic calculus and algebraic symbols. This didactical point can be used, for example, in students learning of algebra through illustrations of how algebraic methods are used in the arithmetic that they learnt in previous grades. In other words, this suggests that there is a need to create a bridge between prior knowledge and new knowledge, as well as make provision for conceptual repetition. This means, that the learning of arithmetic in early grades can be organized by creating a conceptual continuity from whole numbers to rational numbers, and so on.

Bernstein's (1996) conceptualization of the concept of "repetition -without -repetition" highlights that a repetition process needs to implement by every "movement" a new learning component by action. According to Bernstein, repeated practice leads to new ways of thinking. The conceptual framework for repetition is knowledge moving forwards. Bernstein adds that "absolute repetition" (one-by-one) cannot be part of a learning process that aims to successively develop knowledge. This theoretical conceptual framework is used in this study to define a conceptual meaning of repetition as a teaching phenomenon.

From the perspective of transformative learning, it is important to include students' previous knowledge in teaching (Mezirow, 2012). Learning occurs through the integration of prior knowledge into

the different areas of new knowledge. According to Mezirow, the core of learning, which he calls "learning meaning schemes", is an interplay between teaching content and students' cognitive development, as a result of the relationship between prior knowledge and new knowledge. Transformative knowledge through reflections and knowledge transformation takes place through systematic repetition (Brinkmann, 2012). Brinkmann suggested a model of repetition in terms of Mezirow's starting point for learning a process as "movement through time" and claims that new knowledge is a "moving of the repetition through the time".

4. Research methodology

The study was conducted by three upper secondary school mathematics teachers and their three classes comprising 94 students (34 students in class a, 34 in class b and 26 in class c). The collected data comprised the teaching plan for repetition, transcribed discussions, the teachers' arithmetic repetition test, the teachers' analysis and systematization of the test results, the teachers' tasks for the repetition of arithmetic concepts, tasks for teaching algebra, and tasks from the current textbook (Szabo et al., 2021).

The crucial arithmetic content for repetition was whole numbers, rational numbers and potencies and the current teaching content for algebra was algebraic expressions and linear and rational equations. The main component of arithmetic repetition and algebra teaching is Freudenthal's (1973) didactical phenomenology of whole and rational numbers, as well as his point about the number concept, applied arithmetic, and the development of the number concept – the algebraic method. A theoretical point of conceptualization of inverse operations and algebraic concepts was also used (Karlsson & Kilborn, 2024), as well as the mathematics didactics structure for the teaching of arithmetic and algebra (Karlsson & Kilborn, 2015).

In relation to the present study, the key components of the methodology are a qualitative analysis of the research questions and theoretical triangulation, which aimed to identify significant empirical findings. The quantitative analysis was used to analyze the teachers' test for repetition and arithmetic tasks for repetition in the current textbook.

5. Results

With the aim of answering research questions RQ1 and RQ2, the collected data were categorized into four themes, called episodes:

Episode 1. Repetition and the teaching plan for algebra

The teachers' plan showed that the repetition of arithmetic was an isolated act, not integrated with the teaching of algebra. The repetition lasted for five weeks: one week on whole numbers, one week on fractions, one week on decimal numbers and two weeks on potencies. At the end of the five weeks, the students were given an arithmetic repetition test. The teaching plan for repetition was from the first chapter of the current textbook and it did not have any learning goals, specific mathematical tasks, or any documentation of previous teaching.

Episode 2. Repetition and the arithmetic repetition test

The test comprised 10 arithmetic tasks. Tasks 1, 2 and 3 dealt with whole numbers, task 4 with rational numbers and tasks 5 to –10 with potencies. The structure and content of the repetition tasks in the test recognized in greater detail that these tasks had an unclear goal regarding the repetition of arithmetic concepts. Moreover, there was limited conceptual context for the repetition tasks, for example, there were few tasks about the subtraction of negative numbers, subtraction and division of rational number, etc. It was also unclear how these tasks could support the students' systematization of arithmetic and further learning in algebra.

Episode 3. Repetition and students' prior knowledge of arithmetic

It was unclear how the students' prior knowledge of arithmetic would be tied to their learning of algebra. There was a clear intention on the part of the teachers to systematize the students' prior knowledge through repetition, but the teachers' strategies when working with repetition were rather intuitive, not based on knowledge of the students' learning of algebra. Thus, it was obvious that the teachers had episodic and vague perceptions of students' learning of arithmetic and knowledge about how the students' arithmetic repetition could be organized and used as a background for their learning of algebra.

Episode 4. Repetition and textbook's repetition discourse

The current textbook has a special chapter comprising 43 pages for the repetition of arithmetic tasks, aimed at a systematic repetition of prior knowledge before learning algebra. The subheadings are as

follow: Whole numbers, numbers in fractional form, numbers in decimals and potencies. The number of tasks intended for this rehearsal are shown in Table 1. The subheadings, levels 1, 2 and 3 in the current textbook show the complexity of the tasks.

Table 1. Number of tasks in the textbook for repetition.

Repetition of arithmetic tasks	Level 1	Level 2	Level 3
Whole numbers	36	8	0
Fractions	56	17	7
Decimal numbers	25	10	2
Potencies	101	50	22

The quantitative mapping of the repetition tasks for arithmetic shows that the number of tasks about whole numbers, fractions and decimal number are few compared to the number of tasks about potencies The same tendency was found in the teachers' test given after the repetition. Greater emphasis has been placed on the Level 1 arithmetic task than on an equal distribution between levels and difficulty making progress through the tasks. The crucial arithmetic concepts for learning algebra as whole numbers, fractions and decimal numbers are very limited. A qualitative analysis of the tasks shows that most of the instructions for repetition describe *how* to accomplish the tasks, not *why* they should be accomplished. As an example, there is no definition of fractions like $\frac{a}{b} = a \cdot \frac{1}{b}$, where $b \neq 0$, or that $\frac{1}{b}$ is the inverse of *b*. Thus, it is not possible to conceptually understand the formulas for the multiplication or division of two fractions. In fact, many students perceive $\frac{a}{b}$ as division. The arithmetic tasks in the current textbook have no clear and logical structure from level 1 to level 3. For example (level 1, Fractions p. 14) includes 10 arithmetic tasks about "shortening and lengthening". The level 2 tasks about fractions comprise one task about the lowest common denominator and two tasks about the comparison of fractions. Level 3 (p. 14) includes one task about the lowest common denominator. There is no logic to the content of the structure of the repetition tasks, for example, a comparison of fractions is used to identify the lowest common denominator and should be placed at the level 1. This is a poor conceptual transfer from one level to another and there are similar tasks on level 1 in the example above.

6. Conclusions

The results of the study show that arithmetic repetition is used as a tool in teaching, but that provision has not been made for a systematic repetition of content, either in teaching or in the current textbook. Meaningful repetition cannot take place in teaching without a clear choice and the teaching content being prioritized, as well as an understanding of what should be the focus of the repetition and systematization of student's prior knowledge. Teachers need to be taught how repetition can be compatible with their teaching aims and goals, and a structured plan and sequencing of the teaching content. Regarding the present study, the design of conceptual repetition and the repetition of arithmetic tasks is based on Bernstein's and Mezirow's theoretical conceptual framework. The current textbook repetition tasks were interpreted in line with Freudenthal's perspectives on the arithmetic and algebraic content in teaching, as well as conceptualization of arithmetic operations and algebraic concepts (Karlsson & Kilborn, 2015; 2024). The results of this study describe how students' repetition of arithmetic was organized in teaching during the first year of upper secondary school.

The study shows that limited space is given to conceptual repetition that could support students' learning of algebra. Moreover, the teaching plan, repetition test and the current textbook repetition tasks have no conceptual structure and content. The results of the study cannot be generalized due to objective limitations. Regarding the reliability and validity of the current research, this has been ensured by the systematic analysis of the collected data related to the theoretical framework and the support of previous studies that indicated that students have limited opportunities to transfer knowledge from primary to secondary school. One interesting conclusion of the study is the teachers' slowness to accommodate new ideas for teaching. It is easier trying to assimilate, that is, to include new ideas in an older, non-functioning context. This often results in intellectual conflicts and a reluctance to change methods. It took several weeks for the teachers to be convinced of the benefits of changing their teaching strategies.

The researchers have a special interest in continuing this research in order to support teachers and their teaching and organizing of students' repetition through a mathematical intervention study, as well as by analyzing the impact of developing students' learning. The conceptualization of repetition phenomena

with a focus on a transition from arithmetic to algebra can be useful in future research and research discussions about students' knowledge transfer through the conceptual interplay between arithmetic and algebra.

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THE EXTRACURRICULAR PROFESSIONAL INTERNSHIP IN THE TEACHER TRAINING PROGRAM IN THE VOCATIONAL FIELD OF HEALTHCARE

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Abstract

There are numerous internships to be completed within the diverse study program landscape of vocational teacher training in Germany. The prerequisite for a qualifying degree is practical professional experience within the vocational subject area, which is gained either through a completed vocational training of at least three years or an extracurricular internship in the professional field for at least one year. The latter is intended to familiarize students with the professional and working world of the trainees, who the students will train and teach in the future. While internships in schools are quite often subjects of research, there are gaps in the research of extracurricular internships, which gave rise to the author's doctoral thesis, which focuses on the vocational field of healthcare and nursing. In an explorative, qualitative research, based on the methodology of the grounded theory, a sequential trend study with semi-open interviews will be used to find out how students experience the internship, which professional socialization processes occur and what influence the internship has on the professional actions of teachers who completed the internship already. The contribution will present the theoretical foundations and outline initial empirical results, for example an overview of the structures of the extracurricular professional internship, based on a document analysis throughout Germany of similar teacher training courses in various universities and also first results of the interviews. In addition, an outlook on curricular development processes at the university in relation to the professional internship regulations will be given to empirically support and possibly adapt already existing documents about internship regulations.

Keywords: *Vocational training, internship, profession, healthcare, professionalising.*

1. Introduction and terminology

The term internship encompasses various forms and can be categorized in systematically varying ways. The spectrum of existing internships ranges from trial internships to orientation internships, from mandatory to optional internships, from short-term to long-term internships, from paid and unpaid internships, from company-based to home-based internships, depending on the criteria applied and areas of application (Popella, 2017).

In the university context, an internship is characterized from an etymological perspective as a "[...] variety of exercises for the [...] application of theoretical knowledge in certain disciplines of a university as well as [...] as a temporary activity of a student in a company for the acquisition of practical professional knowledge" (translated by author) Pfeifer (2005).

Accordingly, internships in all facets of teacher training are also an important pillar of teacher training courses and the focus of teacher trainees. Embedded in the respective study regulations and sometimes described in detail in internship regulations or handouts, internships with various practical phases offer elementary learning opportunities for the professional development and attitude of prospective teaching staff (Arnold, Gröschner, & Hascher, 2014).

Most of the internships integrated into teacher training courses are characterized by practical assignments at the school, therefore it is argued, that they should be summarized under the term "practical school studies" (Schüssler et al., 2017). The focus here is on the inclusion of academic preparation and follow-up work for students on the part of university support, which can be realized through mentoring programs and curricular embedding in the study regulations (Schüssler et. al., 2017).

While the practical school studies mainly take place at the school, there are also extracurricular internships, especially in the area of vocational teacher training. In contrast to practical school studies, such

extracurricular work placements have the special feature that their aim is not to immerse students in the professional field of the future teacher, but to open up the future professional world of the trainees. Accordingly, the term “vocational internships” or “vocational orientation internships” is often used, which are part of the higher education curriculum in the individual vocational disciplines and are regulated by regulations or handouts, and for example in Bavaria even by law (Bavarian State Ministry of Education and Cultural Affairs, Science and the Arts 2017).

The planned research work will focus on the vocational fields of health and care. These occupational fields comprise more than 60 different professions. The practical phases of the extracurricular professional field internships are an opportunity for students in the professional fields of health and care to acquire implicit and explicit knowledge and to get to know previously unknown health professions (Gahlen-Hoops, 2019).

2. Relevance

Teacher training courses in vocational education have specific structural and organizational characteristics compared to general education teacher training courses, which can be attributed not least to the different vocational disciplines and the associated related sciences. This also results in different characteristics for the research subject of the extracurricular vocational field placement, which are more or less pronounced depending on the vocational subject area. For the occupational fields of health and care, the focus is on high-quality care for people by well-trained specialist staff, particularly due to the associated occupational field. The aim is to train specialists with professional teaching staff and to provide them with sufficient qualifications for their everyday work (Driesel-Lange, 2017). This also includes sensitizing student teachers to the professional field in which the future trainees will work in the form of an extracurricular professional internship.

During the internship, students should be able to gain a multi-perspective view of the field of activity and thereby complete a professional orientation process. On the one hand, the internship experience is placed in relation to the future teaching profession, which mainly takes place at the school as a place of learning. On the other hand, the experiences are considered in the context of the future trainees in order to better understand the job profile to be taught and, for example, to be able to better interpret, understand and convey patterns of action in the training profession. This aspect is also important in the context of the vocational specialization of health and nursing with regard to the double logic of action, as the “[...] teachers must reflexively work on the [health and] nursing situation as a learning object in addition to the teaching-learning situation” (translated by author) Ertl-Schmuck (2018).

In comparison, Darmann-Finck speaks of the phenomenon of dual socialization and its challenges, which students should counteract in their role as reflective practitioners (Darmann-Finck 2018).

Due to the structural variances and the organizationally differentiated structure of the professional field of health and nursing-related study programs, there are different requirements and conditions regarding the design of the professional field internships with divergent target orientations (Arens & Brinker-Meyendriesch, 2020).

These have not yet been evaluated or recorded in research projects.

As an example, the conditions for the TU Dresden and the vocational subject area of health and nursing will be briefly presented below in order to provide an initial starting point for a comparative, document-analytical part of the research.

According to the Saxon Teacher Examination Regulations, the professional internship is mandatory for all students who cannot provide proof of completed vocational training by the time they graduate. Therefore, the professional internship can be seen as a pillar of the degree program, which is binding for the completion of the first state examination and is equivalent to a completed vocational training in the professional field (Freistaat Sachsen, 2022).

Despite the high value of the extracurricular professional internship, the guidelines and framework conditions are only superficially described in §100 of the Saxon teacher examination regulations and in the KMK guidelines of 2007 (Freistaat Sachsen, 2022) and offer a broad design corridor that is used as the basis for the relevant internship regulations for all professional disciplines. If, in comparison to the internal guidelines for practical school studies, the objectives are clearly structured and checked by means of performance records, students on extracurricular work placements face the challenge of relying on their own individual responsibility. Although a 10-page work placement report with the character of a learning diary is required as a final achievement, reflection and specific feedback on the report and a review of whether the goals set by the students themselves have been achieved do not take place under academic-university supervision, as is usual in other work placements (Ertl-Schmuck, 2017).

The extracurricular professional internships are therefore completed without targeted mentoring or the supervision of corresponding practical instructors. At the same time, there are no courses in the study

regulations that accompany the professional internship in a university context (Technical University Dresden, 2018).

The linking of the experiences and impressions of the practical placements is not reflected from a university perspective and there is also no specific practical supervision, insofar as it is not carried out independently in other modules.

The choice of internship locations is also open, which can lead to problems with the recognition of the content and structure of professional internships (Ertl-Schmuck, 2017).

Furthermore, the free choice of internships and internship locations means that there are no official cooperation agreements with the university. The guarantee of a high-quality practical phase is therefore the sole responsibility of the institutions in which the internships are completed, while at the same time different understandings of the roles of the interns, mentors and internship supervisors can lead to conflicts of interest (Egloff, 2002).

Furthermore, there is a relevance of the perspective of the interns. On the one hand, the interns find themselves in the role of a prospective teacher, which places and embeds the internship experience in the context of the future teaching profession. On the other hand, the interns should get to know various professions in the professional field of the professional specialization they are studying. In addition, the focus is on opening up and raising awareness of the professional world in which the future trainees to be taught will operate.

3. Design of research

Due to the planned research steps, the research is to be written in the form of a qualitative design. Due to the division of the work described below, there are initially quantitative parts that can be embedded in the qualitative methodology. This procedure serves to initially make relevant characteristics of the research field visible in order to support the qualitative parts (Kelle, 2014).

As already indicated in the title of the research, the work is intended as an exploration, as the research subject of the extracurricular vocational field placement, as shown in the state of research, has not yet been empirically investigated and is now to be made accessible for the first time. In order to be able to explore and demonstrate the inner core of the extracurricular work placement, grounded theory is to serve as a methodological framework, through which new theories on the extracurricular work placement are to emerge.

Although “grounded theory [...] has become one of the most widely used methods of qualitative-interpretative social research [...]” (translated by author) Strübing (2004) and there is often the suspicion “[...] that people like to reach for the >grounded theory< seal of approval when they themselves do not really know how to arrive at results [...]” (translated by author) Strübing (2004) and which procedure to use for this. In the author's opinion, the research style of grounded theory is particularly suitable for the dissertation project, as it is not only about the pure description of the data obtained, but rather about an understanding of the phenomena recorded. (Wollny & Marx, 2009) Through the methodology of constant comparison and the associated multi-stage coding steps, the research process as such can be more systematized and improve the intersubjective validity of the results (Strübing, 2004).

In the basic structure, the extracurricular professional field placement in the context of vocational teacher training will be discussed first. Subsequently, the object of research of the extracurricular vocational internship in the vocational fields of health and care will be condensed in order to finally delve empirically into the field of research.

In the first part of the research, a basic introduction to the complex of topics and the object of research of the extracurricular professional internship is to take place in the first step and a classification of the associated, sensitizing concepts is to take place. These concepts “[...] do not have the character of firmly established hypotheses [...]” (translated by author) Alheit (1999), but allow conclusions to be drawn about suitable theoretical references through the theoretical sensitivity of the researcher (Alheit, 1999).

This step is highly relevant for an interpretation and discussion of the term as well as the genesis of a final definition that is consistent for the research.

The second step involves an intensive examination of the current state of research and current study results that are relevant to the subject of the research in order to identify overlaps and open up the broadest possible understanding of the extracurricular vocational field placement.

In the third step, a document-analytical review of exemplary professional field placement regulations and handouts from various teacher training courses in the vocational field of health and nursing will be carried out. These are quite heterogeneous in their structure and implementation instructions, although in principle they describe the same subject matter. For example, the regulations for work placements in Bavaria are regulated equally for all universities by law, while other universities rely on

specially developed handouts and work placement regulations (Bavarian State Ministry of Education and Cultural Affairs, Science and the Arts 2017).

In the final step of the first part of the research, data is to be collected on the facilities and institutions in which the students carry out their extracurricular work placement. At the same time, the intentions behind the decision for or against certain practice locations or practice institutions should be determined. This analysis of the current state of the internship landscape can provide an empirical overview of how and for what reasons students organize their extracurricular internships.

The results described are intended to serve as a base and overview to better situate the results of the second part of the dissertation and to be able to quantitatively depict the entirety of the data in parts.

In the second, empirical part of the qualitative research, students who have not completed their professional training will be interviewed using the same survey instruments at different times, namely at the beginning and end of the extracurricular professional internship, as well as teachers who have completed the internship and are already working as teachers, using episodical interviews. The teachers will also be asked about the effects of the extracurricular internship on their current teaching activities. By selecting episodical interviews, the aim is to "[...] elicit and maintain longer narratives, initially without further intervention from the interviewer [...]" (translated by author) Rosenthal & Loch (2002) the principle of openness should be followed. In doing so, "[...] hypothesis-driven data collection is dispensed with and the focus is initially on the relevance of the interviewees and their everyday constructions." (translated by author) Rosenthal & Loch (2002). This is intended to open up a perspective that is as consistent and comprehensive as possible in order to incorporate the experiences of the interviewees and to be able to gain subsequent, theory-developing insights.

Due to the time frame of the research, a panel study was not carried out, as the extracurricular internship is sometimes stretched over 5 years of the standard period of study, depending on the form of study.

The black box 'extracurricular professional internship in the field of health and nursing' is to be opened up to such an extent by the design described above that an insight is generated with the theories gained, with which the object of research is made comprehensible and in parts also representable.

The goal of the research should lead to a better interpretation and understanding of the subject matter of the extracurricular work placement and enable it to be placed in a university context. The results of the planned research can create a basis on which curricular efforts for the extracurricular work placement in the individual degree courses can build. The knowledge gained could be used to identify new perspectives on the curricular positioning of the extracurricular work placement from a higher education didactic perspective. This would also be accompanied by a possible reorientation of the existing internship guidelines and handouts, in which fundamental aspects of university supervision, the possibility of mentoring programs, decision-making in the crediting processes, but also the objective and subjective objectives and their forms of assessment could be taken into account.

4. Conclusion

The relevance made clear in the article is not only evident in organizational-administrative structures, but also in the didactic-reflective subject area. Situation-oriented teaching-learning arrangements with practical work-related situations in the sense of the learning field concept are indispensable for the design of lessons. The learning situations based on this require reflective, practical professional expertise, which could be acquired without having completed vocational training by experiencing practical activities in the relevant professional field. A profound understanding of the students' experiences and completed activity profiles also requires qualitative, exploratory research steps with regard to interprofessional competencies. Interviews with interns can be used to draw initial conclusions for the university curricular embedding of specialist internship activities and to describe the internship landscape in more detail. In the planned presentation, the first results of the document analysis and the interviews conducted will be presented and discussed.

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UTILIZING KNOWLEDGE AND AI COOPERATION APPROACHES IN PROFESSIONAL MUSIC TRAINING — THE TUT EXPERIENCE

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Abstract

The Ministry of Education in Taiwan is motivating educational institutions to incorporate artificial intelligence (AI) into elementary and middle-school education and expects Taiwan to become a leader in AI education in Asia within two years. In addition, the government plans to launch an alliance between universities. The plan will offer three cross-university credit programs and 14 courses, allowing students to learn from the best teachers. The idea is that technology applications require interdisciplinary collaboration for comprehensive research and development in the educational sector, and the collaboration presents an opportunity for music educators to reconfigure and strengthen their pedagogical approaches. What follows are some observations and reflections from the Tainan University of Technology (TUT), Taiwan, and educators' application of AI in teaching music, such as thesis writing. Notable benefits of integrating AI in the curriculum are research support and improvement in teaching outcomes. Additional benefits include recognizing the accessibility of AI to facilitate personalized learning experiences, create adaptive learning environments, provide real-time insights into student performance, enhance engagement and participation, influence teaching methods, and support the development of music students' critical thinking and problem-solving skills.

Keywords: *Artificial intelligence (AI), music, learning approaches.*

1. Introduction

All types of artificial intelligence (AI), such as machine learning, generative AI, and computer vision, are fast becoming prevalent in all areas of higher education today. They are being used to help improve teaching and learning, create enhanced educational experiences, streamline processes, and accelerate academic research (Intel Technologies, 2025). Aguayo-Hernández et al. (2024) suggest that faculty members use different strategies to ensure effective assessments, including continuous evaluation of student progress, familiarity with evaluation models and tools, and constant adaptation and innovation of evaluation practices. Education, including music courses, has seen consistent growth in the use of digital technologies, but integrating artificial intelligence also feels like the beginning of a revolution. Artificial intelligence's emergence has disrupted music education and transformed this new technological development, implying the adaptation of educational ecosystems for its use and integration is a didactic and pedagogical resource (Merchán Sánchez-Jara et al., 2024).

A key challenge exposed in the shift to artificial intelligence in the music education environment is the traditionally focused face-to-face teacher-apprenticeship teaching models. From a critical perspective, the position of AI in the music education environment highlights challenges and opportunities, as well as paradigmatic areas of application, which project the development of AI in the organization and development of teaching-learning processes in music (Merchán Sánchez-Jara et al., 2024). The background to adopting new instructional practices in the classroom provides fascinating insights into the higher education scene where technology and the AI-based portfolio design learning for 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.

This research explores the relationship between using knowledge and AI cooperation approaches and shows how teaching students to write and understand program notes can be facilitated by artificial intelligence that can author essays when provided with a prompt by an end user. The case of the Tainan University of Technology (TUT) Music Department was examined to achieve this aim. The main reason for focusing on the TUT is that the study of the TUT's Music Department and its curriculum and integration of innovations has been ongoing since 2020. The 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. This assumption has ensured that the TUT is a leader in professional music training as music artists shift from amateur to professional status.

2. Background

Like other educational programs, professional music training programs are challenged by significant changes in the socio-cultural 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 regarding music education policy, the Ministry of Education in Taiwan amended the Arts Education Act (AEA) of 1997, which 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 for all students in music education in Taiwan (Ministry of Education, Taiwan, 1997). The TUT Music Department's seven-year program from high school directly to a bachelor's degree in vocational education has served as an example of 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. Handbooks published for 2023 present the benefits and limitations of AI in TUT classrooms, for example, time-saving solutions and ethical issues, and provide concrete examples of how AI can be used to improve student outcomes. In particular, incorporating AI is noted as helpful if experimentation with technological innovation is not only a task for the teacher but also involves the active participation of the learning community, including school organizations and parents.

How can AI help teams improve teaching and learning? "The AI models are a series of large amounts of performance data to provide information on student progress, helping educators to identify areas that need more attention and adapt their teaching strategies accordingly" (Merchán Sánchez-Jara et al., 2024, p. 1172). The first version of AI was released in 1951. Several updated versions, including the first mobile intelligent robot in the 1960s, followed. An AI winter was then followed by an AI renaissance in the 1970s and 1980s, Speech and video processing in the 1990s, and IBM Watson, personal assistants, facial recognition, deepfakes, autonomous vehicles, GPT content and image creation, and lifelike GenAI clones followed in the 2000s (Karjian, 2024).

In 2024, Delphi launched GenAI clones, allowing users to create lifelike digital versions of themselves, ranging from likenesses of company CEOs sitting in on Zoom meetings to celebrities answering questions on YouTube (Karjian, 2024). AI is the latest innovation to be integrated into teaching music at the TUT. This paper focuses on how AI can help solve problems such as students' lack of engagement, offering them tailor-made learning experiences. In the context of AI and the associated variety of industries and applications, further adaptations proved necessary to achieve the formal educational goals for the Music Department at TUT.

3. Literature review

Research examining the impact of AI on higher education has witnessed substantial growth in recent years, as highlighted in notable studies (Al-Zahrani, 2023; Al-Zahrani, 2024; Bozkurt et al. 2021; Chu et al. 2022; Dai & Ke, 2022; Laupichler et al., 2022; Merchán Sánchez-Jara et al., 2024; Zawacki-Richter et al., 2019). Scholars from diverse fields, including education, computer science, psychology, and ethics, have explored various facets of AI implementation in higher education settings. Merchán Sánchez-Jara et al.'s (2024) research results confirm that incorporating AI in music education paves the way for a more personalized, interactive and efficient learning experience. However, there is a noticeable lack of emphasis on higher-order thinking skills, collaboration, communication, self-efficacy, and AI skills in higher education studies (Chu et al., 2022). Laupichler et al. (2022) emphasize that research on AI in higher education is still in its early stages, necessitating refinement in defining AI literacy and determining appropriate content for non-experts to enhance educators' and students' understanding of AI. However, Zhang (2023) emphasizes the advantages of working on teaching strategies according to the unique learning profiles of each student. In this sense, in line with González-Gutiérrez and Merchán Sánchez-Jara (2022), reflection on how, why and for what purpose new technologies are used in educational ecosystems becomes even more relevant in the era of artificial intelligence. This literature review overviews key research areas and offers insights into existing knowledge.

At the TUT, students can receive individualized tutoring and feedback from AI based on their learning requirements and development. Students can receive individualized research support tutoring from a conversational agent built on generative AI tools, which enhance learning outcomes. The conversational agent can adjust explanations to students' comprehension levels and misconceptions.

In the following section, Schumann's Piano Piece *Papillons*, Op. 2 is used as an example to evaluate the merits of using AI as a research assistant, like accessing relevant information and data, with students writing academic papers using AI for writing assistance and suggestions for phrasing, tone, and style.

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 the graduate student level, student performers are expected to write program notes about their performances for a general concert audience, an audience of non-musicians who are interested in music and reasonably knowledgeable. The goal of teaching students to write program notes is to increase the audience's understanding and enjoyment of the music performed (Blom et al., 2020).

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 a relationship between performers and their audiences. Therefore, students presenting recitals are 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.

Before COVID-19, the teacher might have taken time in class to explain Schumann's Piano piece *Papillons*, Op. 2, as students rehearsed the piece. For example, the teacher might have alerted students to what was going on in inventive and descriptive titles from Schumann's piano music when he composed the piece and discussed how it is similar or different to anything audiences had heard. Much like college music lecture recitals, the teacher might have discussed with the students and raised awareness about how Schumann uses titles 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 about what was written before the piece. For example, the scene of the masked ball at the end of Richter's novel *Flegeljahre* (1804, as cited in Perahia, 2014) provides the dramatic "setting" for the cycle. It is 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 inform the audience of this, facilitating a better listening experience by including what is interesting and relevant about the composer.

Therefore, the purpose of learning about this musical piece goes beyond just playing good music well. It incorporates an intentional introduction to new musical discourses and tools for students to add to their cognitive understanding of how music works by helping the student (and audience) understand that music is located within time and culture. With the growth of artificial intelligence (AI) and natural language processing (NLP) technologies, chatbots have evolved significantly, becoming more capable of handling complex tasks and undertaking more human-like interactions.

So, how did my teaching of writing program notes change with the introduction of AI in the online educational context? AI was trained on a massive dataset of text from the internet, allowing it to generate human-like responses to various questions and prompts (Kooli, 2023). Assessing students through case studies is an example of an effective student assessment strategy. Using case studies that require students to analyze real-world scenarios and apply their knowledge to solve complex problems could help mitigate the effects of the excessive use of AI (Kooli, 2023).

While AI can provide students with immediate answers to questions, using AI in the educational field also raises ethical challenges that must be addressed: AI can also lead to academic dishonesty and a lack of learning. In addition, using chatbots can create an uneven playing field because some wealthy students may have access to better or more advanced chatbots than poor students. These are two different issues—one is directed at ensuring all students, regardless of their economic status, have access to the same quality of assistance, and the other supports institutional efficiency.

5. Conclusion

The most disruptive potential of generative AI in music education lies in its ability to create immersive and adaptive learning environments that simulate real-world intervention contexts (Merchán Sánchez-Jara et al., 2024). Various AI tools and techniques can be used in education to help researchers, educators, students and even the institution. This paper has reviewed the utility of AI technologies and the ethical challenges that might emerge from using AI. It acknowledges that the potential benefits of AI systems in the academic field include personalized learning, increased accessibility, and improved efficiency and teaching outcomes; consequently, the use of AI is likely to increase in the coming years.

However, AI tools are limited in providing the same quality of critique for performances as would be the case in face-to-face instruction, in the same way as watching a televised concert performance, which is an inferior experience compared to watching a live performance. Moreover, online distance learning courses in music mean that teaching music online requires knowledge and skills in online design, assessment, and communication. At the same time, regardless of what research reveals about AI tools and their place in education, music teachers will be asked to use remote teaching methods to ensure the sustainability and scalability of music education and attract and retain students. The integration of AI in music teaching is revolutionary and disruptive, but arguments for adopting and adapting online learning approaches for teaching music and musical appreciation should not be ignored.

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STUDENTS' MATHEMATICS SELF-EFFICACY AND MATHEMATICAL LITERACY ABILITIES

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Abstract

Mathematics self-efficacy refers to an individual's belief in their ability to effectively and successfully handle mathematics-related tasks and overcome challenges at predetermined levels. The research literature frequently emphasizes the statistically significant positive correlation between mathematics self-efficacy and both mathematics performance and mathematical literacy achievement. In this research, the mathematics self-efficacy index is calculated as a single composite measure; however, it is further subdivided into four distinct subcategories: self-efficacy in solving mathematical exercises or equations without context, self-efficacy in addressing real-world problems, self-efficacy in mathematical literacy skills, and self-efficacy in information literacy skills. This present study aims to examine students' mathematical literacy skills upon completion of compulsory education in Greece and to address the research question of whether a statistically significant correlation exists between students' mathematical literacy performance and the mathematics self-efficacy factor, both as a single composite measure and when divided into the four previously identified subcategories. The study was conducted with a sample of 650 students from across Greece who were completing their compulsory education. The schools attended by the sampled students were selected based on the level of urbanization of their respective areas, specifically categorized into three levels: major urban centers, small urban centers, and rural areas. The findings of the study indicate a statistically significant positive correlation between performance in mathematical literacy and the single factor of mathematics self-efficacy. Additionally, a statistically significant positive correlation was observed between performance in mathematical literacy and each of the four distinct subcategories within the single factor of mathematics self-efficacy: (1) self-efficacy in solving abstract mathematical exercises or equations, (2) self-efficacy in addressing real-world problems, (3) self-efficacy in mathematical literacy skills, and (4) self-efficacy in information literacy skills.

Keywords: *Mathematical literacy, mathematics self-efficacy, Greece.*

1. Introduction

The term self-efficacy refers to an individual's belief in their capacity to achieve desired outcomes through their actions or abilities, which serves as a significant motivational factor in overcoming challenges and difficulties (Bandura, 1994, 1997). It refers to an individual's confidence in their ability to exhibit the necessary behavior that will result in specific, desired outcomes (Delcourt & Kinzie, 1993). Within this broader framework, mathematics self-efficacy pertains to an individual's confidence in their ability to effectively engage with and successfully complete mathematics-related tasks, even when facing obstacles, at varying levels of complexity (Fast et al., 2010; OECD, 2013; Schunk, 1991; Stankov et al., 2014). More precisely, mathematics self-efficacy encompasses the belief and self-assurance that one can competently manage a range of mathematics-related activities, from comprehending fundamental concepts to solving complex problems (Sharma & Nasa, 2014).

Extensive research has consistently demonstrated a statistically significant positive correlation between mathematics self-efficacy and mathematics performance (Anjum, 2006; Ayotola & Adedeji, 2009a, 2009b; Fast et al., 2010; Goodwin et al., 2009; Jiang et al., 2014; Pajares & Miller, 1994). Additionally, this relationship has been observed specifically in the context of mathematical literacy performance (Cheema, 2018; Cheema & Galluzzo, 2013; Cheema & Skultety, 2017; Hiller et al., 2022; Kalaycioğlu, 2015; Karakolidis et al., 2016a, 2016b; Lee, 2009; Lee & Stankov, 2013; OECD, 2004, 2013; Pitsia et al., 2017).

The concept of mathematical literacy, as outlined in the most recent definition developed for the Programme for International Student Assessment (PISA 2022) and adopted for the purposes of this study (Nolka & Sofianopoulou, 2024a, 2024b), is characterized as "students' capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena" (OECD, 2019).

It is important to highlight that, in this study, the mathematics self-efficacy index was initially considered as a single measure. However, it was later subdivided into four distinct subcategories for further analysis, namely: self-efficacy in solving mathematical exercises or equations without context, self-efficacy in solving real-world problems (contextualized tasks), self-efficacy in mathematical literacy skills, and self-efficacy in information literacy.

2. Research

This study involved a sample of 650 students from various regions across Greece who were either in the final stages of the 9th grade or at the beginning of the 10th grade, coinciding with the completion or recent conclusion of compulsory education. The schools included in the sample were selected based on the degree of urbanization in their respective areas, encompassing large urban centers, small urban centers, and rural regions.

To address the objectives of the research, two distinct instruments were developed and utilized: a mathematical test and a questionnaire. The mathematical test consisted of five authentic, real-world problems, each divided into sub-questions or items. In total, students were required to respond to eleven items. These problems were presented as word problems embedded in real-life contexts, each introduced by a contextual stimulus or narrative. The dependent variable for mathematical literacy achievement was defined as the students' performance or scores on this mathematical test.

The second instrument, the questionnaire, comprised 16 statements designed to assess an index of self-efficacy in mathematics. This index was constructed based on students' responses on a four-point Likert scale, which ranged from "very confident" (4) and "confident" (3) to "not very confident" (2) and "not at all confident" (1), in relation to their perceived ability to handle situations requiring mathematical reasoning or application.

The self-efficacy index was initially analyzed as a single construct, encompassing all 16 sentences listed in Table 1. Additionally, the index was categorized into four subcategories for further analysis:

- Self-efficacy in solving mathematical exercises/equations without a real-world context (S.1–3).
- Self-efficacy in solving real-world problems within a contextual framework (S.4–9).
- Self-efficacy in the abilities of mathematically literate individuals (S.10–14).
- Self-efficacy in information literacy abilities (S.15–16).

Table 1. Self- efficacy index.

Sentences	**How confident are you in your ability to succeed in the following mathematics tasks?**
1	To solve an equation like this: $3x+5=17$
2	To solve an equation like this: $6x^2+5=29$
3	To solve an equation like this: $2(x+3)=(x+3)(x-3)$
4	To calculate how much more expensive a computer will be after tax is added.
5	To calculate, based on a table of train schedules, how long it takes to get from one place to another.
6	To calculate how many square meters of tiles are needed to cover a floor.
7	To calculate the weekly consumption of an electronic device.
8	To find the actual distance between two places on a map with a scale of 1:10,000.
9	To calculate the properties of an irregularly shaped object.
10	To derive information from diagrams, graphs or simulations.
11	To interpret the mathematical solutions, you used to answer a problem in everyday life.
12	To recognize the mathematical aspects of a problem from real life.
13	To represent a situation mathematically, using variables, symbols or diagrams.
14	To understand scientific tables presented in an article.
15	To work with mathematical computing systems (e.g. excel, programming software, graphing calculators).
16	To write a code/program on computers.

The study aimed to address the following research questions:

Is there a statistically significant correlation between mathematical literacy performance and overall self-efficacy in mathematics?

Is there a statistically significant correlation between mathematical literacy performance and self-efficacy in solving mathematical exercises/equations without a real-world context?

Is there a statistically significant correlation between mathematical literacy performance and self-efficacy in solving real-world problems?

Is there a statistically significant correlation between mathematical literacy performance and self-efficacy in the abilities of mathematically literate individuals?

Is there a statistically significant correlation between mathematical literacy performance and self-efficacy in information literacy abilities?

3. Results

Among the individual propositions constituting the self-efficacy in mathematics factor, students reported the highest levels of confidence in solving a first-degree equation (with over 81% expressing confidence or strong confidence) and a second-degree equation (with over 79% expressing confidence or strong confidence). Conversely, students exhibited the lowest levels of confidence in calculating the properties of an irregular shape, with only 21.5% reporting confidence or strong confidence.

To address the research questions, the study first employed Cronbach's Alpha reliability test to evaluate the internal consistency of both the overall self-efficacy in mathematics variable and its four subcategories. The Cronbach's Alpha values for all variables exceeded the acceptable threshold of .700, with the exception of self-efficacy in information literacy abilities. However, as demonstrated in Table 1, this construct is composed of only two statements.

Spearman's rho correlation analysis was conducted to account for the non-normal distribution of the variables. The analysis was performed in two stages: in the first stage, self-efficacy in mathematics was treated as a single variable, while in the second stage, it was disaggregated into its four subcategories.

The results indicated that performance in mathematical literacy exhibited a positive, statistically significant correlation with the single variable of self-efficacy in mathematics ($r=.400$, $p<.01$). This finding suggests that higher levels of self-reported self-efficacy in mathematics are associated with improved performance in mathematical literacy.

In the second stage of analysis, performance in mathematical literacy also showed positive, statistically significant correlations with the four subcategories of self-efficacy. The strongest correlation between the aforementioned variables and mathematical literacy performance is observed with self-efficacy in solving real-world problems ($r=.379$, $p<.01$).

Specifically, the correlations were as follows:

- self-efficacy in solving mathematical exercises/equations without a real-world context ($r=.338$, $p< .01$),
- self-efficacy in solving real-world problems ($r=.379$, $p<.01$),
- self-efficacy in the abilities of mathematically literate individuals ($r=.325$, $p<.01$), and
- self-efficacy in information literacy abilities ($r=.086$, $p<.01$).

These findings provide evidence supporting the research hypotheses.

4. Conclusion

The findings of this study provide a clear answer to the research questions, demonstrating a positive, statistically significant correlation between performance in mathematical literacy and the single variable of self-efficacy in mathematics. This conclusion aligns with the results of several prior studies and researchers (Hiller et al., 2022; Kalaycioğlu, 2015; Karakolidis et al., 2016a, 2016b; Lee, 2009; OECD, 2004, 2013; Pitsia et al., 2017).

The 16 propositions forming the self-efficacy in mathematics variable were further categorized into four distinct subcategories: a. Self-efficacy in solving mathematical exercises/equations without a real-world context, b. Self-efficacy in solving real-world problems, c. Self-efficacy in the abilities of mathematically literate individuals, and d. Self-efficacy in information literacy abilities. All four subcomponents were found to have positive, statistically significant correlations with mathematical literacy performance. Notably, the subcategory self-efficacy in solving real-world problems exhibited the strongest positive correlation with mathematical literacy performance compared to the other three subcomponents.

As an extension of this research, it is recommended to compare its findings with the corresponding results from the PISA 2022 programme.

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ME&MYCITY PROJECT AND ENTREPRENEURSHIP EDUCATION

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Abstract

12-year-old Finnish school children get familiar with working life by coming to work for one day in the Me&MyCity learning environment. The children practice financial, employment, and entrepreneurial skills in the miniature society of the Me&MyCity project. There are eleven Me & MyCity learning environments in Finland. The following video gives an idea of Me&MyCity: https://www.youtube.com/watch?v=9cenCiJ3gVI . The research object comprised 220 pupils. The schools are from Tampere and five municipalities around it. The study of this project: students' perceptions of entrepreneurship education in the Me&MyCity learning environment. The theoretical frame of reference is based on phenomenal learning, Kolb's (1984) experiential learning and the Finnish core curriculum 2016 for sixth graders. The study employs Strauss's grounded theory approach. The empirical material of the study was gathered using various information acquisition methods: interviews, questionnaires, recorded interviews, and field diaries based on observation. Conclusions: According to the research, pupils liked visiting Me&MyCity and working in the profession they had chosen.

Keywords: *National Finnish core curriculum 2016, working skills, phenomenon-based learning, entrepreneurship education.*

1. Introduction

Pirkanmaa has about 530,000 inhabitants, with the center of Tampere. It has about 250,000 inhabitants. The pupils learning environment Me&MyCity Pirkanmaa is placed in this frame of reference. Pirkanmaa needs more small and medium-sized companies and, above all, growth companies, because the high unemployment during the research period. According to the final report on entrepreneurship education, published by the European Commission (2013), Europe has not recovered from the economic downturn of 2008 in the desired time. As a medicine, the report proposes promoting and enhancing entrepreneurship education in schools and universities. At the heart of all this is European education and economic policy, which calls for the European Union to become the most competitive and dynamic knowledge-based economy in the world, capable of sustaining economic growth and creating new innovative jobs. (European Commission 2000.) Me&MyCity Pirkanmaa is in this frame of reference.

2. Me&MyCity Pirkanmaa

Me&MyCity is a learning entity for society, working life and entrepreneurship aimed at sixth grades of comprehensive school. The visit to Me&MyCity is preceded by a course of about 10 lessons and a complementary visit to the visual village of Me&MyCity. Me&MyCity day is led by educational material on economic issues based on the primary school curriculum. The teaching material covered the following issues: private and public services, job search, various companies, taxes, banking, financial accounting, advertising and customer service, and sustainable development. Me&MyCity operates in 13 locations and reaches 91% of sixth graders in Finland. Every school year, about 56,700 pupils visit Me&MyCity. The concept Me&MyCity is funded by the Ministry of Education and Culture, foundations, private partners, and municipalities.

The research of Me&MyCity Pirkanmaa has sixteen different business and public service premises as well as City Hall. The learner work in a mobile Me&MyCity built of cardboard elements for the day in the profession he/she has chosen.

3. Theoretical background of Me&MyCity

The research framework is based on the Finnish current primary school curricula (POPS 2016, see Figure 2). At the school level, the school principal leads curriculum work (See, Uljens et.la 2017). Curriculum work is guided by the Basic Education Act and Government Decree 422/2012. The principal in his or her own school implements the implementation of the curriculum.

Me&MyCity, on the other hand, has been studied quite a bit. Some theses about Me&MyCity have been done, for example, by Lindholm, (2017), and Ojala (2021) and Aura (2024) learning through play and storytelling supports students' role models and working life skills. Prof. Kalmi (2016) at the University of Vaasa has studied how Me&MyCity supports pupils' understanding of financial issues. According that the understanding of financial skills was significantly improved by 17% for those pupils who had participated this in Me&MyCity learning method. All t-values are statistically significant at 1% level. The result was obtained by measuring the pupils' knowledge level before and after visiting Me&MyCity learning environment.

In Finland, phenomenon learning, and its related concept multidisciplinary learning entity (See figure 2) were highlighted in the National Board of Education's curriculum in 2016. The multidisciplinary learning entity has been justified by, for example, motivation, creating a community culture and working life needs.

Kolb's (1984) experiential learning is seen as a circular cycle and includes unconscious and conscious understanding, as well as four related topics that emphasize learning in different ways. These four groups are direct personal experience, for example, brainstorming or a learning diary and critical contemplative observation can be used as a teaching method. In the abstract conceptual phase, theories and models structure personal experience, and teaching, group work, or reading can be used as teaching methods. The active model is an experimental activity model tested model and the knowledge is applied in practice through case studies, role-plays, exercises, and on-the-job learning. The phase of active activities can also take place in the form of a project, where the material to be studied is tested outside a formal learning situation. Kolb's cyclical learning model is suitable as a model for entrepreneurship education because it highlights learning to learn, the pupil's experiences and the uncertainty of experiences (Hakkarainen, Bollström-Huttunen, Pyysalo, & Lonka, 2005; Autio, 2006; Seikkula-Leino, 2007, 21)

Figure 1 shows the course of the study. First, in the class, 10 lessons are taught in economics according to the curriculum and then the things learned are practiced in a Me&MyCity.

Figure 1.

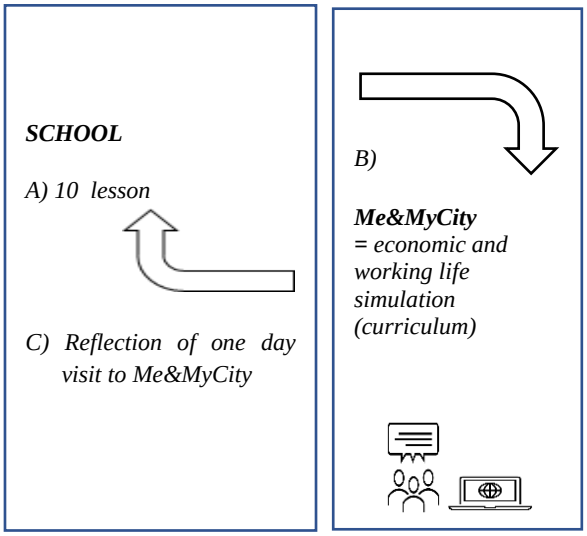
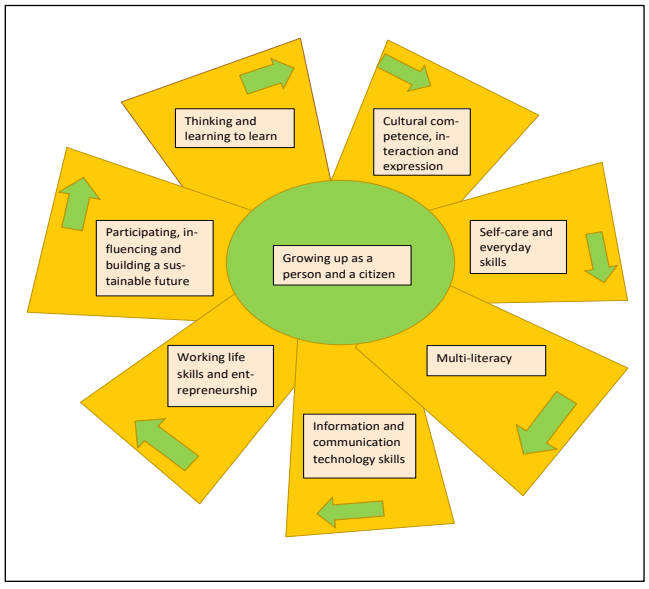


Figure 2. Extensive competence of the comprehensive school curriculum 2016 (Source adapted by Ojala 2021 based on POPS 2016, 20-24).



The curriculum is difficult to define at a general level because it depends on the perspective into seven different blocks. (Figure 2) Thinking and learning create the basis for the development of competence. A key role of the teacher is to encourage the learner to be self-confident and critical of knowledge and to guide the learner in independent knowledge acquisition and to encourage the learner to create new knowledge through play, experimental and playful practices, and teaching methods. Each learner is guided to identify their own way of learning and to develop their learning strategies so that they provide a basis for postgraduate study and lifelong learning (POPS2016).

4. Entrepreneurship education based on the pupil's need

Me&MyCity as a learning environment is understood here as a teaching method. The teaching method is the way of teaching and working. It activates and motivates the pupil. A successful teaching method depends on the level, motivation, and habits of the trainees. Increasing entrepreneurship in Europe was a key element of the Lisbon Strategy for Growth and Jobs (2001). Increasing the number of enterprises was also a key factor in developing the European Economic Area in the Europe 2020 strategy for growth and jobs (European Commission 2010a), which continued the work of the Lisbon Strategy. To increase the number of companies, the Entrepreneurship 2020 program was launched, one of the main pillars of which was entrepreneurship education (European Commission 2016). Today, the development of entrepreneurship education has gradually shifted away from a strictly business and management-focused towards a multidisciplinary approach that brings together different study programs, towards entrepreneurial education based on learner needs, holistic learning (cf. POPS 2016).

5. Research object

The research target is Me&MyCity Pirkanmaa, a total of 220 pupils are involved in the research. Five of the schools are in the vicinity of Tampere: Orivesi, Nokia, Ylöjärvi, Kangasala, Vesilahti and Pirkkala. The neighboring municipalities have been included because in Tampere the curriculum is made regionally and Me&MyCity Pirkanmaa includes schools in the neighboring municipalities. The research material was collected in 2013–2016 and the additional material in 2019-24. The additional material from 70 pupils has been collected immediately after the visit in Me&MyCity. In this way, the students' immediate experiences of visiting Me&MyCity were revealed.

5.1. Research task

How do students perceive Me&MyCity as a teaching method?

5.2. Research analyses

The present research is based on the work of Glaser and Strauss (1967) and is based on the Straussian orientation. The Straussian school enables the study problem to be studied existing bringing ready-made categories derived from theory into the analysis process (See Glaser & Strauss, 1967). The study first modifies qualitative data through meaningful, empirical indicators. This is called open coding. Glaser and Srauss (1967, 101– 102) call this a test of assumption. Axial coding his step can be called coding of pre-selected categories. Selective coding means the core categories are selected as a key phenomenon to which other categories can be associated. These core categories are, Me&MyCity as a teaching method and pupils' experiences of Me&MyCity. Theoretical sampling provides a continuous direction for research, as previous research and literature on the subject can be used in research. The relation of other categories to the core category is done through a paradigm: circumstances, context, strategies, and consequences (Strauss & Corbin, 1990, 124).

6. Pupils' experiences of Me&MyCity and conclusions

Pupils are growing up in a world where they are more concerned with knowledge. The work is based on working together and working in networks. This is precisely the wide-ranging competence that the primary school curriculum (2016) emphasizes. In the interview, the pupils first described the work. They got a real feel for working life in practice, e.g.,

“The computer equipment did not work at times”.

Everyone would like to visit again Me&MyCity and most would choose the same profession. Here Me&MyCity serves as a model for active and experimental activities. The model is tested, and the information is applied in practice through case studies, role-plays, exercises, and on-the-job learning. The active phase can also take place, for example, in the form of Me&MyCity learning environment, where the subject is tested outside the formal learning situation and the learned skills are practiced in practice. Pupils

wanted to go again to Me&MyCity and choose still the same profession. (Kolb1984) This deepens their learning experience.

"Nice taste of working life."

This also supports Kalmi's research, according to which learned financial matters practically closely, earned to save money even though virtual money did not work outside. They learned financial matters practically closely, earned to save money even though virtual money did not work outside. "*The virtual card was hard for it when I didn't know how much money was in the account*." (See Kalmi, 2016; Kolb, 1984,1998, 9-11; Hakkarainen, Bollström-Huttunen, Pyysalo, & Lonka, 2005; Hakkarainen, 2009; Autio, 2006; Lehkonen and Lehtonen, 2006, Leppilampi & Piekkari 1998, 9-11; Ojala, 2021).

7. Validity of the study

In this study, the study validity refers to the accuracy of scientific findings, which means the extent to which the conclusions are reliable and correspond to reality. Additional material (2019, and additional material whole Finland 2024) confirms the research results as well as an earlier parallel article (Kalmi 2016, Ojala 2021)The internal validity of the study is considered in relation to the study results. Internal validity can be improved by interviewing enough and for a sufficient period. This provides enough information about the phenomenon under study. The additional material (2019) was collected by a parallel researcher. The problem of conceptual validity can be reduced by the researcher's prior knowledge (more than 30 years of experience) of the context. (Strauss & Corbin, 1994, 280; Karila, 1997, 155) emphasize good knowledge of the research subject. There are few studies in the area (Kalmi, 2016). Instead, the researcher has more than 30 years of experience as a subject teacher. However, it should be noted that Me&MyCity learning environment is based on Finnish national curricula. This must be considered when considering the transfer-ability of Me&MyCity learning environment.

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VIDEO AND ACTIVE LEARNING: EXPLORING THE ROLE OF FILMS IN TRAINING FUTURE DANCE TEACHERS

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Abstract

The formal education of future dance teachers seeks to focus on practical techniques and methods that combine body control, performativity, and pedagogy dimensions (Huddy, & Stevens, 2011). Even in the more theoretical subjects, these students continue to seek the practical application of the disciplinary study material in their learning, once imagery use is an important part of the comprehension and assimilation of movements. The study reflects on the incorporation of different strategies for raising awareness of professional teaching identity in dance pedagogy, particularly the analysis and sharing of different points of view about teaching roles, teacher-student relations, and classroom management, which can also be fruitfully taken into account in broader educational contexts. For that purpose, this case study uses a qualitative, interpretive approach, and seeks to reflect on the use of cinematographic works as an active learning strategy, with a view to greater student involvement in theoretical learning purposes. From the context of a curricular unit of Psychopedagogy with different strategies, which includes, in addition to the traditional reading of documents, the insertion of educational videos and practical group activities and exercises, in which each student participates in a committed way, the use of fictional films was proposed as a powerful tool to engage students, and to promote their participation in dance-films debate. The films analyzed can function as a form of speculative educational fiction, and as an analysis of the symbolic and fictional role of films in the formation of pedagogical identities, that is, of becoming a teacher. The approach with active learning methods involving films positively achieves the objectives and results aimed at successful learning, and peer feedback reinforces students' self-regulation and self-knowledge regarding their levels of competence and capability perception. The discussion in the classroom, and the statements left by the students who participated as subjects in this case study, prove what the literature has stated, that active learning combined with recognizing the significance of the symbolic representation, improves the quality of learning (De Graaff, & Mierson, 2005).

Keywords: *Active learning, higher education, teacher identity, fictional films, dance teachers.*

1. Introduction

Student-centered learning necessitates the meaningful and contextualized use of diverse learning resources, including printed, digital, multimedia, and other forms of information. In the context of higher polytechnic education, there is a more pronounced focus on experiential practices that aim to prepare students for professional careers. Therefore, among the objectives of developing competencies in these students is also ensuring that such learning functions effectively not only within the classroom context but throughout their lives, through both technical and practical dimensions. In the specific context of dance education, this requires body control, performance, and pedagogy (Huddy & Stevens, 2011). This study examines the implementation of an active teaching method in the course Psychopedagogy I, part of the curriculum for the Master's in Dance Teaching offered by the Escola Superior de Dança (ESD) at the Instituto Politécnico de Lisboa. As stated in its statutes, ESD serves as a center for artistic, technical, scientific, cultural, and professional higher education, dedicated to preparing individuals for highly skilled professional activities in the field of dance, while also promoting the development of artistic activities and professions associated with dance. Consequently, the institution is committed to higher education in dance, adapting to educational, artistic, and professional changes, fostering the technical and aesthetic growth of dance in Portugal, encouraging academic reflection, and maintaining connections with both the national and international artistic community. Students at ESD undergo intensive training in dance techniques, choreographic creation, performance, and teaching methods, within a collaborative and well-equipped environment. The curriculum, integrated into professional artistic education, aims to prepare future dance

educators for qualified entry into the job market, with both academic and professional recognition. The goal is for these professionals to engage critically and innovatively in the art of dance, through rigorous technical training, the exploration of personal expression in choreographic creation, involvement in the performing arts as performers or in production roles, and by learning and experimenting with teaching methods suitable for different age groups, techniques, and objectives in each context. The understanding of their future teaching role is an integral part of the educational objectives. Thus, knowledge in education and teaching, along with pedagogical skills, is promoted to ensure the rational structuring of educational resources to be employed in the application of artistic teaching processes. This forms a critical foundation for the development of the curriculum in this field, contributing to the formation of educators capable of integrating knowledge into dance education. The aim of this study is to describe and explain an activity focused on the reflection of teaching professionalism: how one becomes a teacher through training, experience, and social recognition, ultimately constructing a teaching identity.

1.1. Active methods

Recent research highlights the pivotal role of educators in fostering pedagogical innovation through intentional and strategic planning, emphasizing a student-centered approach (Paniagua & Istance, 2018). Teachers are positioned as creative professionals, with their practices reflecting a pedagogical model that promotes active engagement and participation. A meta-analysis by Hattie (2015) identifies 105 factors influencing academic success, including self-efficacy, organizational skills, peer evaluation, and clarity. Teacher behaviors such as lesson preparation, fostering discussions, and promoting independent thinking are equally critical. Schneider and Preckel (2017) further emphasize that academic performance is enhanced by meaningful learning achieved through clear, relevant, and cognitively challenging instruction. Effective teaching practices involve meticulous course design, clear objectives, and robust feedback mechanisms. High-performing students exhibit self-efficacy, conscientiousness, and strategic learning application. These findings align with active learning methodologies, which prioritize student engagement in dialogical and collaborative activities that apply knowledge in novel, real-world contexts (Danver, 2016; Christersson & Staaf, 2019). Active learning fosters autonomy, experiential learning, and self-efficacy, benefiting diverse educational settings. Numerous studies advocate its integration across disciplines and levels of education (Beichner, 2014; Freeman et al., 2014; Langley & Guzey, 2014). Freeman et al. (2014) confirm that active learning improves exam performance, elevates grades, and reduces failure rates—traditional classes demonstrate a 55% higher failure rate compared to those employing active strategies. These approaches support collaborative knowledge creation and goal-oriented learning, underscoring the transformative impact of active learning on educational outcomes.

1.2. Teacher films and pedagogy

Films have been used as a pedagogical strategy for teaching various subjects, notably having a positive effect on language learning outcomes (Ismail, 2017; Jalmav, 2022); in raising awareness about pre-existing beliefs or models about teachers (McCullick, et al., 2003; Dalton, 2010; Barbero Gonzalez, 2017); or even to explore social perceptions, positive or negative, about the teaching profession, allowing the relationships between teacher-student or between teachers and the education system to be addressed (Van Beveren, et al., 2018). These uses of films as triggers for discussion and reflection in teacher training are very fruitful, as they provide the opportunity, through a universal language, to discuss complex, sensitive and (inter)personal aspects of teaching among students who are also future students. teachers, exploring the relationship and recognizing the identification between the characters and the spectator's lives (Moraes, 1998). A previous study revealed that a combination of films about teachers, an interpretative framework and structured reflection potentiates change in future teachers' beliefs about teaching, allowing them to mitigate unrealistic expectations regarding their performance after training (Delamarter, 2015). In this sense, and as Calles (2018, p. 245) points out, “examining cinematographic works that deal with the different identities assumed by the figure of the teacher in school situations of formal education, allows us to determine how these subjects experience the experience of life and acting teaching professional”. In synthesis, films about teachers allow us to establish meanings and standards of action, verifying the complexity of the processes and social mechanisms in which these professionals are inserted.

2. Methods

This study explores future dance teachers' perceptions of the teacher's social role and the importance of reflection and professional development, adopting a qualitative, interpretative approach. Cinematic works were used as an active learning strategy to enhance engagement with theoretical objectives, offering meaningful educational experiences. Conducted within the Psychopedagogy I course, the study integrated traditional academic practices with multimodal methods, such as educational videos,

group activities, and practical exercises, fostering active student participation and reflection. A key strategy involved analyzing fictional films featuring teacher protagonists, stimulating debates on teaching identities and relational school processes. Students independently analyzed films, connected them to their learning, and presented their reflections in classroom discussions guided by critical questions. Reflective reports captured their perceptions of symbolic representations and their influence on understanding the teaching role. Data were collected through observations, discussions, and reflective reports, analyzed using content analysis to identify categories like (1) the symbolic portrayal of teachers in films, (2) teaching identity formation, and (3) the impact of active methodologies on self-regulated learning. Triangulation of methods ensured validity, highlighting the potential of films as speculative educational tools.

3. Results

The results derived from the qualitative analysis of the activities conducted by the students participating in the study are presented. The methodology involved prior reading of the chapter "The Teaching Profession in Cinema: Teaching Identities in the Teacher Movies Genre (Films about Teachers)" by Calles (2018), followed by the selection and analysis of a film relevant to the topic. As outlined, students had previously viewed the films they selected and engaged in discussions where they addressed the following guiding questions:

- How is teaching identity constructed in the film?
- How does the teacher present themselves in their relationship with students and the school community?
- What additional issues are raised in the chosen film in particular?

Students were instructed to identify the film, director, and year of production, and, where possible, provide a link to the trailer. After preparing their responses, each participant reviewed the contributions of their peers, facilitating collective and in-depth feedback in the subsequent session. This approach aimed to foster critical and collaborative reflection on the symbolic and pedagogical representations presented in the films, as well as their connection to teaching practices. A table summarizing all these results is presented.

Table 1. Synthesis of student reflections on the construction of teaching identity in films.

Film Title	Student's reflexion about Teacher's Identity
Monsieur Lazhar (2011)	The film constructs the figure of the teacher as someone with life experience but without formal qualifications, who uses empathy and personal experience to emotionally support the students. The teacher's identity is defined by their adaptability and their role in helping to resolve emotional traumas, such as the mourning of the previous teacher.
The Boy Who Harnessed the Wind (2019)	The figure of the teacher is built around resilience, dedication, and encouragement of innovation. The teacher believes in the potential of their students and invests in the development of critical thinking, even in the face of material challenges.
Leo (2023)	Leo, a lizard, assumes an informal educational role, influencing students through stories and advice. His educator identity is constructed through the ability to teach via playful experiences and teachings.
The Substitute (2011)	Henry Barthes is a substitute teacher who initially keeps an emotional distance but soon becomes deeply involved in the students' lives. His teacher identity is constructed through empathy and the desire to help students overcome personal traumas and difficulties.
The Substitute (2022)	Lúcio's teacher identity is characterized by empathy and understanding. Despite facing his own personal issues, he takes responsibility for making a difference in his students' lives, particularly in a context of violence and poverty.
Freedom Writers (2007)	Erin Gruwell redefines her teacher identity by adapting to the emotional and social needs of her students, rather than following traditional methods. She strives to understand the students' life stories and uses this to build a learning environment based on respect and trust.
Billy Elliot (2000)	Mrs. Wilkinson, the ballet teacher, builds her identity as an inspiring educator who sees Billy's potential and encourages him to pursue his dreams. She acts as a mentor, helping him explore his abilities and fight for his future.
Good Will Hunting (1997)	Professor Gerald Lambeau builds his identity by recognizing the potential in Will, a rebellious and self-taught young man. He looks beyond Will's challenging actions and understands that his role is not only to teach but also to emotionally support the student, helping him overcome his traumas and reach his potential.
The Miracle Worker (1962)	Anne Sullivan constructs her identity through a deep commitment to teaching Helen Keller, who is deaf and blind. The film highlights her persistence, patience, and pedagogical competence, especially in a context of extreme difficulty. Sullivan is not just a teacher but an emotional and supportive figure crucial for Helen's development.
Dead Poets Society (1989)	Professor John Keating represents a break from traditional teaching. His innovative and charismatic approach challenges the rigid system of an elitist school, encouraging students to

	think critically and express themselves freely. He teaches not just literature, but about the importance of living fully with the philosophy "Carpe Diem."
Les Choristes (2004)	Professor Mathieu views education as a tool for personal and emotional transformation. Through music, he provides a means of expression for troubled students, creating an emotional bond with them and awakening their creative potential.
Whiplash (2014)	Professor Terence Fletcher is an unrelenting and demanding instructor who seeks to extract the utmost from his students, often employing questionable methods. His teacher identity is shaped by an incessant pursuit of perfection and creating constant pressure on students.
Battle of the Year (2013)	Coach Jason Blake assumes a leadership and mentoring role, seeking to teach not only dance techniques but also to unite and motivate his team of dancers. He demonstrates commitment to each team member's personal development.
The Wave (2008)	Professor Rainer Wenger begins with a conventional teacher identity, but his transformation into an authoritarian leader throughout the experience with his students reveals how the manipulation of power and group pressure can distort the educator's role.
To Sir, with Love (1967)	Professor Mark Thackeray, initially unprepared and disheartened, finds his teaching identity by applying respectful and firm methods with his troubled students. His approach centers on mutual respect and creating a healthy school environment focused on emotional and social development.
Coach Carter (2005)	Coach Ken Carter adopts an authoritative position, but simultaneously acts as a mentor and guide for his players, teaching them valuable life lessons beyond basketball. His educator identity is marked by values of responsibility, discipline, and commitment to the students' futures.

4. Discussion

The findings of this research indicate that the incorporation of films as an active learning strategy significantly contributes to the achievement of the pedagogical objectives set forth. Classroom discussions and student testimonies substantiate the conclusions of De Graaff & Mierson (2005), who assert that active methodologies, when coupled with the recognition of symbolic representations, foster deeper and more qualitative learning experiences. Furthermore, peer feedback emerges as a pivotal tool for enhancing students' self-regulation and self-awareness, enabling them to better assess their skills and capabilities. The films analyzed provide distinct portrayals of the educator's role as a leader and agent of transformation. Teaching identity is explored from various angles, with each teacher, in their own manner, striving to profoundly and meaningfully impact their students. Moreover, several of the films selected by students illustrate the positive influence of educators who dedicate themselves to the holistic development of their students, addressing not only academic growth but also emotional and social aspects. These educators assist students in overcoming personal obstacles and envisioning a more promising future, underscoring the critical role of education in both social and individual transformation. Thus, the majority of the examples presented here highlight that teaching identity transcends the mere transmission of curricular content, encompassing issues of leadership, responsibility, resistance, and transformation, aligning this finding with previous research (Calles, 2018). In all the works analyzed, teachers are depicted not only as conveyors of knowledge but as agents of emotional and social change. They assume indispensable roles in helping students surmount personal challenges, explore novel ways of thinking, and cultivate a deeper understanding of their responsibilities and interpersonal relationships.

5. Conclusions

The films analyzed demonstrate that teaching identity is constructed in a multifaceted way, through persistence, empathy and innovation, and that the relationship with students, built on trust and respect, is crucial for the positive impact of education. The films illustrate that teacher-student relationships are shaped by trust, empathy and adaptation to students' needs, highlighting the importance of educational strategies that promote intellectual and emotional development. Educators face difficulties such as a lack of resources or formal qualifications but, as this example demonstrates, these can be overcome by their dedication and ability to inspire significant changes in students' lives, reflecting the effectiveness of the pedagogical approach that combines empathy, commitment and innovation. Studies like this, although specific, demonstrate how active methods are essential. Discussion based on teachers' movies, particularly, as a pedagogical strategy, proves to have merit in the future of dance teachers. This study contributes to a better understanding of the transformative role of education, offering a view on how active methodologies, by integrating fictional elements, can enrich pedagogical training and promote a broader reflection on educational practices.

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DEFINING AND MEASURING STUDENT LEARNING

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Abstract

A foundational purpose of education is to enhance student learning. However, to accomplish this goal effectively requires agreeing on how to define and measure student learning. In the United States, and many other countries, the education systems' formal assessments are infrequent large scale achievement tests. These tests function as program evaluation measures. Classroom teachers characteristically use idiosyncratic informal assessments to gauge the effectiveness of their instruction and evaluate student progress. This article shares a more precise and standard classroom-based learning measurement process that better informs decision making and thus supports equitable individualized education.

Keywords: *Educational measurement, student learning, equity, individualizing.*

1. Introduction

A foundational purpose of education is to enhance student learning. However, to accomplish this goal effectively requires agreeing on how to define and measure student learning. In the United States, and many other countries, the education systems' formal assessments are infrequent large scale achievement tests. These tests function as program evaluation measures. Classroom teachers characteristically use idiosyncratic informal assessments to gauge the effectiveness of their instruction and evaluate student progress. However, there is a need for more precise and standard classroom-based learning measurement to better inform decision making and thus support equitable individualized education.

As a discipline improves in scientific rigor, it more successfully accumulates knowledge. A hallmark of this progress is the standardization and precision in the discipline's measurement units, procedures, display and analysis systems. To enable education to become more effective it is important that we adopt a standard and more precise learning measurement system.

2. Frequency – Our most sensitive performance measure

Performance **always** involves a number of responses and **always** occurs over time. Consequently, both number and time are essential parts of a performance measure. The scientific term for events per unit of time is frequency. Frequency is the most sensitive measure of student performance because it provides information that is the most *complete* (i.e., includes both number of responses and duration of time) and *direct* (i.e., quantifies what we see and hear students do). This is in contrast to other commonly used education measures: *derived scores* (e.g., % correct, achievement test scores) or *inferred scores* (e.g., rating and rubric scales).

As education strives to become more scientific and thus accountable it is useful to note that frequency (events/time) is a universal measure across all sciences (e.g., cycles/second, planetary revolutions/year). Thus, using frequency as our base student performance measure aligns us with the broader scientific community.

3. Mastery

"I can tell when I hit mastery, and it feels good." Colin, 2nd Grade

Learning involves progressing from non-mastery to mastery. This requires that we agree on what constitutes masterful performance. *If we don't know where we are aiming, we are aimless.* Mastery delineates the skills/knowledge we wish to be part of a student's memory - as 3rd grader Melody says, "Memory means it is stuck in our head." Of course, in our internet and artificial intelligence (AI) era, there is less information we need to store in our heads. Parenthetically, being sophisticated and discerning

information consumers is an important area of mastery. Yet, we do need to maintain a certain breadth of knowledge in our memory in order to communicate, solve problems and create. It is important to continuously reevaluate the skills/knowledge students should "*master" versus "be aware of" versus "disregard*." (In accommodating individual needs this will vary within and across students.)

Accepting that frequency is our most sensitive performance measure it follows that mastery is defined in terms of responses per unit of time. For example, if persons are not limited by developmental, environmental or physiological constraints they achieve masterful performance such as the following:

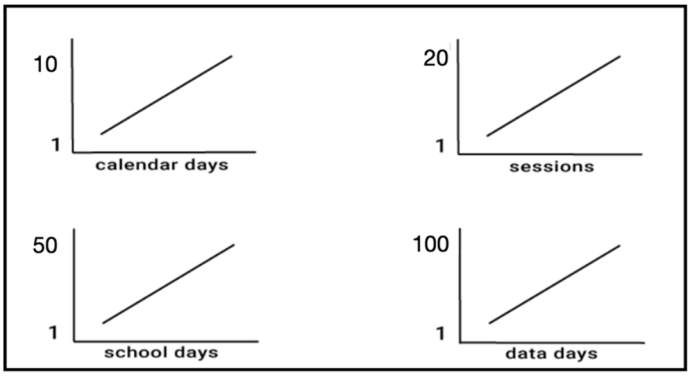
Walking – 120^{+} - 100 correct steps per minute
Oral Reading – 250^{+} - 150 correct words per minute (European-based languages)
Keyboarding (composition) – 60^{+} – 40 correct words per minute (European-based languages)
(See Starlin, 2022, pp. 231-241 for detailed summary of mastery standards.)

4. Measuring and displaying learning

The visual display of quantitative information is generally preferred by the consumer (Tufte, 1997). The visual display and analysis of learning data is more efficient and accurate if the graphic system meets the following criteria: (Kubina, et al, 2023).

1. Remains standard. Measurement standardization is a hallmark of science which facilitates accurate and efficient communication. However, the popular spreadsheet program Excel violates this principle by adjusting graphic scales to fit the data. As a result, we get pictures as shown in Figure 1.

Figure 1. Altering graphic axes based on differences in data elements.



2. Real time scale. In order to view learning, we must have a successive real time scale. The common practice of using sessions to represent the time dimension violates this requirement since we cannot *visually* determine the amount of time within or between sessions.
3. Frequency multiply scale. Using frequency as our base performance measure requires that learning is represented by a change in frequency over time. By using a multiply scale, rather than the commonly used add scale, we can view and quantify the rapidity of learning. In Figure 2 (from Starlin, 2022, p. 31), we see the change from 1/minute to 21/minute compared to a change from 60/minute to 80/minute on an "add scale" versus a "multiply scale." Note on the add scale the visual representation is the same because both change by +20. However, on the multiply scale from 1/minute to 21/minute represents a change of $x20^{+}$ while from 60/minute to 80/minute equals a change of x1.3.

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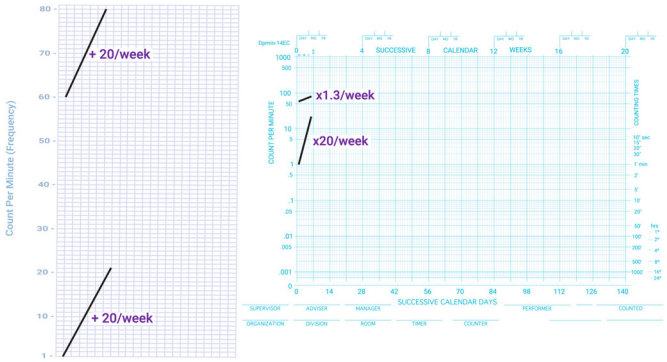
Figure 2. Comparing performance frequencies plotted on an add scale versus a multiply scale.



Add Scale Multiply Scale

The multiply chart represented in Figure 2 is a Standard Learning Chart (technical name Standard Celeration Chart) and has been in use since 1967 (Kunzelmann, et al, 1970, Kubina & Yurich, 2012, Starlin, 2022). Due to the standardization of the horizontal axis as successive calendar days and the vertical axis as a frequency (i.e., count/minute) multiply scale, we can actually quantify learning as a multiplying function (e.g., x2/week improvement in correct performance) or a dividing function (e.g., ÷ 1.5/week improvement in incorrect performance).

5. Student involvement in the learning process

Because learning is dynamic, frequent measurements are necessary versus the more common static performance test measures. It requires from 5 – 11 data points to establish an accurate trend (learning) line. (Koenig, 1972). This is accomplished by collecting short performance samples, ideally on a daily basis. It is not possible for a classroom teacher to manage this volume of data across multiple students and/or curriculum areas. The solution is to teach students how to chart and participate in monitoring their own learning. (Bates & Bates, 1971, Maloney, 1982).

We can reinforce democratic values, by supporting students' involvement in their education. A significant portion of this participation should include monitoring and recording their learning progress. Such involvement stimulates comments such as the following:

"I am doing better than I was. I thought you'd like to know." – Chris
"My chart is going down! (Help!) I don't know why!" – Shelli
"Please look at my chart. I don't think I'm ready for this skill." – Debbie
"I think I need to do something a little harder." – Mary (Sokolove, 1978)

Students may use paper charts available from the Behavior Research Company or make use of digital charting software. (See resources at the end of the reference section). Note: Although students may practice individually, in pairs or groups and measure and chart their learning it is important that teachers create a validation process that confirms achievement of desired benchmarks.

6. Educational equity (individualizing)

"If we wish to give persons equal opportunity, we must treat them all differently." Author Unknown

Educational equity means **learning equity** not **achievement equity**. This re-emphasizes the need for a sensitive learning measurement system to facilitate individualized/differentiated instruction. Most educators would embrace individualized programming with a focus on learning versus achievement. Yet the demands of high stakes achievement testing and the requirement to cover grade level curriculum (regardless of the mastery of previous skills) thwart our efforts. The state of Massachusetts is highly ranked in US measures of educational excellence. Yet the following comments from Massachusetts teachers, highlights the systemic roadblocks that prevent accommodating individual needs.

> ". . . students are being taught grade level standards even though they do not have the requisite knowledge or skills. It is so frustrating for both students and teachers! This exposure approach is just not working for anyone!" *3rd Grade Teacher*
>
> I have begged that we throw out the "scope and sequence" that we must follow and take time to build a solid base for the struggling math students. The response is that we must stay on task with scope and sequence and teach only grade level content." *5th Grade Teacher*

> ". . . in my school where classrooms are highly diverse, and I would say most students are not performing at grade level. We are told to only teach grade level content and keep going, despite the fact that students are not demonstrating understanding. It is purely exposure. As a teacher, it feels, so, so wrong." *Elem ESL Teacher*
>
> "As teachers, many of us I think want to push into curriculum that helps prepare students for the adult world; however, due to standardize testing and state mandates teachers are stuck teaching their grade level material." *Middle School Teacher*
>
> "The students get frustrated because being able to move on to the next level either doesn't happen or they move ahead and are totally lost. Then the behavioral aspect sets in. Every day the same students give up very easily, disrupt the class, act up, and by the time we get them settled, class is over." *High School Teacher* (Starlin, 2024)

Requiring same age peers "learn" (be exposed to) the same content at the same time is at the heart of educational inequity. Note: The term "achievement gap" used in the United States buys into the notion that all same age peers should be "performing at grade level."

Practices such as: Universal Design for Learning (UDL), looping, cross age groupings, grouping by level of skill competence, co-teaching and reasonable class sizes can all facilitate individualized practice. However, to achieve equity and accommodate the diversity of learners we must place each student at developmentally appropriate skill levels and adjust programs based on their **learning** progress.

7. Conclusion

Agreeing on how to define and measure learning is fundamental to educational equity. In order to ensure students are learning we need to monitor learning and make adjustments in their educational programs when learning is inadequate. Such an individualized focus champions *learning equity*. Not all students will learn the same amount of content at the same time at the same age, but we can strive for comparable learning at each student's developmental level.

In the US context, and in many other parts of the world, what will allow equitable individualized education based on learning progress is a deemphasis on high stakes achievement tests. These tests maintain the system that requires **same** age peers be exposed to the **same** content at the **same** age (i.e., grade level scope and sequence). This will require policy changes at state, and at many countries' national levels, such as the following:

1. Define learning as the process of moving from non-mastery to mastery.
2. Define standard mastery ranges for desired skills in terms of frequency (responses/time) analogous to medical *standard health indicator ranges*. (See Starlin, 2022, pp. 231-241).
3. Use the standard mastery ranges to decide when a student is competent to move on to higher level content versus when a unit is completed or the student changes grade level.
4. Replace high stakes achievement testing with precise, standard classroom-based learning measures which can be aggregated across various educational levels as program evaluation measures.

Public schools are the only option available for the less privileged in society. We continue to face challenges in creating public school systems that address the needs of all students. Yet to bolster equitable and democratic societies we need to continue to strive for robust public-school systems that adjust student programs based on a precise, standard measure of learning.

Resources

AimStar Pro Charting Software - Xcelerate Innovations
https://apps.apple.com/us/app/aimstar-pro/id1580401923

Behavior Research Company
Provides paper copies of the Standard Celeration Chart and other related products and publications.
https://www.behaviorresearchcompany.com

Fluency Project
Provides information and publications relating to Precision Teaching, masterful performance/behavioral fluency.
https://www.fluency.org

Heart the Chart Video Segments featuring Clay Starlin
1. Educational Units of Measurement, 2. The Standard Learning Chart, 3. Selecting Describing & Organizing Skills, 4. Mastery, 5. Tools for Measurement
https://www.youtube.com/c/HearttheChart/videos

Precision X Charting Software - Central Reach
https://centralreach.com/products/precisionx/

Standard Celeration Society
Organization that supports use of the Standard Celeration Chart and technology.
https://www.celeration.org

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STRENGTHENING TRADITIONAL FAMILY VALUES THROUGH EDUCATIONAL TOURISM: THE EXAMPLE OF "KARINA HOME" GUESTHOUSE

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Abstract

Considering the changes in modern society and the global challenges affecting family structure, relationships, and values, the issue of preserving and strengthening traditional family values has become increasingly relevant. It is especially important to explore new approaches that would help strengthen family bonds and relationships, promoting an understanding of the foundations of society and core values. One potential solution to this problem is educational tourism, which offers the opportunity to combine elements of education and tourism, enhancing family relationships as well as the preservation of culture and values. This study explores the potential of educational tourism in strengthening family values, using the example of the "Karina Home" guesthouse. It employs both qualitative and quantitative research methods to obtain a comprehensive and deep understanding of the phenomenon being studied, utilizing theoretical literature and empirical practical data collection through surveys to draw well-founded conclusions. Educational tourism is a specific type of tourism that provides visitors with the opportunity to acquire new knowledge, experience new things, and develop emotional and social skills. The "Karina Home" guesthouse offers various educational activities, including master classes, workshops, and creative activities that promote family bonding and support child development. The aim of the study is to analyze how educational tourism can contribute to strengthening family values, improving family relationships, and promoting positive changes in the preservation of societal values, using the example of "Karina Home." The study is based on the analysis of theoretical literature and the examination of practical examples, offering a new perspective on the role of educational tourism in rural Latvia and contributing to the development of this type of tourism as a means of preserving and strengthening family values.

Keywords: *Educational tourism, family values, child development.*

1. Introduction

In modern society, family values have become an important component of public life, promoting healthy and stable relationships not only within the family but also in a broader social context. Traditional family values, such as respect, responsibility, and love, serve as the foundation for the development of societal norms and can significantly impact the development of children and young people. In this context, educational tourism, which offers the opportunity to combine educational activities with relaxation and leisure, becomes an effective tool for promoting the preservation and strengthening of these values (Lundberg, Lexhagen & Ziakas, 2024). Educational tourism not only helps children acquire historical and cultural knowledge but also develops their social skills and emotional intelligence (Abubakar, Shneikat, & Oday, 2014).

Such educational tourism activities enhance children's understanding of societal values, culture, and traditions, which are essential for them to preserve and develop these values within their families in the future (Chau, 2021; Maziliauske, 2024). Educational programs help families acquire new knowledge, strengthen relationships, and create long-lasting memories that promote family identity. They also contribute to the preservation of local identity (Lundberg, Lexhagen, & Ziakas, 2024).

The "Karina Home" guesthouse in Latvia is an example of how educational tourism can serve as a platform for strengthening family values. The guesthouse offers a wide range of services, which include not only traditional event organization options but also educational and entertaining masterclasses, creative workshops, concerts, and psychological training sessions tailored to families with diverse needs.

The publication will explore how the example of the "Karina Home" guesthouse can serve as a positive model for strengthening family values through educational tourism, as well as how such activities contribute to the dynamics of family relationships and the preservation of societal values.

The novelty of the study lies in the concept of educational tourism and its practical applications, especially in the context of strengthening family values. Although educational tourism is relatively underdeveloped in Latvia, this study offers a new approach by examining how the "Karina Home" guesthouse uses this form of tourism to strengthen family relationships. The study analyzes the role of educational tourism activities in improving family relationship dynamics, offering practical examples of how educational events and guest interaction can influence the preservation and enhancement of societal values. This research provides a new perspective on educational tourism as a tool not only for the educational process but also for strengthening family values and promoting the sustainable development of society.

The aim of the study is to empirically explore, assess, and validate the impact of educational tourism on strengthening traditional family values, using the "Karina Home" guesthouse as a case study. The research will analyze the educational activities offered by the guesthouse and their impact on family relationship dynamics, child development, and the social and emotional skills of family members. The study addresses the following questions: How does educational tourism at the "Karina Home" guesthouse promote the strengthening of traditional family values, and how do these activities help preserve local culture, traditions, and family values for future generations? What practical measures does "Karina Home" implement to strengthen family bonds and encourage the development of positive relationships? How does visitors' participation in educational workshops, masterclasses, and events affect family relationship dynamics?

2. Literature review

Family values form the foundation of social relationships and individual growth, influencing family interactions, priorities, and norms (Bengtson, 2016; Cherlin, 2010; Olson, 2000). Passed down through generations, they provide stability for family relationships and societal connection, fostering emotional well-being and societal integration (Collins, 2009). For children's development, family values are crucial, teaching empathy, respect, and conflict resolution, which lead to stable relationships (Lamb, 2004; Delyana & Mudjiran, 2020; Harris, 1998; Maccoby, 1998). Strong emotional bonds in families help children regulate emotions and address the emotions and needs of others (Delyana & Mudjiran, 2020).

Both parents play vital roles in child development: fathers promote self-control and decision-making, while mothers provide emotional support and nurture empathy. Together, they create a balanced environment essential for emotional stability and social development (Friedman, 2024; Delyana & Mudjiran, 2020; Doherty, 2019).

Families that emphasize balanced power distribution tend to form stable, harmonious relationships (Lammers et al. 2012; Popenoe 2017). Wilcox and Wolfinger (2016) highlight that children raised in stable marriages, supported by societies that promote marital stability, religious activity, and clear gender roles, experience better emotional and social development, leading to healthier relationships and improved educational outcomes (Lammers et al., 2012; Popenoe, 2017; Wilcox and Wolfinger (2016). Clear gender roles in traditional families influence children's understanding of relationships, shaping their behavior and social interactions (Lamb, 2004). The quality of family relationships is key to both children's well-being and societal welfare (Friedman, 2024; Lamb, 2004; Popenoe, 2017, Amato, 2001). Culture and religion significantly influence the formation of family values, linking them to specific norms regarding family structure and role distribution. Traditional family values, particularly within Christianity, emphasize marriage and family as foundations of social stability, with many societies asserting shared leadership between man and woman (Wilcox & Wolfinger, 2016; McGrath, 2024). However, globalization and shifting norms increasingly challenge these beliefs (Friedman, 2024). Traditional Christian values play a critical role in shaping spiritual life, family structures, and ethical norms, ensuring emotional security and social stability (McGrath, 2024; Plakans, 2024).

Table 1. Potential Benefits of Strengthening Family Values Through Educational Tourism.

Aspect	Opinions/Impact	References
Improvement of Family Relationships	Educational tourism helps improve family relationships by fostering emotional connection and better communication. In families where love, respect, responsibility, and cooperation are emphasized, positive self-esteem, emotional stability, and social skills are developed.	Harris, 1998; Lamb, 2004; Maccoby, 1998; Abubakar, Shneikat, & Oday, 2014.
Development of Social and Emotional Skills	Children and adolescents develop social and emotional skills that promote better collaboration within the family and society. Families based on strong values provide a secure environment for children's emotional and social development.	Friedman, 2024; Widawski, Krzemińska, Zaręba & Dzikowska, 2023.

Aspect	Opinions/Impact	References
Preservation of Traditions and Values	Families gain an understanding of local traditions, strengthening their identity and promoting the preservation of cultural heritage. Traditional family structures with clearly defined gender roles help create a stable social order.	Friedman, 2024; Popenoe, 2017; Maziliauske, 2024.
Positive Impact on Societal Values	Educational tourism strengthens societal values by fostering more unified communities and cultural cohesion. A balanced distribution of power within families promotes respectful relationships and harmony.	Lammers, Galinsky, Gordijn, & Otten, 2012; Maziliauske, 2024
Development and Sustainability of Local Communities	Tourism promotes the local economy and culture, supporting community development and social capital. The father's role influences children's self-control and responsibility, while the mother's role fosters empathy and emotional support.	Friedman, 2024; Harris, 1998; Zaleckienė & Turčinskaitė, 2019 Lundberg, Lexhagen & Ziakas 2024.

Table 1 outlines the impact of educational tourism on family values, highlighting its benefits in enhancing family relationships, social and emotional skills, and preserving traditional values. This fosters individual and societal well-being, strengthening family structures, social cohesion, and community development.

3. Methodology

The study used a qualitative research strategy to gather insights (Sakoda & Takahashi, 2014). The questionnaire consisted of 13 questions aimed at examining family structures, the frequency of participation in educational tourism activities, and the impact of these activities on family relationships and child development. The survey questions were designed using a Likert scale, which allowed for the assessment of participants' attitudes and experiences regarding the quality of family relationships and the impact of educational activities. The study participants were 123 families who took part in educational tourism activities at the "Karina Home" guesthouse. Respondents were selected randomly, but the selection process ensured representation of families with different structures (family size and composition). The most common family structure was "parents and children," with the average family size being 4–5 people. Completing the survey took approximately 10–15 minutes.

Quantitative data were processed and analyzed using calculations of the mean and standard deviations. Additionally, factor analysis was conducted to identify the key factors influencing family relationship dynamics and values.

4. Study results

The quantitative phase of the study involved the participation of 123 families in a survey to assess the impact of educational tourism on family relationships and changes in values. The survey included questions about relationship dynamics, emotional connection, and understanding of family values before and after tourism activities. The majority of respondents were parents aged 30–45, indicating an interest in strengthening family values and children's development. Gender can influence relationship dynamics, as men and women may perceive family values differently and choose different activities. For example, women are more likely to participate in emotional activities, while men tend to engage in practical events.

Each family highly values time spent together. The average ratings range from 4.5 to 5.0, indicating a positive perception of family time and cooperation. The average value is also high at 4.7, suggesting that most families view time spent together very positively. The standard deviations are relatively low, at 0.8, indicating that responses were consistent across families with little variation from the mean. This suggests a common belief that time spent together is beneficial for strengthening family bonds.

Regarding educational benefits, the average ratings range from 4.0 to 4.8, suggesting that families generally regard education as important, though there are still some small differences. The average value is 4.3, indicating that families overall consider education an essential family value. The standard deviations are relatively low at 0.6, indicating that responses were mostly similar and that families shared a common approach regarding the importance of education.

Educational tourism events help strengthen family relationships, with the most common response being "Yes, it helps a lot." The average ratings range from 4.2 to 5.0, suggesting that most families are very satisfied with the impact of tourism activities on their relationships. The average value is 4.6, indicating that families consider such events very useful for strengthening relationships. The standard deviation is 0.7, which is relatively low and indicates consensus in the families' feedback on this topic.

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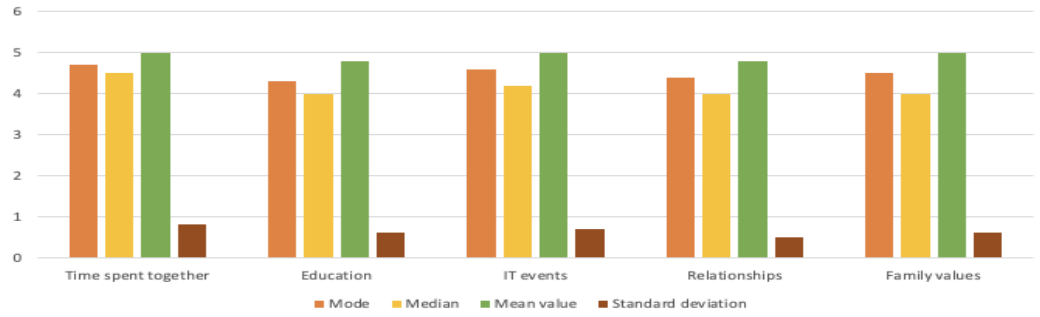
Figure 1. Strengthening Traditional Family Values through Educational Tourism.



The most common responses show that families highly value the time spent together and education. The average values are high, indicating a positive opinion regarding family time, education, and tourism activities. The standard deviations are low, indicating a high degree of agreement in the responses.

Factor Loading Matrix: This shows how strongly each original variable is associated with each factor. A high loading (e.g., above 0.4 or 0.5) indicates that the variable strongly influences the factor.

In the factor loading matrix, the key idea is to identify which variables are closely related to each factor. For example, you might find that "family time" and "emotional connection" load highly on one factor, while "education" and "learning experience" load on another. By analyzing these loadings, you can better understand the underlying structure of the data and the main dimensions influencing family dynamics in the context of educational tourism. This analysis helps reveal the key factors that contribute to the overall perceptions of educational tourism's impact on family relationships and values.

Table 2. Factor Analysis.

Variable	Communication	Emotional Connection
Quality of communication	0.85	0.30
The quality of time spent together	0.80	0.35
The quality of cooperation	0.70	0.25
The quality of love and respect	0.45	0.90

Factor coefficients and weight coefficients**:** These coefficients indicate the extent to which each factor influences the data. Higher values suggest a greater impact of the respective factor on the overall structure of the data. Additionally, factor analysis aids in determining the number of factors required to fully account for the variation within the dataset. The majority of families participating in the study comprised 4–5 members, predominantly consisting of parents and children. The respondents identified love, respect, and cooperation as the core values most emphasized within their families. A significant portion of participants reported that educational activities contributed positively to the enhancement of family relationships and supported the development of children. Workshops and master classes were the most frequently selected activities, with respondents deeming them most effective in strengthening familial bonds. More than 80% of the participants indicated a willingness to recommend the "Karina Home" guesthouse to other families seeking to foster stronger relationships and traditional values. The findings generally suggest that these activities have a beneficial influence on family dynamics, promoting both the development of children and the preservation of family values. The primary values emphasized by the families—namely love, respect, and cooperation—were found to contribute to the cultivation of a positive familial environment. Over 80% of respondents expressed satisfaction with their participation in the educational activities, reporting that the events had a measurable positive impact on their family relationships. Furthermore, respondents highlighted the value of time spent together and the master classes in fostering stronger family connections. There was also a noted desire for more customized activities tailored to the specific developmental needs of children at varying ages.

5. Conclusions

The study highlights the significant positive impact of educational tourism on family relationships and values. Data from 123 families at "Karina Home" guesthouse revealed that activities like workshops and master classes strengthened family bonds and enhanced communication, emotional connection, and overall dynamics. Over 80% of participants reported a positive impact, particularly regarding children's development and shared family experiences.

The research further suggests the potential for personalized activities catering to different developmental stages, especially for children, which could enhance the educational tourism experience. Families emphasized values like love, respect, and cooperation, and over 80% believed that educational tourism helps preserve traditional family values.

In conclusion, educational tourism plays a key role in fostering family cohesion, promoting children's growth, and reinforcing traditional values. The study recommends continuing to develop educational tourism offerings, with attention to different age groups and gender inclusivity. These activities are valuable tools for improving family life and well-being, making them a worthwhile investment for family-focused tourism.

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EXPLORING SEXUALITY IN EDUCATIONAL AND TEACHING DEGREE PROGRAMS

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Abstract

Comprehensive Sexuality Education (CSE) is a lifelong learning process that begins in early childhood. International literature and guidelines emphasize the necessity of CSE in the school environment, highlighting educational and teaching staff training needs. However, Italy lacks a law supporting CSE in schools and has no initial training curriculum for teachers and educators focused on CSE topics. In undergraduate programs for early childhood and primary school education, topics related to sexuality are rarely addressed. Training is offered in the Italian context, typically through specific courses that individuals can voluntarily undertake; however, a significant challenge is that these courses often come with high costs, making them inaccessible to many. Within this sociocultural, educational, and training context in Italy, the educational project for the EDUSex Open Badge was developed at the Sapienza University of Rome as part of the Open Badge EDU Sapienza and service-learning framework. This elective and no-cost course is specifically designed for educational and training degree program students. The course consists of 12 in-person sessions, with one three-hour meeting per week, following a pilot training program offered during the 2023-24 academic year, including in-person and online sessions for two three-hour weekly meetings. The course has been adjusted based on student feedback, including only weekly three-hour in-person sessions. The project aims to promote methodologies and skills to address educational, social, and practical needs through participatory activities. Additionally, the course helps students reflect on their concepts, sexual scripts, beliefs, and attitudes toward sexuality and CSE, enabling them to separate their personal perspectives from scientific and accurate information in the future. The course covers a wide range of CSE topics, including sexual health, sexual identity, rights, the LGBTQIA+ community, emotions and relationships, consent, respect and gender-based violence, contraception, sexually transmitted infections, sexual development, sexual pleasure, stereotypes, socio-cultural and personal influences, and educational planning for CSE across different age groups. Competency evaluation includes three formative assessments: the first involves small group work in which students present an insight into a chosen topic; the second requires each student to design an educational or teaching project to propose to schools hypothetically; and the third is a written test to assess knowledge gained from the training. This three-step assessment is accompanied by initial and final questionnaires that evaluate knowledge and attitudes.

Keywords: *Sexuality education, student teachers, student educators, early childhood education, primary school education.*

1. Introduction

Sexuality Education (SE) is recognized as a lifelong learning process beginning in early childhood, as sexuality develops from life's first steps and can be expressed in different ways during life's phases (Dias & Sim-Sim, 2024). By following the natural sense of education, from the Latin word educĕre – conducting out and guiding – during the entire body, psychologic, affective, and brain development (Arain et al., 2013; Gavin et al., 2009), SE should go along with sexual development, and early is the start better are the results (Advocates for Youth, 2009). Literature indeed affirms that implementing CSE since early childhood education and primary school contributes to healthy development, both individuals' and society's well-being, and preventing abuse (Bruno et al., 2024a; Putri, 2022; Schneider & Hirsch, 2020).

However, in Italy, SE still faces traditional and conservative attitudes (Parker et al., 2009) and government resistance (Bruno, 2024). The Standards for Sexuality Education in Europe, although published more than a decade ago, provides a clear definition of SE that is still current and coherent with our societies (WHO & BZgA, 2010). SE means discussing topics related to sexual rights, sexual identities, emotions, consent, respect, development, and healthy behavior to promote knowledge, increase skills, and positive

attitudes toward all sexualities. This holistic and global vision toward sexuality shows that SE aims to combat the stereotype that sexuality is equal to sexual intercourse. Meanwhile, sexuality is conceptualized as an integral and fundamental part of the individual's life, crossing all aspects of it from the moral, ethical, and personal influences to the socio-cultural and historical ones passing through the anatomical, psychological, and affective ones. This vision aligns with the Comprehensive SE (CSE) approach, the gold standard between the three approaches known in the literature. Several international documents share the WHO & BZgA vision on SE (Plan International, 2020a; UNESCO, 2018), building a sort of community around the sexual right to have access to education on sexuality-related issues (WAS, 2014). CSE has positive effects on the promotion of healthy and safe sexual development for everyone, promoting respectful social relationships (Jiménez-Rìos et al, 2023), contrasting the other two approaches known as Abstinence-only and Abstinence-"plus" (Hawkins, 2024) and fostering three Goals of the 2030 Agenda – numbers 3, 4 and 5 (IPPF, 2016; UN, 2015; UNESCO, 2023).

The aim of providing CSE during every step of an individual's development collides with our current educational and training opportunities as a society. To improve empowerment, knowledge, skills, positive attitudes, comfort in discussing sexual topics, the feeling of being respected, the possibility to make informed decisions and give consent, and the urge for a greater sense of self-determination, CSE should be implemented in school curricula to help people understand and deconstruct stereotypes or taboo on sexuality. However, considering the context of teacher training, CSE seems to face global resistance. For instance, only a few countries have laws or national policies, and this lack produces various mandates for teacher education (IPPF, 2018; UNESCO, 2023). To develop shareable, replicable, and culture-based CSE teacher training programs, it is necessary to focus on increasing the implementation and assessment of designs for teacher training. Teachers perceive a lack of knowledge and competence, leading to a need for training; show the importance given to issues and the sense of adequacy and comfort in addressing CSE; and finally, the willingness and motivation to be trained in and teach CSE in the future (Balter et al., 2018; Bruno et al., 2024b; Klein, 2021). The literature shows that student educators and teachers already perceive a lack of knowledge to address CSE in their future educational practices (Brouskeli & Sapountzis, 2017; Jiménez-Ríos et al., 2023). Global comparisons published by UNESCO (2021; 2023), in which Italy is not present, emphasize the need for training, stating the importance of initiating investments, increasing pedagogical knowledge and skills in offering CSE in schools, and investing in research on teacher and educator training models. The literature seems predominantly focused on short educational interventions or workshops and specific content to train teachers on CSE. Hence, this paper aims to present the training course on CSE in the frame of the Open Badge (OB) EDU Sapienza. Badges, from scouting, aim to stimulate interest development (Baden Powell, 1919), and as an educational tool, badges help people overcome their limits and enhance their skills and talents (Freinet, 1949). Nowadays, the OB EDU tool is a digital certification of knowledge, practical skills, and personal quality that aims to enhance the competencies of pre-service or in-service educators and teachers, promoting creative methodologies, collaborations, and skills on social and educational needs. By integrating informal and non-formal learning in an academic context, OB EDU enriches the training offered, aligning with professional needs. It has a transparent assessment process to increase specific and transversal skills, consisting of three steps: technical, written, and practical. This allows participants to participate actively in the assessment process, integrating peer-evaluation sessions, discussions, and peer-group work and facilitating both autonomous and critical competencies (Boud & Falchikov, 2006; Topping, 2009). Following the construction of OB EDU at Sapienza, the training project we present is the OB EDUSex Sapienza, an elective and no-cost course on CSE for future educators and primary school teachers. The methodological and structural aspects are presented below as the project is ongoing. The broader purpose is to understand how to design future CSE training as a university course.

2. Design

The OB EDUSex Sapienza was built based on literature, precisely two international recommendations for CSE contents (WHO & BZgA, 2010; Plan International, 2020c) and training structure (Plan International, 2020a; 2020b). The recommended structure should be 3-5 days of training; however, discussing CSE contents while facing own attitudes, values, opinions, and beliefs in a maximum of 5 days could be unproductive in the Italian context.

Increasing the number of days' training and focusing on reflection and acquisition of knowledge and skills, the OB EDUSex Sapienza is dedicated to students enrolled in Early childhood education (ECE) course, Pedagogy course (P), and Primary school education (PSE) course of Sapienza University of Rome.

In the academic year 2023-24, the first cycle of the OB EDUSex Sapienza provided training of 12 sessions, each of 3 hours, and in an alternative setting. Some sessions were, in fact, in-person, and some others online. From the final participants' feedback, in the second cycle of the training during the academic

year 2024-25, the 12 sessions were always in-person. Both cycles of training courses were divided into three phases.

1. Welcome, group warm-up, and introduction to CSE (1 meeting).
2. Course implementation and ongoing evaluation (9 meetings).
3. Final evaluation for awarding the OB EDUSex Sapienza certification (2 meetings).

The meetings include experiential activities and active and creative participation to put the knowledge acquired and own reflections into play. At the end of the second phase, two meetings are scheduled for the final evaluation. The group's oral presentation on a chosen and agreed-upon topic is evaluated during the first. The last one is dedicated to completing the final questionnaire with a subsequent individual oral interview. While the first cycle is completed, allowing to adjust the training for the second cycle based on participants' feedback, the second training cycle is not finished yet.

2.1. Objectives

The training aim is to transmit scientific information contributing to reflection and awareness of own beliefs and experiences, helping future educators and teachers develop the capacity to manage conflictual or problematic situations and the project skills on CSE contents. Moreover, it aims to develop respectful, nonjudgmental, and inclusive communicational and relational skills through individual study, group work and discussion, and experiential activities. Three sub-objectives and several specific objectives correspond to the general objective (Table 1). The training course aims to increase the personal wealth of competencies toward CSE, defined as knowledge, attitudes, and practical skills.

Table 1. Objectives of the training project.

General objective	**Sub-objectives**	**Specific objectives: To increase ...**
To increase CSE expertise	To increase information	Knowledge of CSE definitions
		Knowledge of existing approaches
		Knowledge of CSE contents
	To raise awareness of a positive, non-judgmental, and scientific attitude	Awareness of judgments and stereotypes about sexuality
		Awareness of false myths and beliefs on sexuality and CSE
		Awareness of CSE results
	To increase design expertise on CSE	Knowledge of existing school practices on CSE
		Knowledge of legislative Italian context
		Knowledge about services and experts
		Expertise in design projects and lessons on CSE

The project, therefore, aims to increase knowledge and skills in educational project designing and communication, the management of group dynamics or critical situations, and awareness of individual and socio-cultural influences.

2.2. Methods

In the first training cycle, which was the pilot one, 12 students participated, while in the second one the students were 9. The 9 sessions of course implementation included discussion and reflection on several topics, thinking about possible methodologies to integrate and adapt each topic in different school subjects or educational activities. Each session offered literature references, materials, and tools to deeply understand how to communicate and implement the CSE content in school. It was thus possible to deepen listening skills, manage situations, and plan to transversal CSE content in school subjects. Below are the topics addressed in the order of the meetings held.

1. First warm-up session and introduction to the course: Presentation of OB EduSex; moment of acquaintance between registered people and initial questionnaire to identify basic knowledge; warm-up activities and introduction of CSE.

2. Consent and sexual identity: Participatory activity on consent and discussion on gender violence and rape culture, sexual identity, and its development.

3. Sexual rights and educational design: The 16 sexual rights and the methodological aspects of planning when dealing with CSE in school; consequently, the roles of different people, the importance of informed consent, and shared responsibility were discussed.

4. LGBTQ+ community, bullying, and discrimination: The sexual identity and its components were proposed again to deepen perceptions, attitudes, and experiences, examining the phenomenon of stereotypes, bullying, and discrimination.

5. Bodily, sexual development, and sexual manifestations: Bodily changes from birth to puberty, and sexual development, discussing theories of development and life experiences; finally, time was

dedicated to the topic of childhood sexual manifestations, what is typical to observe and what constitutes a risky behavior, with related tools useful for addressing the topic.

6. Disability: Visibility of differences in terms of issues that are still little addressed in CSE; this session undermines stereotypes and cultural resistance regarding the sexuality of people with disabilities, addressing the legitimate presence of mixed emotions of parents to support.

7. Adolescence and sexual pleasure: CSE works to prevent future discomfort situations; consequently, this session addresses sexuality and its development in the delicate phase of adolescence; physiological aspects in the activation of sexual desire, sociocultural and personal influences; sexual response cycle from a historical point of view; finally, sexual dysfunctions and the role of education to prevent and/or treat them.

8. Online sexual activities (OSA), adulthood, relationships, and families: The topic of OSA and their use was discussed with differences based on age; the phenomenon of sexting for adolescents; sexuality in adulthood in general; and finally, relationships and attitudes towards the various types of families.

9. Contraception: More medical and preventive parts in which the different types of contraception were addressed - natural, barrier, hormonal, intrauterine, and sterilization.

10. Sexually transmitted infections (STIs), voluntary termination of pregnancy (VTP)/abortion, and broad language: The topic of STIs was addressed, followed by the difference between IVG and abortion; finally, the topic of broad language, i.e. the use of alternative forms to the over-extended masculine: *, ə, з, and over-extended feminine.

11. Final session: Oral group presentations on agreed topics – Influences on sexuality in childhood, sexuality in adolescence, and religion on sexuality – which allowed people to get involved and develop a lesson with associated participatory activity to experience the ability to respond to questions and curiosities. The work was part of the final evaluation to obtain the OB EduSex certification.

12. Final assessment: The final knowledge questionnaire was constructed, administered, and then explored in depth through an oral interview alongside discussing the individual project requested on a self-choice topic.

3. Conclusions

The training project adopted a multidimensional and integrated approach to address the complex challenges of CSE in contemporary society. The integration of the OB EDU represented a pedagogical innovation, allowing participating people to certify the assessment process through a digital certification, thus improving the transparency and traceability of learning.

The OB EDUSex focused on several topics, promoting active participation, personal reflection, and open discussion on sensitive issues. This approach can create an inclusive and stimulating educational environment, increasing knowledge and positive attitudes towards sexuality. Although the positive experience from both training cycles, some limitations must be underlined. Since it is not a compulsory course or included in the degree course, it does not provide training credits that can be added to one's study path. Consequently, the participants have had the best opportunity to manage study, work, and personal commitments to follow the training with the active participation required. Therefore, the data cannot be analyzed to allow an effective pre-post evaluation of the training; moreover, each cycle is different, and it is impossible to compare the pilot training with the second one. It seems crucial to consolidate these initiatives, pursue a continuous commitment to guarantee equal access to CSE, and promote respect for sexual differences and rights. Offering a CSE course at the Italian University represents a significant step. However, further efforts are needed to address challenges such as formal recognition of acquired skills and long-term impact analysis.

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CONCEPTUALIZATION OF A DIAGNOSTIC TEACHING DISCOURSE: A CASE STUDY

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Abstract

The purpose of the current empirical research, which departs from a socio-psychological perspective in terms of the concept of diagnostic teaching, is to explore and analyze mathematics teachers' reflections about students' learning of algebra. The theoretical approach proposed by Bernstein and Miller, and the concept of inverse operations in algebra was applied. In this theoretical context, the purpose of developing a diagnostic framework is to include a conceptual triangulation of three domains: (1) conscious inclusion in the teaching environment of a component that addresses students' different levels of prior knowledge and mathematical experience; (2) teacher-student content-oriented conceptual communication; and (3) a gradual sequencing of teaching content. The methodological approach is a mathematical intervention, based on the main principles of the diagnostic framework conceptualization that is rooted in the Swedish PUMP project. The methodological tools are based on qualitative research and data collection from secondary school teachers' group discussions, teachers' analysis of students' diagnostic tests, and written reflections. The participants comprise three teachers and 94 students. The crucial content of the study is a conceptual transition from whole and rational numbers to algebraic equations and problem-solving. The findings of the study illustrate that teachers are aware of the importance of diagnostic teaching and the implementation of diagnostics in the teaching of algebra, practical awareness of students' knowledge of algebra, and what should be taught. The results of the study show teachers' practices and the challenges they face with handling mathematical content and content-oriented communication. The findings clearly indicate that diagnostic teaching that addresses students' mathematical needs and teachers' reflective teaching practice directed at student learning have not been fully developed in practice.

Keywords: *Diagnostic teaching of algebra,* the *PUMP -project, mathematical intervention, content-oriented communication.*

1. Introduction

The importance of diagnostic teaching and its implementation in mathematics classrooms has been described by several researchers (Bell, 1993; Booth, McGinn, Barbieri, & Young, 2017). The key idea behind the conceptualization of teaching using a diagnostics-based approach is to effectively identify the student learning process in a formative way. A prerequisite for learning mathematics is the students' continuous cognitive development and knowledge of mathematical concepts and methods (Davydov, 1990). A diagnostic teaching approach can be helpful for teachers to plan teaching with a focus on students' development of knowledge and help them adjust their misconceptions of mathematical concepts (Galeos, Magno, Galeos, & Apdian, 2024).

2. Background

The current learning discourse of mathematics is complex, and teachers need to be more involved in the mathematical development of their students. In terms of a diagnostic framework, a conceptual structure of teaching content is crucial in order to achieve a dynamic transition in the students' learning process. Researchers claim that it is still the quality of mathematics instruction and the conditions for students' learning of mathematics that need to be further explored (Cohen, Ruzek, & Sandilos, 2018; Friesen & Dreher, 2024). At the same time, students' knowledge development is situated and depends, among other things, on optimal coherence when sequencing the teaching content based on the teachers' explanations and communication (Planas, & Pimm, 2024). There are also current research discussions about

the importance of organizing knowledge-oriented content in the teaching of mathematics directed at the development of students' mathematical cognitive functions and mathematical achievements (Brophy, 1986; Stein & Lane, 1996; Thiessen & Blasius, 2008; Chen et al., 2022). Thus, it is important to look back at the history of mathematics education in order to reflect and analyze what has been achieved in the past, pay attention to the contributions of scholars, and identify what is unfinished and should be developed in current research that focuses on teachers' teaching practice. The background to the analysis is also based on a new proposal to reform teacher education in Sweden (SOU 2024:81), as well as the Swedish National Agency for Education preparing courses for teachers' professional development with a focus on students' mathematics development. What do we need to learn in order to develop mathematics education research and teaching practice?

In a study by the innovative Swedish PUMP -project (Kilborn, 1979), particular emphasis was placed on students' difficulties in learning arithmetic and how to individualize the teaching of mathematics using a diagnostic approach, as well as the sequencing of teaching arithmetic content in order to achieve optimal student learning. The roots of the PUMP project were the conceptualization of diagnostic teaching concerning research-based subject-specific content, with particular focus on how this content should be communicated to students. The PUMP project significantly impacted Swedish research into mathematics education, the construction of a successful 1980 mathematics curricula for primary school, and the production of textbooks and constructive guidelines for teaching practice in school using diagnostic matrices (Prytz, 2020). This current research project aims to reinvent the theoretical-methodological perspective that was used in the PUMP project. Against this background, it is important to incorporate diagnostic discourse into teaching practice.

The purpose of the current empirical research, which departs from a socio-psychological perspective related to the concept of diagnostic teaching, is to explore and analyze mathematics teachers' reflections about students' learning of algebra through integration and using a diagnostic teaching discourse. The study is part of a research project about teachers' professional development in a "research circle" (within the framework of the ULF -project).

3. Methodology

The methodological tools are based on qualitative research and data collection obtained from secondary school teachers' group discussions, teachers' analysis of students' diagnostic tests, and their written reflections. The participants comprise three teachers with their 94 students. The crucial content of the study is a conceptual transition from whole and rational numbers to algebraic equations and problem-solving. The teachers received guidance from the researchers to construct and analyze diagnoses, as well as to construct teaching content as a transition from arithmetic to algebra. The crucial arithmetic content is whole and rational numbers, and potencies. The algebraic content is algebraic expressions, rational and linear equations.

4. Theoretical background

The theoretical approach proposed by Bernstein's (1971) and Miller's (1969), concept of inverse operations in algebra (Karlsson & Kilborn, 2024a; 2024b) was applied. In this theoretical context, the meaning of constructing diagnostic framework is to include a conceptual triangulation of three domains: (1) conscious inclusion in the teaching environment of a component that addresses students' different levels of prior knowledge and mathematical experiences; (2) teacher-student content-oriented conceptual communication; and (3) a gradual sequencing of teaching content.

In order to include the teaching environments component as students' different level of mathematical development led to two researchers as Basil Bernstein and George Miller. With his theory of language codes, Bernstein (1971; 1972) studied communication as language codes and found socio-linguistic inequalities based on social strata. The theory is that there are elaborated and restricted codes of communication within the broader category of language code of communication. This explains why students from the lower social strata had to follow the teaching of mathematics with a very restricted code of communication. Another example, from Bernstein's research related to teaching slow learners, was that they became confused when an algorithm required multiple mental(cognitive) tasks before notation of a difference or product. Miller (1956; 1957; 1969) explained this by referring to the capacity of the working memory. In his research, he claims that the capacity of the working memory is 7 ± 2 units of information. For a slow learner, the capacity is just 5 units. When learning algorithms, this will cause serious problems that could be solved using two strategies. The first strategy is to teach in a such way that multiply operations will be collected into a few chunks that can be processed in the working memory. The second strategy is to store some important chunks like subtraction and multiplication tables in an easily accessible way in the

long-term memory. Bernstein's and Miller's theoretical perspectives are crucial domains for the conceptualization of the teaching-learning environment, teacher-student communication, and the sequencing of the teaching content in this research project, and previously in the PUMP project. The PUMP diagnostic matrices broke down arithmetic content into units and organized them in two-dimensional patterns called *matrices*. In these matrices it is possible to follow how content develops from the simplest to the most complex, on a step −by −step basis. Bernstein's research was used for the diagnostic teaching of arithmetic, the sequencing of arithmetic tasks and, not least, studying the outcome of teaching by comparing what was taught with what was learned. The same principle is used in the current study with a focus on the teaching of whole and rational numbers by inverse operations (Karlsson & Kilborn 2024b), and how the conceptual transition from arithmetic to algebra can be taught diagnostically (Karlsson & Kilborn, 2024a).

5. Results

An outcome of the present study is teachers' focus on teaching algebra tasks from the current textbook, not on algebraic content concerning students' individual capacity for learning.

The teachers' diagnostic tests regarding students' knowledge of algebra was designed as "summative". When analyzing the diagnostic test results, the teachers focused on correct answers, not on algebraic methods or concepts. In order to support a student who lacks knowledge of algebra, it is important to continuously identify the student's understanding of algebraic methods and concepts. However, this assumes that diagnostic teaching is based on teachers being able to analyze the conditions for students' learning, as well as their algebraic challenges and needs.

The results clearly show that teachers lack experience of working with the diagnostic approach in their teaching and are not trained to carry out diagnostic tasks or activities. In addition, teachers were unable find any diagnostic algebraic tasks in the current textbook that focused on didactic structure of conceptual algebraic content by given algebraic tasks. Against this background, it is interesting to study the proposal for diagnostic tasks in the current textbook. The section about fractions begins with many formulas about how to operate with fractions. However, many of the students had already encountered these formulas before and failed to use them. A smarter approach would have been to define the concept of fractions, because many students think of fractions as division, which causes a lot of misunderstanding. With correct definitions like $\frac{a}{b} = a \cdot \frac{1}{b}$, $b \neq 0$, it is easy to understand all formulas by using the same laws of arithmetic that the students learned in grades 1−3.

Another important outcome of the current research is teachers' reflections on diagnostic teaching: the more exercise with algebraic tasks, the more learning. Thus, according to the interpretation of the teachers' reflections, if a student, for example, is unable to solve a certain kind of equation due to a misconception an exercise by training of such tasks will rather strengthen that misconception. This means that there is a need for a clear teaching plan with a priority of content and sequencing of algebra content, students' clear instruction, and systematic diagnostic guidelines.

6. Conclusions

The findings illustrate that teachers are aware of the importance of diagnostic teaching and the implementation of diagnostics in the teaching of algebra, practical awareness of students' knowledge of algebra, and what students should be learnt. At the same time, the results of the study show that teachers' diagnostic practices and experience of diagnostic teaching, as well as algebraic content and content-oriented communication is limited. The findings clearly indicate that diagnostic teaching that addresses students' learning of algebra, as well as teachers' reflective diagnostic teaching practice directed at student learning, have not been fully developed in practice. We should consider studying this problem on a deeper level. When a students' struggles because they lack knowledge, they will probably struggle forever if they do not receive qualitative systematic diagnostic support. There is, however, another explanation. For social reasons (Bernstein, 1971; 1972), limited working memory (Miller, 1956; 1967) or lack of aptitude for learning mathematics, some students will never be able to solve tasks of a certain level of complexity, maybe due to time constraints. This often involves 50% of students and there ought to be differentiating curricula, with different learning goals that allow students to study according to their ability. With framework of the PUMP project, Kilborn (1979), created a tool for constructing individual learning goals for such students in the form of teaching matrices. The experiences from the PUMP project, specifically these teaching matrices, can be useful for designing a diagnostic discourse for teaching and provide the necessary support for teachers.

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THE ASSOCIATION RULES FOR HIGH SCHOOL TEACHERS IN TAIWAN PARTICIPATING IN IN-SERVICE CONTINUING EDUCATION COURSES

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Abstract

This study examined the in-service training participation of Taiwanese high school teachers using data mining techniques. Analyzing data from the National Teacher In-service Training Information Web (2011–2020), it categorizes training courses into six domains: 1) Curriculum, Teaching, and Assessment, 2) Class Management and Tutoring, 3) Professional Development and Responsibility, 4) Emerging Education Policies, 5) School Administration and Leadership, and 6) Practical Knowledge and Life Literacy. Courses are further classified into four levels: Foundation, Advanced, Leadership, and R&D. The study identifies key factors such as gender, educational background, and region that influence participation, highlighting trends that can inform future professional development programs.

Keywords: *Association rules, high school teachers, in-service continuing education courses.*

1. Introduction

High school teachers in Taiwan engage in in-service training to enhance their professional competencies. The Ministry of Education has established 24 subject centers as platforms for professional learning and curriculum development. This study utilizes big data analytics to explore association rules among teachers' participation patterns, providing insights into training trends and needs.

Table 1. Number of Teacher Training Activities Courses Conducted by High School Subject Centers in Taiwan.

Year	Total number of schools/units	Number of schools/units	Courses (Sessions)	Total Approved Hours (Hours)
2020	518	495	24,810	80,969.50
2019	517	493	26,276	86,680.50
2018	514	496	25,140	86,286.50
2017	511	486	25,171	85,552.50
2016	355	340	18,193	52,431.00
2015	354	344	19,018	46,031.00
2014	352	345	18,898	52,485.50
2013	350	348	22,844	64,429.00
2012	346	336	17,641	49,343.00
2011	340	318	13,651	40,674.00

Source: Compiled from the Department of Teacher Training and Arts Education, Ministry of Education (2023). *Statistical Annual Report on Teacher Training in the Republic of China.*

2. Literature

In the process of teacher training under the rapid social changes, teachers must undergo on-the-job training at any time in order to meet the requirements of the profession (Wei et al., 2023). Greenwood (1957) emphasized that the so-called profession must have the following five things: complete and systematic knowledge, recognized intellectual authority by customers, sanctioned and praised by peers, strict professional ethics, and the establishment of a formal professional organization. Kornhauser (1982) proposes four professional criteria: expertise in intellectual aptitude, sufficient self-control, strong work ethic, and a sense of responsibility and influence in the use of expertise.

Xu & Wu (2014) showed that distance factors, inconvenient transportation, access hazards, and time factors were the main difficulties of teachers' professional development in remote areas. However, due to the rapid change of teaching environment, teachers need to supplement new knowledge from time to time in order to meet the learning needs of students, and rural schools lack educational resources and cultural stimulation due to their long distance and inconvenient transportation, so for rural teachers with a high proportion of novices, professional support and experience exchange are more needed (Zhan & Huang, 2017). Interestingly, according to Cai et al. (2020), teachers in remote areas were more

motivated to participate in in-service learning courses than teachers in general areas, and the more they participated, the more they could feel the effectiveness of teachers' professional growth, and the better their professional growth performance, the more they could improve their teaching effectiveness.

Teachers must first discover the distance relationship through data mining or database knowledge, and use machine learning, statistics and database systems to mine large databases, and the mining process is "pre-processing", preparing suitable datasets, removing meaningless data from the original data, and using the remaining data to build models. "Modelling" is about using a selected set of data and using appropriate techniques, while "Post-processing" is about applying the model to actual situations and new cases (Ketui, N. et al., 2019).

3. Study design

3.1. Algorithms for association rule mining

Using the Apriori algorithm, this study identifies association rules based on support, confidence, and lift values. The Important Association Rule Mining (IARM) algorithm is applied to assess rule significance.

3.2. Data sources

The dataset, drawn from the National Teacher In-service Training Information Web (2011–2020), includes attributes such as gender, education level, subject area, and training format.

4. Results

In this study, two different types of data were designed to carry out data exploration calculations: one is the teacher training record data of the "Teacher In-service Education Database", with a total of 138,384 in-service teacher training courses for exploration. The second is to divide the teacher training courses in the teacher in-service training database into regional groups of teaching schools, and divide the number of trainees into the northern group (1_N, counted as 67,548 people), the central group (2_M, counted as 34,891 people), the southern group (3_S, counted as 31,728 people), and the eastern and outlying island groups (4_R, counted as 4,217 people).

4.1. Data type 1: The total number of students taking courses in the database of teachers' in-service training was 138,384

The association rules found first must be greater than the minimum support level (0.1 and the minimum confidence level of 0.1, and the minimum length rule is limited to 2, a total of 35 association rules are found at this stage. Then, the 35 association rules were cut down to reduce the duplicate rule combinations, and a total of 12 rules were obtained from the positive association rule (*lift* (X,Y)>1), and the positive association rule (*lift*(X,Y)>1) and a support degree of 0.2 or higher. Calculate the negative association rules of positive and negative association rules, extract the positive association rules {$X \Rightarrow Y$} and their corresponding negative association rules {$\overline{X} \Rightarrow$Y}, and calculate the importance indicators of the *four positive association rules Imp. (*$X \Rightarrow Y$), as shown in Table 2.

Table 2. The importance index of positive correlation support of teacher in-service training is above 0.2.

No.	*LHS*	=>	*RHS*	*Supp.*	*Conf.*	*lift*	*count*	*Imp.*
[1]	{Implementation - Lecture}	=>	{The first stage of foundation-to understand and be familiar}	39.72%	90.39%	1.0011	2102	91.22%
[2]	{Implementation - Workshop}	=>	{The first stage of foundation-to understand and be familiar}	37.95%	80.17%	0.9781	2008	85.13%
[3]	{Northern group}	=>	{The first stage of foundation-to understand and be familiar}	37.10%	89.39%	0.9901	2008	86.77%
[4]	{Southern group}	=>	{The first stage of foundation-to understand and be familiar}	25.25%	81.43%	0.9935	1336	77.53%

In terms of the overall data, the rule with a support degree of 0.2 (20%) or more was discussed, and the positive association rule (*lift*(X,Y)>1).There are a total of 4 rules with a support degree of 0.2 or more. Based on these 4 rules, the materiality indicator (*Imp.)* is further calculated. In this way, we can determine which rules are relatively important for the second-order advanced - application analysis, with the highest importance index being the implementation method - lecture (91.22%), followed by the implementation method - workshop (85.13%), the northern group (86.77%), and the southern group (77.53%). So in terms of overall data, the importance indicator (*Imp*) for the implementation method - teaching, implementation method - workshop, northern group, southern group; The results are consistent with the overall data of Wei et al. (2023) on the association rules of on-the-job continuing education courses, and the southern group is consistent with the part of the association rules and importance indicators.

4.2. Data type 2: Teachers grouped by the region of the school where they teach

The number of refresher courses was D_N76,900 in the northern group, 39,567 in the central group and 46$D_M D_S$ in the southern group, 206 and 5,555 (Eastern and Outlying Islands), for a total of 138,384. The attributes of the research database include the background information of teachers, the information of the teaching school, and the information of the continuing education course, which are the advanced education level, a total of 4 attributes, and the minimum support degree of the course data of the four regional groups in this study is set to 0.1 and the minimum confidence degree is 0.1, and the minimum length rule is limited to 2$D_R D_N X_N Y_N D_N$ 、D_M 、D_S 、D_R, and a total of 49 association rules are found in this stage. A total of 36 association rules were identified in this phase. A total of 41 association rules were identified in this phase. A total of 43 association rules were identified in this phase, D_N $D_M D_S$ D_R as shown in Table 3.

Table 3. The course of teachers' in-service education based on the rules of the four regional groups.

City_Cluster	Counties and cities	Total number of rules	Remove duplicate rules	Number of rules available
D_N	Northern group	49	41	8
D_M	Central group	36	26	10
D_S	Southern group	41	32	9
D_R	Eastern and offshore-island group	43	33	10

4.2.1. The northern group is positively correlated with the rules. Northern Group D_N. There are 8 positive association rules (*lift*(X,Y)>1), as shown in Table 4. There are a total of 4 rules with a support degree of 0.2 or more. The characteristics of the rules are listed in descending order of support: academic qualifications - master's degree, areas of study - practical knowledge and life literacy, areas of study - curriculum, teaching and assessment, and areas of study - emerging education policies. There are 4 importance indicators greater than 80%, from the highest order, to the field of further education - practical knowledge and life literacy, academic qualification - master's degree, first professional specialty - Chinese, field of study - curriculum, teaching and assessment.

Table 4. D_N Positive association rules（lift（X,Y）>1）A total of 8 rules.

No.	*LHS*	=>	*RHS*	*Supp*	*Conf.*	*lift*	*count*	*Imp.*
[1]	{Education - Master's degree}	=>	**{**The first stage of foundation - to understand and be proficient**}**	24.85%	100%	1.1811	1209	92.66%
[2]	{Scope of Study - Practical Knowledge and Life Literacy}	=>	**{**The first stage of foundation - to understand and be proficient**}**	24.50%	100%	1.5557	1209	92.81%
[3]	{Areas of Study - Curriculum, Teaching and Assessment}	=>	The first stage of foundation - to understand and be proficient	24.22%	100%	1.3501	945	90.22%
[4]	{Continuing Education - Emerging Education Policy}	=>	**{**The first stage of foundation - to understand and be proficient**}**	23. 57%	84.02%	1.3110	945	79.56%
[5]	{Areas of Study - Professional Development and Responsibility}	=>	{The first stage of foundation - to understand and be proficient}	18.94%	91.11%	1.7954	916	75.55%
[6]	{Subject Central Area - Language Field}	=>	{The first stage of foundation - to understand and be proficient}	18.59%	93.44%	1.6990	870	62.41%
[7]	{First-registered specialty - Chinese}	=>	{The first stage of foundation - to understand and be proficient}	17.94%	92.52%	1.4934	870	90.24%
[8]	{Non-credit Classes (On-campus Study)}	=>	{The second stage of advancement – to apply and analyze}	13.32%	93.79%	1.2584	870	61.16%

4.2.2. The central group is positively correlated with the rule. The central group D_M. There are 10 rules in total, as shown in Table 5; There are a total of 4 rules with a support degree of 0.2 or more. The characteristics of the rules are listed in descending order of support: women, academic qualifications, master's degrees, areas of further education, emerging educational policies, and implementation methods. There were 7 indicators of importance greater than 84%, which were female, implementation method - workshop, age 35 to 39 years old, subject center area - language field, academic qualification - master's degree, field of study - curriculum, teaching and assessment, and field of study - emerging education policy.

Table 5. D_M positive association rules（lift（X,Y）>1）10 rules in total.

No.	LHS	=>	RHS	Supp	Conf.	lift	count	Imp.
[1]	{Female}	=>	{The first stage of foundation - to understand and be proficient}	43.79%	100%	1.6363	2017	88.52%
[2]	{Education - Master's degree}	=>	{The first stage of foundation - to understand and be proficient}	34.47%	100%	1.6308	1824	82.37%
[3]	{Continuing Education - Emerging Education Policy}	=>	{The first stage of foundation - to understand and be proficient}	27.91%	100%	3.2563	1477	84.07%
[4]	{Implementation - Workshop}	=>	{The first stage of foundation - to understand and be proficient}	25.66%	100%	1.6480	1358	86.43%
[5]	{Subject Central Area - Language Field}	=>	{The second stage of advancement – to apply and analyze}	19.87%	72.96%	3.1932	1032	84.23%
[6]	{Age 35 to 39 }	=>	{The first stage of foundation - to understand and be proficient}	8.69%	74.89%	3.2775	936	84.24%
[7]	{Age 30 to 34}	=>	{The first stage of foundation - to understand and be proficient}	15.36%	64.20%	1.6130	813	69.86%
[8]	{First-registered specialty-History}	=>	{The first stage of foundation - to understand and be proficient}	14.09%	62.19%	1.5626	746	68.76%
[9]	{The range of in-service education-curriculum、instruction & assessment}	=>	{The first stage of foundation - to understand and be proficient}	12.83%	64.64%	1.6240	642	84.12%
[10]	{First-registered specialty-Physics}	=>	{The first stage of foundation - to understand and be proficient}	12.90%	72.22%	3.1606	630	68.59%

4.2.3. The southern group is positively correlated with the rules. The Southern Group D_S. There are 9 rules, as shown in Table 6; There are a total of 4 rules with a support degree of 0.2 or more. The characteristics of the rules are listed in descending order of support: women, mode of implementation-teaching, education-university, field of further education-emerging education policy; Among them, there are 4 indicators of importance greater than 84%, and the highest order is women, implementation method - teaching, academic qualifications - university, and field of further education - emerging education policy.

Table 6. D_S positive correlation（lift（X ,Y）>1）a total of 9 rules.

No	LHS	=>	RHS	Supp	Conf.	lift	count	Imp.
[1]	{Female}	=>	{The first stage of foundation - to understand and be proficient}	40.80%	100%	1.6260	1603	88.28%
[2]	{Practice-Lecture}	=>	{The first stage of foundation - to understand and be proficient}	30.29%	100%	3.2563	1267	85.77%
[3]	{Education - University}	=>	{The first stage of foundation - to understand and be proficient}	24.90%	100%	1.6364	1109	85.37%
[4]	{Continuing Education - Emerging Education Policy}	=>	{The third stage of leadership - to integrated and evaluate}	23.74%	100%	1.6364	1250	84.37%
[5]	{Age 30-34}	=>	{The first stage of foundation - to understand and be proficient}	15.36%	67.20%	1.6130	813	69.86%
[6]	{First-registered Specialty - Chemistry}	=>	{The first stage of foundation - to understand and be proficient}	12.75%	84.75%	1.6364	1249	81.37%
[7]	{Class size 13 to 24}	=>	{The first stage of foundation - to understand and be proficient}	11.21%	74.79%	1.6364	1309	82.37%
[8]	{School Administration & Leadership}	=>	{The first stage of foundation - to understand and be proficient}	10.34%	84.27%	1.6130	813	69.86%
[9]	{Scope of Study - Practical Knowledge and Life Literacy}	=>	{The first stage of foundation - to understand and be proficient}	9.47%	86.73%	1.6364	1539	81.84%

4.2.4. The eastern and outlying islands are positively related to the rule. The eastern and offshore island group D_R. A total of 10 rules, as shown in Table 7; There are a total of 4 rules with a support degree of 0.2 or more. The characteristics of the rules are listed in descending order of support: "female, education-university, field of study-practical knowledge and life literacy, county and city of teaching - Taitung County"; Among them, there are 4 indicators of importance greater than 84%,

and the highest order is academic qualifications, universities, women, and further education fields, emerging education policies, implementation methods, and lectures.

Table 7. D_R positive association rule（lift（X,Y）>1）a total of 10 rules.

No	*LHS*	=>	*RHS*	*Supp*	*Conf.*	*lift*	*count*	*Imp.*
[1]	{Female}	=>	{The first stage of foundation - to understand and be proficient}	49.21%	100%	1.6183	2959	84.46%
[2]	{Education - University}	=>	{The first stage of foundation - to understand and be proficient}	39.25%	100%	1.7260	2221	84.98%
[3]	{Scope of Study - Practical Knowledge and Life Literacy}	=>	{The first stage of foundation - to understand and be proficient}	28.27%	100%	2.6180	1840	78.67%
[4]	{County and city of the teaching school - Taitung County}	=>	{The first stage of foundation - to understand and be proficient}	24.52%	100%	3.2573	1980	81.01%
[5]	{Subject Central Area - Language Field}	=>	{The first stage of foundation - to understand and be proficient}	17.87%	92.58%	1.6259	1011	78.88%
[6]	{Non-credit Classes (On-campus Study)}	=>	{The first stage of foundation - to understand and be proficient}	16.44%	89.71%	1.6360	916	64.57%
[7]	{Continuing Education - Emerging Education Policy}	=>	{The third state of leadership-Integrated and evaluates}	15.68%	89.74%	3.2492	883	80.07%
[8]	{Continuing Education - Emerging Education Policy}	=>	{The first stage of foundation - to understand and be proficient}	14.70%	92.36%	1.5897	822	84.87%
[9]	{Implementation - Workshop}	=>	{The first stage of foundation - to understand and be proficient}	14.53%	91.22%	3.2622	689	65.23%
[10]	{Implementation - Lecture}	=>	{The third stage of leadership-Integrated evaluates}	13.51%	96.58%	1.6621	621	84.43%

5. Conclusions

- As a whole, the implementation method - teaching, implementation method - workshop, northern group, and southern group are related rules and importance indicators.
- The northern and central groups were associated with education-master's degree as the association rule and important index, while learn to associate rules and important indicators.
- Continuing Education Sector - Emerging education policies are relevant and important in the Central, Southern, Eastern and Outlying Islands groups Index.
- The area of study - Practical knowledge and life literacy are related rules and importance in the northern group, the southern group, the eastern group and the outlying islands group.
- The central area of the subject - the language field in the northern group, the central group, the eastern group and the outlying island group are all related rules and important indicators.

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EXPLORING UBUNTU: TEACHING CHARACTERS IN SELECTED DRAMA TEXT AS A MEANS OF "SHARING" AND COMMUNITY BUILDING

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Abstract

The paper seeks to express "sharing" as the principle of Ubuntu in human connectedness and community mindedness. At its core, it suggests that when we share our resources, time, or knowledge, we demonstrate care for others and nurture collective well-being. In pedagogy, Ubuntu has been used to guide and promote African education using a drama text in ensuring an understanding of the responsibilities that come up with characters' interconnectedness, that characters interact with one another to develop his or her theme and conflict, while casting aside worn-out perceptions and outdated thoughts. The aim was to establish that all the facts that are vital to the interconnectedness of characters for the success or failure of the principles of Ubuntu be identified by the students in the Setswana drama text The study adopted a qualitative method approach. Interviews were used to enlist 22 second year students who major in Setswana as their home language to identify the characters that maintained and contravened "sharing" as the principle of Ubuntu. Data obtained from interviews were sorted and categorised into themes and analysed from the text systematically. The findings also demonstrate the importance of recognising students' learning that through the critical analysis of literature, the characters as actors in the development of theme and conflict in drama text.

Keywords: *Drama text, sharing, characters, students, maintain/contravene the ubuntu principle.*

1. Introduction

According to Ngubane (2021), Ubuntu philosophy which is indigenous to African people, when embraced with the understanding and dignity it deserves, has the potential not only of reconnecting students in the South African education system with their indigenous values, heritage and cultures, but to learn that Ubuntu philosophy has a capacity to promote co-existence, social cohesion and inclusivity among students from diverse ethnic and cultural backgrounds. A deeper understanding of Ubuntu philosophy and its principles is essential to maintaining its cultural integrity by incorporating the prescribed selected drama text into the education system.

Reading the prescribed selected drama text in the classroom was relevant for the second-year students, in terms of vocabulary, context and principles of Ubuntu to be implemented where characters are interconnected for the success or failure of their role in the text. Students bring Ubuntu principles from their cultural backgrounds into higher education contexts, however, when these principles are not carried out into classrooms, students lose their identity and forget their cultural values. Ubuntu pedagogy reminds the Setswana second year students that, respecting others' opinions kindness towards one another, sharing ideas and knowledge with their peers, thus helping them to understand the learning tasks. Students could realise that Ubuntu principles ensured that they relied on each other for support where they had learning challenges. Similar notions are also shared by (Goduka, 1999; 2000) who argues the proponents of Ubuntu have shown that Ubuntu could be a useful way to improve human relations in diversified learning contexts. Ubuntu principles have been viewed as a philosophy that bears a role to unify people and discourage inequalities and indignities within the academic setting. This article elaborates on how sharing as the principle of Ubuntu is implemented and experienced by students in interconnectedness, that characters interact with one another to develop his or her theme and conflict in a drama text.

2. The theoretical framework

The theoretical importance of enhancing the Collective Fingers Theory (CFT) of (Mbigi, 1997) draws from the principles of the Ubuntu philosophy. An African principle behind the CFT is that "a thumb although it is strong cannot kill aphids on its own; it would require the collective cooperation of the other fingers" (Mbigi, 1997). From this African proverb we can construe two meanings. Firstly, like fingers, individual people need to work cooperatively to achieve any aspired goal. Secondly, the fingers in the proverb can represent core African values, which when internalised and nurtured can promote a collective culture. The five core values of Ubuntu as identified by Mbigi (1997) are: survival, spirit of solidarity, compassion, respect and dignity. Survival enabled African communities, during harsh environmental conditions, to rely on each other for existence despite differences they might have had amongst themselves. Solidarity entails working together and cooperatively to achieve a common goal. The third value, compassion, refers to the human's ability to understand other people's challenges and problems. Compassion is fundamental to the feeling of belonging and interconnectedness among African communities. The last values of the theory, respect and dignity are important for a high regard for rights, values and beliefs for others, irrespective of diversity. Dignity is a behaviour or a trait that can earn someone respect. For Africans, if a person seeks to achieve a positive engagement with members of the community, respect and dignity are paramount requisites (Mbigi, 1997).

The CFT, becomes a collective, supportive and social process, as opposed to individual and competitive experience (Ngubane & Gumede, 2018). Furthermore, learning within the context embodied by the Ubuntu core values of survival, solidarity spirit, compassion, respect and dignity can reunite indigenous students with their African value systems. Based on these positive implications of applying the CFT, this study draws from the Collective Fingers Theory, to examine the extent to which the principles of Ubuntu philosophy can cultivate and restore African indigenous values and cultures and transform educational practices in diverse South African classroom.

3. The implementation of Ubuntu principles in a drama text

The focus of the implementation of Ubuntu principles was on the development of the interconnectedness of characters for the success or failure of the principles of Ubuntu be identified by the students in the drama text. Students were divided into four groups, reading of a drama text, using the principles of Ubuntu to critically reflect on issues raised in the text and engaging on activities that critically challenge the ideas emerging from the text. Before the implementation, students were given open-ended questions in which they were asked to provide their understanding of the concept of Ubuntu and prepare them to establish that all the facts that are vital to the interconnectedness of characters for the success or failure of the principles of Ubuntu in the text be identified. Responses were consolidated into a summary and discussed before the class commenced. Once the students internalised the concept of Ubuntu interconnectedness, the principles were made into posters and pasted on the walls to remind, guide and assist the incorporation during learning. This way activities mediated academic reading, critical thinking and supported the development of specific discourse among the students.

To introduce critical reading of the text, questions were posed by the lecturer, to analyse the characters in the text for the success or failure of the role they are playing when using Ubuntu principles of sharing. The questions were to assist students gain insight into the author's purpose of writing and for detection of possible bias in the text. Critical reading and analysis also entailed that students could differentiate between the fact and author's opinions and learn to challenge questionable assumptions and unsupported claims in the text. Through questions while reading and after reading, the lecturer guided students to identifying contradictions and competing claims and evaluate evidence presented by the author. It was also important to encourage students to draw own conclusions instead of accepting the author's words. Van Wyk and Greyling (2008) argues that academic literacy involves skills to interpret different kinds of text type, understanding the meaning they convey and the target audience; make meaning texts beyond the level of sentences; knowing what counts as evidence for an argument and making distinctions between essential and non-essential information, fact and opinions. The lecturer designed the questions and for some articles, questions were provided for students to critically engage with the text. After each reading, questions were posed to groups to ignite interactions and discussions and to stimulate critical thinking processes. In small groups, students were encouraged to challenge and question authors views and opinions and through debates and discussions. Students attempted questions, summarising each other's ideas, asking each other for clarification on their ideas, challenging each other's opinions in a more respectful manner and appreciating each other's way of thinking and beliefs.

4. Data collection

Qualitative data collection techniques were used in this study using Interviews. Interviews were conducted with 22 second year students who major in Setswana as their home language to identify the characters that maintained and contravened "sharing" as the principle of Ubuntu. Data obtained from interviews were sorted and categorised into themes and analysed from the text systematically. Discussions were held with students to point out the challenges they encountered during the reading and understanding of the drama text. Responses were analysed to identify similarities in the responses as well as differences. Similar ideas were grouped into themes. Furthermore, the interviews were conducted randomly from the group. The purpose of the interviews was to explore the students' perceptions to identify the characters in the drama text that maintained and contravened "sharing" as the principle of Ubuntu for their support programme. All interview responses were tape recorded and transcribed immediately after the interviews. Interview questions sought to understand how students felt about using sharing as the principle of Ubuntu for their learning, to explain the aspects that they felt promoted in establishing interconnectedness of characters for the success or failure of the principles of Ubuntu in their prescribed drama text.

5. Results and discussions

All 22 students responded to the open-ended questions and were analysed. At the end of the lesson, interviews were used to collect the data from 11 students. Data from the interviews were analysed with the indication that prior to the lesson, students had their own understanding of what the concept of Ubuntu means. Out of 22 responses on the questions of how sharing is used as the principle of Ubuntu to develop the interconnectedness, that characters interact with one another in the selected drama text, 11 respondents indicated that after reading with understanding, and the explanation they got from the lecturer, they could easily analyse the characters when reading that their behaviour and attitudes could tell that they succeed or fail in the implementation of using sharing as the principle of Ubuntu in the selected drama text. From the responses the students provided, one could see that students understood and enjoyed reading the selected drama text. This is how four participants responded when asked how sharing is used as the principle of Ubuntu to develop the interconnectedness, that characters interact with one another in the selected drama text:

Student 1:

> "Using sharing as the principle of Ubuntu in the drama text, refers combined effort of individuals for the survival of their community. The existence of and the survival of the indigenous of African communities was maximised by interdependence and interconnectedness among community members. The principle of sharing entails the commitment and willingness by community members to abandon the acts of individuality and 'self' for the mutual flowering of the entire group. For example, in the drama text, Tiroeng was very considerate to slaughter the cow and share it amongst the community so that every household could have food on the table. There should no one to be left with hunger in the village they lived in".

Student 2:

> The principle of sharing thrives on unity, unconditional love and respect for one another, mutual interest for collective survival and responsibility towards fellow members as opposed to selfishness and competitiveness towards or among African community members. One student in the group explained further that the spirit of sharing is best epitomised by a metaphor that "one finger cannot crush a grain of wheat on its own, it needs the help of the other four fingers" in her explanation; the ability of humans to interdependently pull together in a 'one for all and all for one' spirit is the value of sharing. I this context, she refers to Tiroeng who is very rich in the village, he is warm and loving, he cares for his community and is always willing to help.

Student 3:

> For me, the principle of sharing is the ability to live with others in harmony. It is framed by mutual Ubuntu values of respect, one of the educational goals is to promote peace and coexistence in educational settings. Coexistence thrives on mutual independence among members of the group, cooperation and mutual respect. Sharing as ubuntu principle is more concerned with the fact that as human beings we cannot exist in isolation. Tiroeng know very well that no man is an island. He is surrounded by people who work for him and give advice with honesty.

Student 4:

> I understand this question regarding the characters in the text that; the sharing as the principle of Ubuntu asserts that human ability to understand others dilemma and challenges is compassion. For

me, compassion promotes feelings of belonging and interconnectedness observed in African communities. Compassion is probably one of the most important principles of Ubuntu philosophy and the indigenous African way of life. It is a sense and feeling of care, sympathy and concern for another person which becomes evident through helping another human being, sharing and showing sympathy towards others. Showing kindness through sharing and sympathy towards another human being is important in African cultures. Sharing what you have with another is confirmation of belonging and brotherhood in African cultures. The student further explains that compassion explains love and caring for one another and motivates feelings of "I cannot have all while you have nothing". Tiroeng could not afford to see his village people starving while he has plenty at his disposal. He would share what he has with his people because he cares and loves them.

Student 5:

The value of the spirit of sharing embrace principles of social justice. My understanding is that social justice relates to principles of equality, equity and fairness towards members of a community or individuals who have been previously marginalised, disadvantaged or excluded economically, politically and socially based on their race, gender, social class, language, religion, sexual preference and beliefs. Equally, where Ubuntu principle is recognised, there is respect for diversity in religion, race, gender, beliefs, sexual orientation and language. Lecturers practising within Ubuntu perspectives provide all students, irrespective of their cultural, linguistic, social class, religion and sexual orientations, with equal opportunities to develop and to exercise their full capacities. The student refers to the teaching of characters in the drama text, that lecturers do not favour and student when teaching, she is treating all students equally so that they all enjoy and understand the content of the drama text. Tiroeng, as the main character, he values every member of the society, he respects them and makes them feel that they all belong to the community.

Data show that students understood the role of ubuntu in the creation of conducive teaching and learning environment. Important data for this study also came from the question on how much Ubuntu is practiced in their classroom. On this question, data from participants differed. On one side, some students felt that ubuntu practices were evident in their classroom because they could analyse the themes and give example from the drama text. On the other hand, the lecturer was kind and helpful to them, she was showing solidarity and compassion. Data from the other side to establish that all the facts that are vital to the interconnectedness of characters for the success or failure of the principles of Ubuntu indicated that students felt that "no one is an island in higher education" said one participant, Tiroeng needs people to help him even though he is rich and has everything at his disposal. One person cared about the next person" responded another student. The study implemented sharing as the principle of Ubuntu to establish that all the facts that are vital to the interconnectedness of characters for the success or failure of the principles of Ubuntu in engaging students to participate in the classroom where they could analyse themes and provide examples from the textbook. Students are motivated to interconnect the characters in the drama text by using Ubuntu principles. They are encouraged and inspired to compare the use sharing as the principle of ubuntu in the drama text. While the drama text was used to promote critical reading and critical thinking, cooperative learning groups and open-ended critical questions based on the text was used to stimulate debates and discussions among group members. It was within these activities that the researcher was interested in understanding how students would utilise the principles of ubuntu to engage with the tasks and to learn. At the end of the lesson. students were interviewed to solicit their experiences of Ubuntu principles within their teaching and learning context. Data from interviews indicated that students enjoyed the Ubuntu-centred teaching and learning environment. It also showed that positive academic benefits for students as they indicated that the learning environment was more supportive. Students established that all the facts that are vital to the interconnectedness of characters in the selected drama text are for the success.

6. Conclusion

The investigation has indicated that ubuntu remains an important component of African way of life, including education. Ubuntu principles of solidarity, respect, communalism, compassion and love hold high impact for promoting respect among students, sharing of ideas and knowledge, cooperation, caring for one another and fostering of feelings of unity and love towards fellow students as findings from this study indicated. These aspects can bring peace and social cohesion among university students and encourage success for all. The study revealed that a higher education learning setting that bases its practices through sharing, diligence, respect, dignity, caring and support, and integrity is highly likely to yield better learning outcomes that will hopefully increase student success in the interconnectedness of the characters in the selected dram text. Hence, sharing as Ubuntu principle could be an attempt to combat the problem of high failure and attrition rates among second-year students. Students established that all the facts that are vital to the interconnectedness of characters are for the success.

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ARTIFICIAL INTELLIGENCE TOOLS IN SPECIALIZED MBA COURSEWORK FOR MEDICAL PROFESSIONALS

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Abstract

We report on active and engaged learning with collaborative inquiry in the AI enhanced, MBA professional track coursework. In this coursework, we utilize a teaching approach that requires students to derive knowledge by engaging collaboratively with medical center partners, and it has proven more effective than traditional didactic approaches in developing innovative thinking, knowledge creation capacity, and professional skills. With this approach, dubbed, Nexus Learning, students learn by designing and constructing actual solutions to real-life medical problems. AI enhanced, MBA course projects outcomes are tied to curriculum and learning goals, and are based on authentic real-world issues that students care about, and exhibit empathy for patients who go through those issues. Simulated exercises utilizing IBM® Business Analytics Enterprise software that provides a single entry no-code content hub to discover, personalize and recommend business analytics content, is utilized. It is an analytics platform that combines predictive analytics, reporting, data analytics and data integration capabilities natively out-of-the-box to help students navigate real data healthcare challenges. In addition, AI Trilogy package is employed to provide students with actionable recommendations based on the data. It provides analysis of independent variables (inputs) to help determine which ones are most important in the healthcare models. At Jefferson Center for Digital Health, we seek to provide answers and explore the processes, actions, challenges, and outcomes of learning, teaching, and research. The goal is to provide a platform for professors, students, researchers, from a range of academic fields, interested in exploring and giving their contribution to educational issues that impact health and wellbeing of communities. The International Conference on Education and New Developments (END) provides an avenue to promote growth in research methods intimately related to teaching, learning, and applications in Education. It aims to illustrate developments and new ways of thinking in Projects and Trends, as well as Teaching, Learning, and Research, and their impact on healthy and thriving communities.

Keywords: *Higher education, Artificial Intelligence, MBA professional track coursework.*

1. Changes in educational theory and learning

Noteworthy, Thomas Jefferson University (TJU) was an academic medical center with a campus in the center of Philadelphia that has a long history rooted in the graduate health sciences. Philadelphia University, on the city's outer edge, had a long history rooted in undergraduate education, particularly in design, engineering, and business. In 2017 these two universities merged and are now known as Thomas Jefferson University. The East Falls campus, formerly Philadelphia University, has a long history of student research and scholarship, and had experienced success with a signature pedagogy known as Nexus Learning. Nexus Learning actively engages all learners in a collaborative approach to solving real-world problems and uses a humanistic approach to designing effective solutions (Frisby and Sztandera, 2020).

Educational theories of learning have changed as well. Professors encourage group learning activities following constructivist models. Students work in teams to solve real world problems. Thomas Jefferson University has captured these components and integrated them into Nexus Learning "with a little help of your friend" Artficial Intelligence (Sztandera and DiSantis, 2024).

2. Active and engaged learning with empathetic inquiry

Active and engaged learning, along with empathetic inquiry, as well as use of health and social issues and experiences, supported by the strong integration of life sciences with professional disciplines, has defined Nexus Learning approach. As reported before by Mathews and Soistmann (2016) as well as Frisby and Sztandera (2020), campus learning spaces, including libraries and team meeting places, had to be re-designed to represent innovative rethinking of the classroom space that allowed the learning facilitator to be less encumbered by the physical constraints of space, furniture and technology. Those spaces ultimately enhanced student learning and creative teaching.

For example, Nexus Learning classrooms allowed for seamless transitions to different modes of active and engaged learning. The knowledge hubs also optimized collaborative involvement for all students through movable furniture and appropriate technologies that fosters co-creation and sharing of ideas. Our students self-reported significant gains in class participation, ability to focus, Professor feedback opportunities, learning through multiple means, physical movement, stimulation, and comfort level in Nexus Learning classrooms compared to traditional classrooms on campus, as indicated in Frisby and Sztandera (2020).

3. Artificial Intelligence focus

Data scientists are in high demand, with employment in industries ranging from business, engineering, health and medicine expected to increase by more than a third until 2033, according to the U.S. Bureau of Labor Statistics (2024). Under an exemplary leadership of Thomas Jefferson University President, Dr. Susan Aldridge, Jefferson is meeting this demand for data-savvy professionals who can make sense of vast troves of information with courses and degree programs in academic schools and colleges across the University. Now faculty experts from diverse disciplines who teach and research on data are coming together in the new programs in the School of Business, School of Design and Engineering, as well as Computational Medicine program in the Jefferson College of Life Sciences. The three new graduate Data Science programs are expected to infuse fresh energy into existing data-centric programs and support the students, as well as foster increased collaboration among faculty. Starting Fall 25 semester, new graduate Data Science initiatives provide a platform under which Jefferson students and faculty can engage in innovative approaches to the use of data in modern society to have community impacts, develop cutting-edge educational outcomes, and initiate interdisciplinary research projects.

As Universities and Colleges update their classrooms to enable active learning methodologies, adjust their student-centered teaching approaches, Artificial Intelligence aided curricula could provide meaningful support to teaching and research communities in academia to affordably educate professional students. Large amount of data are collected through clinical trial processes, including multimodality imaging/treatment planning/verification digital data, associated pre- and post-treatment (quantitative) imaging data, and associated metadata, including outcomes. The most impactful data are focused on the "self-seeding" of prostate cells with metastatic properties back to the site of origin, contributing to disease progression. As the capabilities of Artificial Intelligence (AI) surge, the healthcare sector is rapidly finding new ways to use Genetic Algorithms and Machine Learning for patient care. Specialized, AI enhanced, professional track MBA courses aid medical professionals in that mission. In particular, MBA Competitive Intelligence course provides a comprehensive hands-on exposure to Data Analytics through IBM® Analytics software.

The IBM® Analytics software and Artificial Intelligence (AI) Trilogy package have been utilized to provide students with actionable recommendations based on real-life data. The software packages provide in-depth analysis of independent variables (inputs) to help determine which ones are the most significant and differentiating in the models. In our cases, in research supported by Jefferson Center for Digital Health, the power of Artificial Intelligence approaches in the specialized graduate coursework for medical professionals, students discuss the experiences with AI in processing Prostate Cancer data, for example, AI highlights and advantages, as well as ethical issues associated with its use. The MBA students, many of them practicing physicians and professional staff, work in teams to solve real medical problems and design new medical equipment with solid business models. All of it with a little help from their friend, AI. Students work on development of models to discover and prioritize data patterns to provide information and actionable knowledge to stakeholders as well as public health policy decision makers. Artificial Intelligence is used: 1. To explore data to find new patterns and relationships (data mining); 2. To evaluate and test previous decisions (randomized controlled experiments, multivariate testing); 3. To explain why a certain outcome happened (statistical analysis, descriptive analysis); and 4. To venture into the future (forecast) results (predictive modeling, predictive analytics). All four research avenues capture very well the significance and impact of Artificial Intelligence to discover hidden and and actionable outcomes. These packages listed below are part of the AI Trilogy business and scientific Artificial Intelligence software that was highlighted previously in (Sztandera and DiSantis, 2024).

NeuroShell Predictor

The NeuroShell Predictor contains state-of-the-art algorithms that train extremely fast, enabling you to effectively solve prediction, forecasting, and estimation problems in a minimum amount of time without going through the tedious process of tweaking neural network parameters. Designed to be extremely easy to use, this product contains our most powerful neural networks, it reads and writes text files for compatibility with many other programs. The prediction algorithms are the crowning achievement of several years of research. Gone are the days of dozens of parameters that must be artistically set to create a good model without over-fitting. Gone are the days of hiring a neural network expert or a statistician to build your predictive models.

The two training models available to the students are:

1. The first training method, which is called the “neural method” is based on an algorithm called Turboprop2, a variant of the famous Cascade Correlation algorithm invented at Carnegie Mellon University by Fahlman and Lebiere (1990), TurboProp2 dynamically grows hidden neurons and trains very fast. TurboProp2 models are built (trained) in a matter of seconds compared to hours for older Neural Newtorks.
2. The second method, the “genetic training method”, is a genetic algorithm variation of the General regression neural network (GRNN) invented by Specht (1991). It trains everything in an out-of-sample mode; it is essentially doing a "one-hold-out" technique, also called "jackknife" or "cross validation". If you train using this method, you are essentially looking at the training set out-of-sample. This method is therefore extremely effective when you do not have many patterns on which to train. The genetic training method takes longer to train as more patterns are added to the training set.

NeuroShell Classifier

The NeuroShell Classifier was crafted from the beginning to help optimization of classification and decision-making problems. NeuroShell Classifier can detect categories in new data based upon the categories it learned from case histories. Outputs are categories such as {cancer, benign}, {buy, sell, hold}, {acidic, neutral, alkaline}, {highly qualified, qualified, unqualified}, {winner, loser}, {product 1, product 2, … , product N}, {decision 1, decision2, … , decision N}. Like the NeuroShell Predictor, it has the latest proprietary Neural and Genetic Algorithms classifiers with no parameters to set. It also reads and writes text files, which is of the highest importance to process data from patient interviews.

The classification algorithms are the crowning achievement of several years of research of software development. Gone are the days of dozens of parameters that must be artistically set to create a good model without over-fitting. Gone are the days of hiring a neural network expert or a statistician to build the predictive models.

There are two training models to select from:

1. The first training method, which is called the “Neural Method” is based on an algorithm Turboprop2, a variant of the famous Cascade Correlation algorithm invented at Carnegie Mellon University by Scott Fahlman (1991). TurboProp2 dynamically grows hidden neurons and trains very fast. TurboProp2 models are built (trained) in a matter of seconds compared to hours for older Neural Networks types.
2. The second method, the “Genetic Training Method”, is a genetic algorithm variation of the Probabilistic Neural Network (PNN) invented by Donald Specht (1991). It trains everything in an out-of-sample mode; it is essentially doing a "one-hold-out" technique, also called "Jackknife Procedure" or "Cross Validation". If one trains using this method, one is essentially looking at the training set out-of-sample. This method is therefore extremely effective when one does not have many patterns on which to train. The Genetic Training Method takes longer to train as more patterns are added to the training set.

GeneHunter

The Genetic Method provides an analysis of independent variables (inputs) to help determine which ones are dominant, most contributing ones in the selected approach. GeneHunter is a powerful software solution for optimization problems which utilizes a state-of-the-art Genetic Algorithm Methodology. GeneHunter includes an Excel Add-In which allows the user to run an optimization problem from Microsoft Excel, as well as a Dynamic Link Library of Genetic Algorithm functions that may be called from programming languages such as Microsoft® Visual Basic or C.

Genetic Algorithms (GAs) seek to solve optimization problems using the methods of evolution, specifically survival of the fittest. In a typical optimization problem, there are a number of variables which control the process, and a formula or algorithm which combines the variables to fully model the process.

The problem is then to find the values of the variables which optimize the model in some way. If the model is a formula, then we will usually be seeking the maximum or minimum value of the formula. There are many mathematical methods which can optimize problems of this nature (and very quickly) for fairly "well-behaved" problems. These traditional methods tend to break down when the problem is not so "well-behaved", or when it is a real-life medical domain problem.

The power of Artificial Intelligence approaches, as related to increasing the efficiency of medical image processing, is explored in the MBA Professional Track coursework. In terms of pattern recognition, essential for proper medical diagnosis, development of models to discover and prioritize data patterns, to provide information and actionable knowledge stakeholders as well as public health policy decision makers, is explored. Artificial Intelligence is used: 1. To explore data to find new patterns and relationships (data mining); 2. To evaluate and test previous decisions (randomized controlled experiments, multivariate testing); 3. To explain why a certain outcome happened (statistical analysis, descriptive analysis); and 4. To venture into the future (forecast) results (predictive modeling, predictive analytics). All four research avenues capture very well the significance and impact of Artificial Intelligence to discover hidden and actionable outcomes.

4. Conclusions

As the capabilities of Artificial Intelligence (AI) surge, the healthcare sector is rapidly finding new ways to use Neural Networks, Genetic Algorithms and Machine Learning for patient care. Specialized, AI enhanced, professional track MBA courses aid medical professional in that mission.

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ADDRESSING THE NEED FOR COMPREHENSIVE SEXUALITY EDUCATION IN ITALY

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Abstract

Many countries lack the systematic implementation of age-appropriate and culturally relevant Comprehensive Sexuality Education (CSE) in schools and comprehensive teacher training programs, even if CSE is widely recognized as a fundamental human right. In Italy, teacher training is typically available only through voluntary courses outside the academic context, which often come at a high cost, making them inaccessible to many. CSE views sexuality, in its broadest sense, as a fundamental aspect of human life that evolves from early childhood. A lifelong learning process is required to address a wide range of topics, which can be categorized into several macro areas: sexual health, sexual identity, and its development, rights, the LGBTQIA+ community, emotions and relationships, intimacy, and sexual behaviors (private, public, healthy, and risky), consent, respect, and gender-based violence, contraception, sexually transmitted infections, sexual development, sexual pleasure, stereotypes, socio-cultural and personal influences, and educational planning for different age groups. For these reasons, the UNI-T project – a collaborative effort initiated in 2022 within the network of European universities CIVIS alliance, aimed at enhancing teacher education across Europe through innovative, international, and practical approaches – introduced the blended learning course Sexuality Education Training for Teachers and Educators (SETTE). The course aims to raise teachers' awareness of educational needs, helping them recognize how their own beliefs influence the messages they convey to students. Its goal is to create safer, healthier school environments where students can express their sexuality openly and respectfully. The course focuses on improving knowledge of CSE, developing educational skills, promoting positive and respectful attitudes, and fostering critical reflection. The course is considered complete after participants successfully finish two assessments: the evaluation of all modules' training and a final questionnaire.

Keywords: *Sexuality education, teacher's training, Italian school education, blended learning.*

1. Introduction

Italy has a long story with Sexuality Education (SE). While many speculations are focused on the religious Italian context or conservative perception toward sexuality (Lavizzari & Prearo, 2019; Parker et al., 2009), others focus on the sexuality concept. Since 1975, with the first law draft proposal, nothing has changed regarding SE implementation in schools and training programs (Bruno, 2024). In the present work, sexuality is considered an integral part of life experience in all its aspects – sociocultural, moral, ethical, psychological, emotional, and biological – that can influence and be influenced by personal beliefs, experiences, and life context (WHO & BZgA, 2010). Consequently, a comprehensive SE (CSE) refers to a lifelong learning process that begins in early childhood education. It follows the individual's development (ibidem) to guide people in their sexual exploration and disclosure to provide a safe and healthy approach to own and other sexuality. The elective setting would be each school's grade and level, adapting the CSE contents to the different ages of students and their sociocultural context, maintaining a shared responsibility with family's education and society's openness to every sexuality (UNESCO, 2018). However, only a few countries have laws supporting CSE in schools, and among these countries, there is Italy (IPPF, 2018; UNESCO, 2023), leading to poor teacher training and strengthening the false cultural myths about sexuality. In-service teachers perceived indeed a lack of knowledge regarding sexual topics, along with discomfort when forced to answer students' questions or to face problematic situations; moreover, they state the importance of CSE in school and a willingness to be trained and then a strong motivation to teach CSE in their lessons (Ang & Lee, 2017; Bruno et al., 2024; Klein, 2021). Global comparisons emphasize the need for training and investments to increase knowledge and skills regarding CSE in schools and to research new teacher and educator training models (UNESCO, 2021; 2023).

The urge and need for training aligns with the UNI-T project launched as a collaborative initiative within the CIVIS alliance, a European universities' network that aims at enhancing teacher training and education through innovative, international, and practical approaches. Specifically, CSE training would align with Work Package 2 (WP2), which focuses on developing and implementing blended learning modules (BLMs) designed for pre-service and in-service teachers. The BLMs foster collaboration between educators or teachers and institutions locally and internationally, enabling several mobility mechanisms within the UNI-T project, including physical and virtual formats, creating a hybrid instructional approach that maximizes flexibility, accessibility, and resource optimization (Graham et al., 2003). Furthermore, it fosters more profound learning and the development of critical competencies (Coyle et al., 2019). UNI-T project works through four strategies: (1) developing hybrid learning modules based on literature and exchanges between participants; (2) providing webinars and summer schools to encourage transnational and intercultural dialogues with different educational actors, such as schools, universities, and educational institutions; (3) emphasizing transnational action research projects bringing together teachers and educational actors with researchers; and (4) offering a transversal approach to the mobility of students, in-service and pre-service teachers and educators, including open badge recognition systems.

In 2025, the project will introduce a course dedicated to CSE for the first time. Specifically, the Sexuality Education Training for Teachers and Educators (SETTE) course. This pilot teacher training will focus initially on Italian in-service educators and teachers, offering an opportunity for mobility within the national context and online exchanges of knowledge, experiences, and practices among participants. The decision to begin with Italian educators and teachers is due to the legal, educational, cultural, and social differences among the countries involved in the UNI-T project. Hence, this training aims to fill a training gap in responding to the teachers' needs, providing collaboration and mobility opportunities between teachers of Italian schools to increase their knowledge and skills about CSE implementation.

2. Design

The SETTE course follows CIVIS's recommendation, integrating international guidelines for CSE teacher training. Specifically, the Plan International documents (2020a; 2020b; 2020c) recommend a maximum of 5 days of training on several topics regarding individuals' sexuality. The SETTE course provides seven training modules respecting the Standard for the European Union (WHO & BZgA, 2010) regarding the topic to discuss in CSE and from the cited recommendations.

Using BLMs, the SETTE course provides a first meeting divided into two in-person sessions. Then, it offers an autonomous study on the CIVIS platform, where participants will find materials and references. Each module will indeed provide a full package with PowerPoint presentations and additional references material to explore the specific topic in greater depth, including a summary of activities or materials that can be implemented in schools, divided for different ages, as well as videos, online references, or book recommendations. To monitor the training, at the end of each module, there will be self-assessment questions on knowledge, expectations, and reflections regarding the module. An intermediate online meeting will allow discussion about critical questions raised from the training during the individual study. To those who want to explore the contents and increase their knowledge of the Italian context, it will be possible to download the package in English. However, some steps of this pilot teachers' and educators' training are exclusively in Italian. Those are the two days of face-to-face meetings, the middle course online meeting, and the online final questionnaire.

Below is a brief description of the topics that the modules will address.

- Definition of CSE, educational and training standards, application methodologies, strategies, materials, and sexual rights; general practical implications: methodological approach of the teacher or educator, reference bibliography, creation, and use of a support network.
- Emotions, feelings, and relationships – intimate, friendly, relative, and other relational relationships – and types of families: dual-parent, single-parent, same-sex parent families
- Sexual identity, physical and sexual development, gender stereotypes and gender-based violence, consent and respect; additionally, socio-cultural influences and values such as sexuality and religion, consequences of pornography abuse, and cultural transmission of stereotypes.
- Inclusion and visibility of diversity; contraception, reproduction, and sexually transmitted infections/diseases.

2.1. Objectives

The SETTE course aims to fill a critical gap in Italian teachers' and educators' training, enhancing teachers' and educators' technical competencies and fostering a reflective approach that is essential when addressing complex and sensitive subjects like sexuality. By covering several topics, the course promotes inclusivity, aligning with recent calls for educational and training programs that support social cohesion and equality (Jiménez-Ríos et al., 2023); it aims to increase knowledge of CSE, enhance educational skills

regarding the topic, and promote positive and respectful attitudes, as well as critical reflection. The approach utilized will focus on sexual rights (WAS, 2014), specifically on number 10 – the right to have a sexuality education – aiming to promote rights' protection in the school context while ensuring safe and healthy sexual development for everyone. Furthermore, by providing new teacher and educator training on sexuality education, the SETTE course aims to the goals number 3 (Good health and well-being), 4 (Quality education), and 5 (Gender equality) of the 2030 Agenda, emphasizing the role of educators in fostering a more inclusive, equitable, and sustainable future (IPPF, 2016; UN, 2015; UNESCO, 2023).

2.2. Methods

Participants will enroll in the SETTE course by answering a brief online registration form. To permit everyone to be part of a significant experience, the course will have a maximum number of participants. The course will open to a maximum of 50 in-service teachers or educators to allow everyone to participate actively and collaboratively.

The SETTE course is divided into seven modules. Below is a brief description of the course.

The first two in-person sessions – one on a Friday morning and one the following Saturday – will introduce the Sexuality Education concept, definitions, and the three known approaches. Beginning with the separation of sexuality from the idea that it is just sexual intercourse, the course will address methodologies, strategies, and materials for future CSE implementation, sharing opinions and experiences or transversal practices applicable even to sexual topics. Lastly, school planning for interventions, projects, or lessons on CSE topics will be discussed.

The course will continue online for the remaining six modules with more independent learning. Specifically, the second module will discuss consent and relationship topics, addressing the school and classroom context by describing the phenomena of violence and discrimination regarding sexuality, like homolesbobitransfobia, bullying, gender stereotypes, and sexual and gender violence. Finally, the topic of online sexual activities will be addressed, with a specific focus on sexting, which has become increasingly popular among younger people in recent years. The third module will cover physical and sexual development, childhood sexual behaviors, emotions, and self-determination. The fourth module will specifically address sexual identity with its four components – assigned sex at birth, gender identity, sexual and romantic orientation, and gender expression – and its development, discussing also stereotypes, sexual stigma, heterosexism, and social heteronormativity.

There will be an online meeting between the fourth and fifth modules to discuss the topics covered until then. The course will continue as previously – online and autonomously – with the fifth module focusing on adolescence and adulthood, sexual pleasure and sexual dysfunctions, and desire. The sixth module will specifically address the theme of visibility, not inclusion, because it will offer training regarding the sexuality of people that society includes but does not see or does not consider. Consequently, this module will cover disability, third age, and the importance of broad language according to the various sexual identities. The seventh and last module will conclude the training by covering contraception, sexually transmitted infections and diseases, and voluntary termination of pregnancy. The decision to discuss these medical aspects at the end of the training is due to the refusal to categorize sexuality education solely as the prevention of risks and negative consequences of sexual relations and intercourse; by doing so, the SETTE course considers all the topics addressed equally important, while at the same time trying to combat stereotypes and beliefs related to sexuality.

At the end of the training, a final assessment questionnaire with closed and open questions will be administered. The course is completed when all modules and the final questionnaire have been properly completed.

3. Conclusions

In Italy, CSE teacher training is often left to the individual's discretion; teachers and educators choose to enroll in training through external professional courses or academic studies and then to include and address CSE topics in their educational activities in school. To develop future shareable, replicable, and culture-based CSE teacher training programs, it is necessary to focus on increasing the implementation and assessment of teacher and educator training designs. While for some CSE means teaching sensitive and challenging topics, for many it is necessary to develop crucial skills for daily life. CSE has three objectives: to increase and improve knowledge by imparting information and skills, enabling recipients to apply their knowledge, and finally, positive attitudes, helping develop a respectful self and other view. The SETTE course, therefore, contributes to an important paradigm shift, positioning sexuality education within a framework of human rights and digital literacy, both vital in contemporary education (Goldfarb & Lieberman, 2021). Whitin the UNI-T project, the SETTE course benefits teachers and educators and aligns with broader recommendations that advocate for CSE in schools. Further research is encouraged to explore the long-term impacts on teachers, educators, and student attitudes, as well as the potential of the SETTE model to support a rights-oriented education.

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EXPLORING TEACHERS' PERCEPTIONS OF SELF-REGULATED LEARNING IN PRIMARY SCHOOLS: INSIGHTS FROM INTERMEDIATE-PHASE TEACHERS IN SOUTH AFRICA

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Abstract

The summary report of the National Education Evaluation and Development Unit (NEEDU 2018) states the reason for the South African school education crisis and the problem of underperformance in schools is primary schools. Primary schools have not received much attention during the education crisis in keeping up with education, which is suitable for the twenty-first century and the Fourth Industrial Revolution. Self-regulated learning skills have become increasingly crucial in the 21st century, both within education and beyond, as it equip learners with knowledge and skills that improve academic performance and lifelong learning. Teachers' perceptions of self-regulated learning play a pivotal role in shaping how learners develop autonomy, motivation, and effective learning strategies to achieve academically. Recognizing and enhancing these perceptions is essential for fostering learning environments that support self-directed and lifelong learning. Teachers' knowledge and beliefs about SRL directly impact their teaching strategies. If teachers lack familiarity or confidence with SRL concepts, they may struggle to integrate these skills into their lessons. A large body of literature attests to the value of developing self-regulated learning skills in learners, and there is thus a need to identify whether teachers are familiar with the concept of self-regulated learning and have the pedagogical content knowledge to promote these skills in their own learners. In the 21st century, the shift toward learner-centered approaches and the growing need for independent, critical thinkers make self-regulated learning a vital educational priority. The study highlights gaps in teachers' knowledge and training about self-regulated learning offering an opportunity to address these deficits through targeted professional development and curriculum reforms. Against this background, the main aim of this study was to explore what intermediate-phase primary school teachers know and believe about the value of self-regulated learning. The qualitative study is situated within an interpretivist research paradigm, which allowed the researchers to investigate a real-life scenario and the influences that shape teachers' perceptions of self-regulated learning in their daily teaching and learning environments. Purposive sampling allowed the researchers to select five participants from each of the three schools. Data was collected by single, semi-structured face-to-face interviews. Findings indicate while participants see the value of self-regulated learning and their role in fostering it, their limited knowledge and training on the concept hinder effective implementation. Various recommendations are made to address these gaps through professional development courses and training which is essential to enable teachers to guide learners in developing self-regulated learning skills.

Keywords: *Self-regulated learning, teachers, perceptions, pedagogical content knowledge, professional development.*

1. Introduction

Primary schools are the primary source of the South African school education crisis and the issue of low academic performance, according to the National Education Evaluation and Development Unit's (NEEDU 2018) summary report (Agbenyegah, 2022). In the NEEDU (2018) report, the Minister of Basic Education acknowledges the crisis in South African school education, noting that the primary schools, which have received little attention, are a fundamental cause of this underperformance. Moreover, amidst the education crisis, primary schools have not had enough attention to keep up with the Fourth Industrial Revolution and 21st-century education.

In the twenty-first century, self-regulated learning (SRL) skills have grown in importance in the classroom and beyond because they give learners the information and skills they need to succeed academically and pursue lifelong learning (Taranto & Buchanan, 2020). According to Fuentes et al. (2019),

SRL is the process through which learners actively take charge of their educational journey, controlling their behavioral, emotional-motivational, cognitive, and metacognitive elements to meet their academic goals. Self-control in learning environments which is aligned with SRL behaviour improves one's capacity for problem-solving, academic achievement, intrinsic drive, and task interest. Moreover, SRL also offers social and behavioral advantages, particularly within communities of learners engaged in co-regulated or shared regulation (Hadwin et al., 2017).

Teachers' views on SRL significantly influence learners' motivation, autonomy, and study skills (Karlen et al., 2023). Enhancing teachers' perceptions of SRL is crucial for fostering environments that promote SRL, self-directed, and lifelong learning, as teaching practices are shaped by these perceptions (Ehlers, 2022). Teachers unfamiliar with SRL or lacking confidence in it may struggle to integrate SRL practices into their classrooms (Greenquist-Marlett et al., 2025). Studies highlight the need to ensure teachers understand SRL and possess the pedagogical knowledge to guide learners in developing these skills (Greenquist-Marlett et al., 2025; Kramarski & Heaysman, 2021). SRL is a critical priority in the 21st century, aligning with learner-centered approaches and the demand for autonomous, critical thinkers.

Due to the limited research on South African primary school teachers' understanding and beliefs about SRL, this study is essential. South Africa has significantly fewer SRL studies compared to the rest of the world (Alharbi, Paul, Henskens & Hannaford, 2011; Zimmerman, 2013). As noted by Schulze and Van Heerden (2015), most SRL research, both locally and internationally, tends to focus more on higher education rather than on primary and secondary education. The main aim of this study was to explore what intermediate-phase primary school teachers know and believe about the value of self-regulated learning. This investigation furthermore aims to enhance the limited understanding of teachers' perceptions of SRL within the context of primary school education in South Africa.

2. Literature review

Teachers' perceptions of self-regulated learning (SRL) are shaped by a complex interplay of factors, as highlighted by various studies (Greenquist-Marlett et al., 2025). Karlen et al. (2023) emphasize that beliefs, attitudes, and prior knowledge of SRL strategies interact to form teachers' understanding and beliefs about SRL. Central to this process are teachers' general beliefs about education and life, which influence their attitudes and subjective norms. These beliefs often shape teachers' autonomy in teaching and learning and their willingness to adopt new teaching strategies, making it challenging to dissociate their personal views from their professional practices (Dignath, 2016).

Teachers' engagement with SRL is shaped by beliefs in three key areas: epistemological beliefs about knowledge and learning systems, beliefs about SRL promotion and instructional strategies, and self-efficacy beliefs regarding their confidence and ability to foster SRL (Dignath, 2016). Teachers with strong SRL skills are more likely to value and nurture these skills in learners, drawing from their own experiences. Intrinsic factors like competence, motivation, and self-efficacy also influence their perceptions and knowledge of SRL. Hirt et al. (2022) found a positive correlation between teachers' intrinsic interest in SRL and their promotion of these skills in the classroom.

Even when teachers value SRL, limited content knowledge, low motivation, or lack of confidence can hinder their effectiveness (Greenquist-Marlett et al., 2025). Content knowledge includes understanding SRL terminology, models, methods, and components like metacognition. Pedagogical content knowledge involves strategies to help learners develop SRL skills (Karlen et al., 2023). Teachers lacking both forms of knowledge often rely on teacher-directed approaches rather than promoting SRL (Geduld, 2019).

Recent studies found that despite recognizing the importance of SRL in learners' self-regulatory activities, many teachers struggle to explicitly teach or model these skills in the classroom (de Boer et al., 2018; Dignath & Büttner, 2018). A possible reason can be according to Spruce and Bol (2015) a significant gap between teachers' positive perceptions of SRL and their practical knowledge of its strategies. This misalignment between beliefs, knowledge, and practice often results in the failure to effectively foster SRL in learners. Moreover, teachers' mindsets significantly influence their approach to SRL (Karlen et al., 2023). Some teachers hold personal beliefs and fixed mindsets that their learners are incapable of attaining SRL skills, which further limits their willingness to support learners' academic achievement and lifelong learning skills by implementing SRL skills (Spruce & Bol, 2015). On the other hand, teachers with a growth mindset are more likely to believe that both their teaching and their learners' SRL abilities can improve over time, fostering a more supportive learning environment for SRL development (Karlen et al., 2023).

Pre-service and in-service training are essential, as explicit SRL instruction fosters its appreciation. Experienced teachers often develop SRL strategies over time, while novices may need more guidance. School culture, policies, and curriculum emphasizing autonomy, metacognition, and self-assessment can support or hinder SRL efforts (Ehlers, 2022). Teachers' beliefs about students' abilities, motivation, and prior knowledge, as well as their own self-regulation skills, influence their SRL approach and effectiveness

(Karlen et al., 2023). Collaborative environments, resources, and professional development enhance teachers' SRL implementation and understanding, shaping their ability to foster these skills in students (Geduld, 2019).

3. Research design and methodology

The research paradigm, interpretivism, encompasses this qualitative study. Proponents of the interpretative paradigm believe reality is created by subjective perceptions. According to Maree (2016), the interpretivist paradigm serves as the foundation for any study that examines the perspectives and opinions of both individuals and groups regarding a given phenomenon. This study is appropriate for an interpretivist paradigm because it explores the lived experiences, attitudes, and viewpoints of individual primary school intermediate phase teachers as well as their understanding of SRL.

All 4 528 primary school teachers in the Lejweleputswa area, which has 213 schools, made up the study's population. We chose fifteen individuals from three elementary schools using purposive sampling. Data was gathered by the study's first author through single, individual, semi-structured interviews with participants. To analyze the data using inductive coding, we employed a thematic approach and content analysis. Legal authorities, including the Department of Basic Education and school principals, granted us permission to conduct the research after we requested ethical approval from North West University. The University's ethical standards were consistently followed.

4. Discussion of findings

Based on the responses relating to participants' knowledge and beliefs of SRL one main theme, Knowledge and beliefs of SRL, was created.

Participants' knowledge and beliefs of SRL

The main theme and the five sub-themes constructed give insight to participants' knowledge and beliefs of SRL. The five sub-themes are: Prior knowledge of the concept of self-regulated learning, comprehension of the concept self-regulated learning, the value of SRL for academic learning, instruction to utilise and develop self-regulated learning, and the roles of teachers to develop and enhance self-regulated learning.

Prior knowledge of the concept of self-regulated learning

This is how participants responded when asked if they had practical or theoretical knowledge on how to develop SRL skills in learners: *There was no training that I received on self-regulated learning; it is the teacher who must take an initiative by learning more, going to the internet on what strategies to use when I teach learners (P5S2). Another teacher said: No, the curriculum we did that time was different from the one we are doing now but I must say we also like learners to work on their own, to be independent and not always do everything for them (P4S2). No, I was trained on how to teach learners using different teaching strategies and methods, but nothing on self-regulated learning (P2S2*).

The sub-theme reveals that the teachers' (P3S2, P2S3, P1S2, P4S3, P4S1, P3S3, and P2S1) knowledge and perceptions of SRL are quite limited. Out of 15 participants, only four (P1S1, P3S1, P1S2, P2S2) had prior knowledge of SRL mostly obtained through workshops: *Yes, I came across this strategy during the workshops that I attended (P1S1).* This indicates that formal training on SRL is scarce among the teachers, which may hinder their ability to effectively foster SRL skills in their students. The responses suggest that a significant number of participants (P1S1, P4S1, P3S1, P4S1, P5S2, P4S3) were either unaware of SRL or had vague, uncertain notions about it. This is how one responded: *No, I do not know anything about self-regulated learning or even heard about it (P4S1)*. This lack of understanding and gap in awareness can negatively impact their instructional practices, as teachers who are not knowledgeable about SRL may struggle to identify and develop these skills in their learners (Zimmerman, 2000). Consequently, this sub-theme underscores the importance of professional development in SRL for teachers, as it is essential for creating a conducive learning environment that nurtures learners' SRL.

Comprehension of the concept self-regulated learning

The participants who demonstrated an understanding of SRL described it as a process or strategy that learners use when they learn. The following are how the participants explained their understanding of SRL: *Self-regulated learning is to have control, you take responsibility of your work, and you set goals* (P1S3). *Yes, teaching self-regulation in the classroom is important because the emotions and cognitive areas of the brain may not reach the full potential if children do not continually practice at young age. Self-regulated learning helps to support the children ability to handle their emotions and reactions to new situations (P2S3). Self-regulated learning starts from babies to toddlers, pre-school years, adulthood. It is lifelong learning whereby you are able to monitor the emotional state of learners, e.g., frustrations, whether they are coping or not (P3S1).* These participants have a growth mindset towards the development of SRL

and will be more likely to develop supportive learning environments for SRL development (cf. Karlen et al., 2023).

The value of self-regulated learning for academic learning

According to the responses, teachers perceive SRL as valuable for academic achievement and developing confident, knowledgeable learners in the 21st century. They believe SRL enables learners to work independently and take ownership of their learning. Teachers also recognize their role in guiding learners properly, preparing lessons, and avoiding frustration, which can have a positive impact on learners' academic achievement and lifelong learning skills. The following are two examples of teacher's responses: *... if you can see the world outside now, needs people who are motivated and do things on their own (P3S2). Learners should be made more interested in what I'm teaching, they must be inquisitive, I must push them and give them ideas that there is more to what I'm teaching them (P5S2).*

Instruction to utilise and develop self-regulated learning

The majority of teachers did not receive training on how to develop SRL skills in learners during their initial teacher training or subsequent workshops. *There was no training that I received on self-regulated learning; it is the teacher who must take the initiative by learning more and going to the internet on what strategies to use when I teach learners (P5S2).* Another one concurred: *No, the curriculum we did at that time was different from the one we are doing now but I must say we also like learners to work on their own, to be independent, and not always do everything for them (P4S2).* Only two teachers (P1S3 and P1S1) reported receiving some information on SRL, and this was during their further studies or teaching certification programs. Teachers feel that they lack knowledge on how to develop SRL skills in learners and believe they need to take the initiative to learn more, such as through online resources. The teachers' educational programs and training focused more on content-area knowledge and pedagogical methods rather than principles of learning, development, and motivation, which may have contributed to their lack of knowledge of SRL (cf. Geduld, 2019).

Obstacles to positive teacher beliefs about self-regulated learning

This theme revealed the participants' responses to factors that negatively influence their perceptions of SRL. Seven participants *(P1S1, P2S1, P4S1, P5S1, P2S2, P5S3) indicated that time constraints are a challenge.* P2S2 responded: *Time is a challenge because we are forced to cover the curriculum.* A lack of SRL training and professional development, challenging students, overcrowding, inadequate resources, and a lack of parental participation are some of the causes or barriers participants face daily in public schools. The following verbatim quotes encapsulate their negative experiences: *I have never received any support or workshop on SRL; I do everything on my own (P2S3). The majority of learners in my class do not do their homework... (P2S2).*

Overcrowding in classes is a problem, my class has about 50 learners and it is very difficult as a teacher to give all of them individual attention (P4S1)

Lack of resources, in terms of textbooks, posters, and atlases, because I am also teaching Social Sciences, we don't have a globe to show learners the world. (P5S3).

I don't really involve parents because it's actually a waste of time for me because you call parents, sometimes they don't come when they come if you tell them problems you have regarding their children, they will just say they will be involved but they don't. (P4S1)

5. Conclusion

The teachers who participated in this study may not have a deep understanding of SRL, but they have a positive perception of its potential benefits and recognize the importance of a supportive learning environment for its implementation. This suggests that teachers are open to learning more about SRL and are willing to adapt their teaching practices to promote SRL, given the necessary resources and support. Overall, teachers view themselves as facilitators of SRL, recognizing the importance of empowering learners to take charge of their own learning and development.

Targeted professional development on SRL is essential to equip teachers to support learners effectively. Without it, primary school teachers may struggle to implement SRL strategies, leading to passive learning environments and learners lacking essential SRL skills for academic and workforce success. This knowledge gap hinders teachers' ability to identify and support learners struggling with SRL, reducing engagement, motivation, and performance. As a result, learners may remain unprepared to take responsibility for their learning and develop critical 21st-century skills.

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"FLYING SCHOOL OF TEACHING INTERNSHIPS" – IN SEARCH OF AN ALTERNATIVE MODEL FOR IMPLEMENTATION OF TEACHER INTERNSHIP

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Abstract

The purpose of the speech is to present a two-year (2024-2026) project: *Flying school of teaching internship*, implemented at *Maria Grzegorzewska University* in Poland, within the framework of the ministerial program *Science for Society*. Its main idea is to build cooperation between academia and the community of practice - school-university partnership (Day, 2008) through the creation of the so-called learning community (Smith, MacGregor, 2009) and learning through reflective practice (Schon, 1984). The project was created in response to, on the one hand, the questionable quality of professional practice in teaching courses, and, on the other hand, the common allegation of a growing gap between pedagogical theory and school practice. The theoretical assumptions learned by students in their studies in school practice are usually not implemented, thus perpetuating the traditional constantly reproduced model of school teaching (Gevorgyan, Sargsyan, Aramyan, 2012, Sisyan, Babayan, 2024). Research component: The project involves teaching internships in selected public and non- public elementary schools by students - future early childhood education teachers - and accompanying academic teachers. The project has a research and application character. The subject of the study is the experience of students carrying out internships. The chosen method is participatory action research (Kemmis, McTaggart, 2005, Heck, 2024), while the means of collecting research material are focused interviews conducted with the students carrying out internships after each visit to the school, as well as reflective observation diaries kept by the students. Implementation component: Promoting good practices at conferences and in academic journals, introducing recommendations for the organization of student internships in Poland, and attempting to permanently implement the alternative model of teaching internships in elementary schools developed in the project.

Keywords: *University-school partnership, student internships, primary school, reflective practice.*

1. The role of professional internships in preparing future early childhood educators

Professional internships for students are a crucial element of the education process for future teachers. Collaborative learning and cooperation within communities of practice, as a form of mutual exchange of experience and reflection, are integral to the transformation of teaching culture. Combining practice with formal knowledge supports the development of critical and reflective thinking, allowing students to "think about practice through theory" (Klus-Stańska, 2019). A practitioner in education, in order to "make appropriate decisions, must essentially engage deeply in discussions about values and be able to provide justifications for their decisions" (A. T. Person, 1994, p. 25). They cannot treat previously acquired values as an immutable guidepost, because practice requires systematic analysis and constant reflection on the validity of their actions (A. T. Person, 1994, p. 25). Scientific theory and pedagogical theory are fundamental categories for explaining phenomena occurring in the educational process. Scientific theory allows for the recognition of general principles and patterns in education that can be applied to various situations, but it does not offer ready-made solutions for specific everyday problems in practice. Pedagogical theory, meanwhile, helps to ponder and reflect more deeply on various issues, encouraging discussion and reflection, and provides an important backdrop for action, though it is not sufficient on its own to effectively guide actions in everyday practice (Żytko, 2018, p. 15). Understanding the relationship between these two types of theory helps to better interpret educational processes and supports the development of conscious reflective (pedagogical) practice. Particularly important here is the concept of *theory in action*: "knowing in practice" — knowledge built through practical experience and reflection on future actions planned by the teacher, allowing for the construction of both "what" knowledge and "how" knowledge (Schon, 1984; Żytko, 2018).

During their internships, students verify the pedagogical theories they have learned during their studies and take their first steps as teachers, having the opportunity to apply their previously acquired knowledge, observe experienced practitioners, and learn through action — through direct interaction with children. It is at this moment that they form their image of the school and begin to define themselves as future teachers.

Contemporary approaches emphasize how crucial it is to develop professional pedagogical knowledge from the very early stages of a teacher's career. Particularly important here are experiences gained directly in the professional environment and the processes of interaction and joint negotiation of meanings within a community of professionals (Bałachowicz & Zbróg, 2022; Zbróg, 2019). This means that teachers learn not only through practice but also through dialogue and the exchange of experiences within their professional communities. The experiences they gain — especially in the context of interactions with students, parents, and colleagues — form the foundation of their professional knowledge development, enabling the exchange of perspectives and the collaborative interpretation of educational phenomena. In this way, pedagogical knowledge is co-created within a dynamic community of practice rather than developed in isolation.

Today's teacher must be flexible and ready for lifelong learning, responding to the changing social and educational needs. Teachers' knowledge is a dynamic resource that evolves along with the socio-cultural context in which students and schools operate. This requires teachers to be willing and ready to change their practices, engage in continuous learning, remain in a constant process of professional and personal development, and be open to reflection.

Internships develop the ability to reflect on one's own attitudes, strengthen interpersonal competencies, teach responsibility, and provide the opportunity to discover individual predispositions. At the same time, they allow students to confront their ideas about the profession with its reality. In the long term, the experiences gained during internships often become the foundation for further professional and personal development, inspiring students to adopt a conscious, engaged, and critical approach to their role in the educational process (Żytko, 2018).

2. Implementation of pedagogical internships at higher education institutions

The organization of teacher training, including the requirements for completing pedagogical internships, is regulated by the Law no 1450, July 25, 2019. The objectives of professional internships for future teachers of grades I–III in primary schools, as defined in this document, are as follows:

1. To understand the specifics of the profession of a preschool and early childhood education teacher;
2. To create conditions that foster the readiness to assume the role of a teacher;
3. To prepare for the effective organization of one's own teaching practice;
4. To consciously build relationships with children and pupils, their parents or guardians, and colleagues;
5. To implement innovation in teaching practice, particularly in the individualization of the teaching process, taking into account the diverse educational needs of students, supporting their comprehensive development, their activity, and their participation in the educational and social life processes (Journal of Laws, item 453, p. 34).

An analysis of the internship regulations of selected higher education institutions offering preschool and early childhood education programs showed that professional internships are described in very similar ways across different universities ("Principles of Pedagogical Internships" of the Faculty of Education at the University of Warsaw, "Internship Regulations" of the Faculty of Education and Psychology at UMCS in Lublin, "Student Internship Regulations of the Faculty of Social Sciences" at UWM in Olsztyn, "Student Internship Regulations" at APS in Warsaw, and "Regulations of Compulsory Professional Internships at the Institute of Pedagogy, Faculty of Social Sciences" at the University of Gdańsk).

Information regarding the objectives and tasks of students during their internships is included in the course syllabi. These objectives are consistent with those described in the above-mentioned regulation. The syllabus also contains information about the internship documentation that the student must prepare and submit to the university's internship supervisor, in order to obtain internship credit after review and approval of its completeness. Students are usually allowed to choose their own internship dates. During the internship, a mentor from the host institution accompanies the student. In some universities, a university-appointed supervisor also oversees students during their internships. The choice of internship placement is either assigned — with the university providing a list of recommended institutions — or left to the student's independent selection.

Currently, students at our institution, the Maria Grzegorzewska University in the field of preschool and early childhood education, complete two types of internships over the course of their five-year studies.

The first is a 30-hour assistant internship, during which students are tasked with learning about the organization of primary school work, observing the teacher's work methods and teaching strategies, and reflecting on their own predispositions for the teaching profession. The second is the assistant-pedagogical internship in grades I–III, in which students develop their didactic and educational skills by planning and conducting their first lessons, as well as observing the work of school specialists such as pedagogues, psychologists, and other professionals[1].

3. Methods

The study was designed as **participatory action research** (Kemmis & McTaggart, 2005; Heck, 2024), with an applied objective of actively seeking solutions in the area of teaching internship implementation. The research was carried out by social participants – academic teachers and students of Pedagogy, who are future early childhood education teachers. The project aims to develop, through the collaborative efforts of this community, recommendations for the organization of student internships in Poland and to work towards the permanent implementation of an alternative model of teaching internships in elementary schools developed within the framework of the project. The project received a positive opinion from the Senate Committee for Research Ethics at APS, reference number 201/2024.

The research is being conducted as part of the Flying School of Teaching Internship project (Koterwas et al., 2024), by researchers from Maria Grzegorzewska University in Poland[2]. The project is co-funded by the state budget, with funds granted by the Minister of Science and Higher Education as part of the "Science for Society" program. The project began in 2024 and will run until mid-2026. Its core idea is to foster cooperation between academia and the community of practice – a school-university partnership (Day, 2008) – by creating a so-called learning community (Smith & MacGregor, 2009) and promoting learning through reflective practice (Schön, 1983). So far, eight one-week internships – study visits – have been carried out in selected public and non-public elementary schools (grades 1–3) across Poland. The selection of schools was purposeful; we aimed to include "model" schools whose teaching practices align closely with constructivist principles. The goal was for students to be inspired by innovative didactic approaches that reflect the theoretical foundations they explore during their studies. The internship format is continuous, lasting one week and conducted under the supervision of academic teachers.

The research was participatory in nature, focused on partnership with the study participants by initiating social change and generating local, practical knowledge (Reason & Bradbury, 2008). A total of 94 students and 6 accompanying academic teachers participated in these visits. Before the school visits, the students took part in workshops, during which they analyzed and evaluated the existing internship model used at the university. During the visits in selected schools, their tasks included classroom observation and **completing reflective journals.** After the visits, they shared their experiences through **focus group interviews**. Collecting research material are focused interviews conducted with the students carrying out internships after each visit to the school (6), as well as reflective observation diaries kept by the students (94). We analyze the material assigned to main categories concerning: 1) students' approach to the university's adopted model of internship implementation 2) benefits resulting from participating in internships within the Flying School of Internships project.

4. Discussion and conclusion

The research material was presented by us in the form of a comparison between students' experiences of the standard internship model and the experiences gained through participation in the Flying School of Practice project. We structured this comparison using the following categories:

1. *Time*: Students clearly criticized the standard model of internships conducted during the academic year. They pointed out that the university schedule does not account for continuous internship periods. Their fragmented, irregular nature makes these internships perceived as ineffective, chaotic, and inconsistent. Students suggested that two weeks should be set aside during the academic year for internships in a selected school.

Within the Flying School of Practice project, students completed internships continuously during the summer break (in September) and the winter break (January/February), which is not possible in the standard model. According to students, maintaining continuity allowed for full engagement and a better

[1] Data based on syllabi available on university websites:
https://ususosweb.aps.edu.pl/kontroler.php?_action=katalog2/przedmioty/pokazPrzedmiot&kod=PW-5P-PRA2a
https://ususosweb.aps.edu.pl/kontroler.php?_action=katalog2/przedmioty/pokazPrzedmiot&kod=PW-5P-PRA4

[2] The project was carried out by a research team from Maria Grzegorzewska University, consisting of: Agnieszka Koterwas, Edyta Nowosielska, Małgorzata Zambrowska, Marta Krasuska-Betiuk, Monika Kupiec and Ewa Lewandowska.

understanding of the realities of a teacher's work. This intensive format made it possible to observe a broader range of educational phenomena and deepened reflection on the teacher's role.

2. *School Educational Environment*: Students noticed a clear contrast between the traditional model of teaching and the experiences they gained during the Flying School of Practice project. They highlighted the use of project-based learning, activating teaching methods, and outdoor education. They sought experiences that aligned with what they were taught at the university.
3. *Learning Community*: The Flying School of Practice project fostered the creation of a reflective community, including students, teachers, pupils of the visited schools, and university staff. Students shared their experiences regularly during organized meetings as well as informally in spontaneous conversations. In the standard model, students typically completed internships individually, and discussions with the university supervisor were limited to formal evaluations without deeper analysis. Students appreciated the presence of university supervisors during school visits. Daily conversations and ongoing consultations made the internships more reflective.

The presence of groups of students and lecturers in one school built a sense of security, allowing students to freely explore different classes and teaching methods. The internships were experienced collectively in an atmosphere of openness and exchange of observations. Students felt partnership, support, and mutual understanding. In contrast to individually organized internships, students were not limited to one supervisor and one class, which they reported reduced their stress levels.

4. *Documentation*: Internship documentation in the standard model was often perceived as a formality, lacking substantive value. Students described it as passively copying lesson plans from methodological guides. In the project, the documentation had a reflective nature — guiding questions encouraged deeper analysis of observed classes. Students stated that this approach made them more attentive and engaged.
5. *Participation in Different Classes*: The opportunity to observe many classes and different teaching styles was extremely valuable for students. It offered a broader perspective on a teacher's work and enabled comparisons between different pedagogical approaches. However, some students also appreciated the deep relationships with pupils, which could only develop during longer stays in one particular class.
6. *Selection of Schools*: Students pointed out that within the standard internship model, school selection was random, leading to experiences that were often cognitively unproductive. Students ended up working with random mentors and often did not observe the teaching or communication methods promoted during university courses.

Another difficulty was the lack of preparation of school internship supervisors. As students noted, school mentors often were unaware of the expectations, unfamiliar with the internship syllabi, and unclear about their responsibilities. In contrast, students participating in the project appreciated that the selection of schools was intentional and that they were warmly welcomed by the school communities.

7. Professional Inspirations: Participants of the Flying School of Practice project reported that it had a significant impact on their motivation and professional identity development.

These internships not only helped overcome negative experiences from previous internships but also inspired further action: choosing their own professional paths, undertaking work as teachers, or planning individual projects. Students strengthened their sense of pedagogical competence.

In conclusion, students of pedagogy undertaking internships in schools play an important role in building their professional competencies as well as influencing the student environment, having a real impact on the course and quality of the educational process. The opinions of students are very important to us — we treat them as full participants in the education process and active co-creators of the project. Thanks to a subject-oriented approach, they share with us their insights and recommendations, which constitute a valuable contribution to the development of an effective model of professional internships. Among the students' recommendations, the most frequently mentioned suggestions include: extending the duration of internships to a minimum of two weeks to truly experience the school environment, and carefully selecting mentor teachers whose work methods with children can serve as positive models. Students emphasize that the opportunity to observe teachers who effectively manage the classroom and use activating teaching methods is a valuable source of practical knowledge and serves as inspiration for further development of their pedagogical skills. Another important aspect they point out is the possibility of participating in various classes instead of being limited to just one. They notice that each class has its own atmosphere, dynamics, rituals, and challenges, which helps prepare them for working with diverse groups. Experiencing a variety of classes also enables student interns to adapt their own teaching styles to different students' needs and expectations, fostering the development of flexible responses to educational situations. Another key recommendation that emerged from the students' feedback is the reduction of internship documentation requirements and the preparation of schoolteachers to welcome interns. This is an important factor influencing the quality and effectiveness of pedagogical internships. Perhaps teachers serving as internship

supervisors should participate in workshops to help them understand how to fulfill this role effectively? Such training could include learning how to provide constructive feedback, support the intern's development, and manage internship time efficiently. In summary, these recommendations could be addressed by creating an active network of collaboration among early childhood education teachers, university lecturers, and student interns, operating as a mutual learning community.

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AN EXPLORATION ON THE ASSOCIATION RULES OF SECONDARY EDUCATION TEACHER QUALIFICATION EXAMINATION IN TAIWAN

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Abstract

Since 1994, Taiwan has amended the Teacher Education Act to establish a "diversified, reserve, and self-funded" system, initiating a diversified teacher training framework. The most recent full revision of the Teacher Education Act occurred in 2019, which adjusted the sequence of the teacher qualification examination and the educational internship. Under the new system, candidates must first pass the teacher qualification examination and obtain a teacher qualification certificate before proceeding to the internship stage. The internship lasts for six months, and only after successfully passing the internship evaluation can candidates officially obtain a teaching certificate and qualify to teach. This highlights that the teaching certificate serves as a critical threshold to determine whether a teacher meets the required professional competency standards. This study focuses on secondary education teacher candidates who participated in the teacher qualification examination between 2016 and March or April 2022, as well as those with various background variables who completed their educational internships from 2015 to January 2022. Using data mining techniques for 23,368 persons, the research aimed to establish the best model for analyzing, predicting, and exploring the association rules and passing rates for teacher candidates based on different background variables and sources of teacher training. The findings revealed that the key association rules and significant indicators for secondary education teacher candidates were: gender (female), age (20-24 years old), recent graduates, qualification exam passed, exam-before-internship sequence, and public-school attributes. These factors were identified as crucial association rules and predictors of success in the teacher qualification examination.

Keywords: *Association rules, secondary education, teacher qualifications.*

1. Introduction

Since 1994, Taiwan amended the Teacher Education Act to be a "diversified, reserve, and self-funded" system, and a diversified teacher training system has been introduced. The role of determining whether a teacher has met the standards of work competence has opened a new era of teacher qualification examinations. After the amendment of the Teacher Education Act in 2002, the internship period was shortened to half a year, and only after passing the internship can you register for the Teacher Qualification Examination (Ministry of Education, 2022). In 2019, the Teacher Training Law was amended to provide that student must first pass the teacher qualification examination and obtain a teacher qualification certificate before entering the internship stage, which lasts for half a year, and can only obtain a teacher certificate after passing the internship performance assessment (Ministry of Education, 2022).

In Taiwan's teacher training, the number of teachers has increased dramatically from the era of unified planning to the era of diversified reserves, while the number of students has been decreasing due to the declining birth-rate, so it has become important to test and select the quality of teachers through the teacher qualification examination (Lin, 2009). In the face of the challenges of education reform and emerging educational technologies, it is an innovative research trend to use big data to analyze and mine teachers' career development data and transform them into valuable information (Kuo and Lin, 2017; Wu et al., 2021). Extracting valuable knowledge from complex data can help improve education policies and processes, especially in the discovery and analysis of big data for teacher qualification examinations, which is an innovative research direction.

This study attempts to understand the impact of background variables of teacher training students on the pass rate of teacher qualification examinations through the database of statistical annual reports on teacher training in the Republic of China, and uses association rules to analyze education big data, so as to provide model prediction and construction (Daniel, 2019).

2. Literature review

Since Taiwan's teacher training has become diversified, it is necessary to select excellent teachers through accreditation, so as to control the quality of teachers, protect students' right to education, and enhance the professional image of teachers. Teacher qualification examination is the embodiment of teacher professionalism, which can not only promote teachers to continuously improve their education and teaching ability through qualification examinations, but also reflect the problems of teacher training, promote their continuous reform and progress, and promote the degree of teacher professionalism as a whole (Lu et al., 2016). Since 2005, the Ministry of Education (MOE) has launched a teacher qualification examination in order to control the quality of teachers by addressing the formality of the initial review (Zhang, 2009).

In 2019, the Teacher Education Act was amended from the original "first practice and then inspection" to "first inspection and then practice", and the original name of "Teacher Qualification Examination was amended to "Teacher Qualification Examination" in accordance with the law. The process requires those who have completed the pre-service education certificate or certificate according to their respective subjects, and passed the teacher qualification examination, before they can apply to the university where the teacher is trained to take a half-year full-time education internship including teaching internship, tutor (grade) internship, administrative internship, and research activities (Teacher Training Law, 2019).

For example, the introduction of a new teaching certification system in the United Kingdom, where teachers must renew their teaching qualifications every five years in order to continue to have teaching qualifications; In terms of teaching practice, all teacher training students must go through two school internships, and observe teaching and trial teaching in the class. In Germany, after passing the first state examination, you can only carry out internships, and in the internship system, you need to participate in 8-10 weeks of internship in teacher education courses, and then 1 and a half to 2 years of internship after passing the exam, after half a year of internship, one year of independent teaching, and then prepare for the second state examination. In the United States, the "Bring Every Student Act" stipulates that every teacher must have a bachelor's degree, licenses and certificates set by each state, and each state will arrange a teaching internship in the last semester of the teacher training program, stipulating that teacher training students must have at least 15 weeks of on-site teaching trial teaching, teaching and other on-site experience; In terms of advanced internships, administrative internships and counselling internships are often added (Wang et al., 2011). For example, the introduction of a new teaching certification system in the United Kingdom, where teachers must renew their teaching qualifications every five years in order to continue to have teaching qualifications; In terms of teaching practice, all teacher training students must go through two school internships, and observe teaching and trial teaching in the class. In Germany, after passing the first state examination, you can only carry out internships, and in the internship system, you need to participate in 8-10 weeks of internship in teacher education courses, and then 1 and a half to 2 years of internship after passing the exam, after half a year of internship, one year of independent teaching, and then prepare for the second state examination. In the United States, the "No Child Left Behind Act" stipulates that every teacher must have a bachelor's degree, licenses and certificates set by each state, and each state will arrange a teaching internship in the last semester of the teacher training program, stipulating that teacher training students must have at least 15 weeks of on-site teaching trial teaching, teaching and other on-site experience; In terms of advanced internships, administrative internships and counselling internships are often added (Wang et al., 2011).

Teacher development faces many challenges such as policy changes, funding issues, and teacher recruitment and retention, and in terms of teacher certification exams, Bowling and Ball (2018) investigated alternatives in education across education, vocational and technical education, and agricultural education certification, which argues that these challenges, whether at the national, state, regional, or school level, can lead to ongoing teacher shortages, with many U.S. school districts facing challenges in recruiting qualified teachers, retaining open positions, or eliminating positions altogether.

3. Study Design

3.1. Algorithms for association rule

The main purpose of this study is to explore the association rules of teacher qualification verification at the secondary education stage, explore the characteristics and association rules between secondary teacher qualification verification data and secondary teacher qualification verification attributes, and supplement the association analysis with the help of Apriori algorithm. Based on the Apriori algorithm proposed by Agrawal and Srikant (1993), the support, reliability and correlation are calculated, and then the Important Association Rule Mining (IARM) algorithm is developed to calculate the importance of the rules. The IARM algorithm uses the Importance Indicator (*Imp.).*) measures the importance of association rules to strengthen the support and confidence based on the Apriori algorithm architecture (Weng, 2012).

3.2. Research databases

A total of 23,368 students enrolled in the secondary education stage from 2016 to March and April 2022 and completed internships in the middle education stage from 2015 to January 2022. The variables analyzed are in order of fresh graduates, the source of teacher training students, the school attributes of the teacher training university, the public and private attributes of the teacher training school, age, gender, educational background, the number of times they participated in the teaching inspection in 2016-2022 years, the passing of the teaching examination, and the teacher qualification examination system.

4. Results

4.1. Data type 1: The total number of teacher training students participating in the teaching and inspection database was 23,368

After the second data exploration, there were 8 association rules with a lift value greater than 1 and an importance index greater than 80%, as shown in Table 1. If the importance index is greater than 80%, in the highest order, it is education = bachelor's degree, first inspection and then practice, education inspection passed, gender = female, fresh graduate, age = 20-24 years old, number of participations in education inspection 1-time, public attribute, age = 25-29 years old, age = 30-34 years old.

Table 1. Positive association rules for teacher training students participated in data exploration of teaching inspection database.

No.	LHS	=>	RHS	supp.	Conf.	lift	count	Imp.
[1]	{Gender = Female}	=>	{Group 1-Teacher/Educational University}	88.51%	88.68%	1.9953	3665	89.91%
[2]	{Age = 20-24}	=>	{Group 1-Teacher/Educational University}	87.92%	84.31%	1.1454	3296	89.47%
[3]	{Fresh graduate}	=>	{Group 1-Teacher/Educational University}	80.58%	69.29%	1.1235	3109	87.02%
[4]	{The inspection was passed}	=>	{Group 1-Teacher/Educational University}	80.41%	61.43%	1.0070	2849	85.21%
[5]	{Certified first, then practice}	=>	{Group 1-Teacher/Educational University}	78.57%	54.27%	1.0008	2710	84.92%
[6]	{Public attribute}	=>	{Group 2-College/ university with teacher education program}	90.31%	98.82%	5.7430	2568	93.29%
[7]	{Fresh graduate}	=>	{Group 2-College/ university with teacher education program}	82.34%	83.49%	1.0295	2489	90.51%
[8]	{The inspection was passed}	=>	{Group 2-College/ university with teacher education program}	78.96%	60.69%	1.1807	5039	87.17%

4.2. Data type 2: Teacher training students are grouped according to the school attributes of the teacher training university

The number of participants in the education inspection was $D_{Normal-u}$10,585 (teacher training and education universities), D_{Tt-cM}10,022 (teacher training centres), and 2,761 (D_{STt-d}teacher training departments), totalling 23,368 people. The attributes of the research database include the background information of teacher training students, the information of the school where they teach, and the data of participating in the teaching inspection, which are$D_{Normal-u}X_N$Y$_N$ teacher/education universities, with a total of 4 attributes, and the minimum support degree of the course data of the three attribute groups in this study is set to be 0.1 and the minimum confidence level is 0$D_{Normal-u}$、D_{Tt-c}、D_{Tt-d}4. When the minimum length rule is limited to 2$D_{Normal-u}$, a total of 16 association rules are found in this stage; A total ofD_{Tt-c} 12 association rules were identified at this stage. D_{Tt-d}A total of 11 associated rules were identified in this phase, as shown in Table 2.

Table 2. Teacher training students participated in the teaching inspection based on the three-attribute groups $D_{Normal-u}$、D_{Tt-c}、D_{Tt-d} rules of the school attribute cluster.

School attributes Cluster	School attribute of college/university with teacher education programs	Number of rules	Remove duplicated rules	Number of available rubles
$\boldsymbol{D_{Normal-u}}$	Normal university / Educational college	16	10	6
$\boldsymbol{D_{Tt-c}}$	Center for Teacher Education programs	12	7	5
$\boldsymbol{D_{Tt-d}}$	Department/ graduated school with teacher education programs	11	7	4

Normal University or College with Teacher Education Program$D_{Normal-u}$ There are 16 rules, and in the case of the first attribute (group 1 - teacher training/education university), the positive correlation rule ($D_{Normal-u}$*lift*(X,Y)>1) has a total of 6 rules Table 3 shows; Discuss the rules of association with rules that have a degree of support (60%) or more. Therefore, the positive correlation rule ($D_{Normal-u}$*lift*(X,Y)>1) and the degree of support is 0There are a total of 4 rules with 6 or more, and the characteristics of the rules are listed according to the degree of support from large to small "gender = female, pass the education inspection, age = 20-24 years old, fresh graduate". There are 4 importance indicators greater than 80%, and the highest order is gender = female, pass the education examination, fresh graduate, age = 20-24 years old.

Table 3. $D_{Normal-u}$ Normal/ Educational Universities positively related to the rules.

No.	*LHS*	=>	*RHS*	*Supp*	*Conf.*	*lift*	*count*	*Imp.*
[1]	{Gender=female}	=>	{Group 1-Teacher/Educational University}	87.38%	90.40%	2.9677	1577	89.13%
[2]	{The inspection passed}	=>	{Group 1-Teacher/Educational University}	74.35%	90.27%	2.4778	1541	88.50%
[3]	{Age 20-24}	=>	{Group 1-Teacher/Educational University}	64.15%	89.47%	2.1284	8127	81.27%
[4]	{Fresh graduate}	=>	{Group 1-Teacher/Educational University}	63.97%	88.55%	1.9142	7945	83.51%
[5]	{Check first, then practice}	=>	{Group 1-Teacher/Educational University}	32.94%	62.22%	1.8807	4956	64.40%
[6]	{Education = Bachelor's degree}	=>	{Group 1-Teacher/Educational University}	30.46%	51.36%	1.8602	1042	42.41%

Center for Teacher Education Program $D_{\boldsymbol{Tt-c}}$A total of 12 rules were generated, and the positive association rules ($D_{\boldsymbol{Tt-c}}$*lift*(X, Y)>1) were 5 rules, as shown in Table 4. Continued with association rules to support the degree of 06 (60%) or more, so the positive correlation rule ($D_{\boldsymbol{MTt-c}}$*lift*(X,Y)>1) and the support is 0A total of 3 rules with 6 or more.

$\boldsymbol{D_{Tt-c}}$Positive correlation rule (*lift*(X, Y)>1) with 0There are a total of 3 rules with 6 or more (inclusive), and the rules are listed according to the support degree from large to small: "public attributes, fresh graduates, and education inspection passed". There are 3 items with an importance index greater than 80%, which are passed by public attributes, fresh graduates, and education inspections in the highest order.

Table 4. D_{Tt-c} Positive Association rules for Center for Teacher Education Program.

No.	*LHS*	=>	*RHS*	*Supp*	*Conf.*	*lift*	*count*	*Imp.*
[1]	{Public attribute}	=>	{Group 2 – Center for Teacher Education Program}	88.24%	94.63%	6.3232	1678	82.94%
[2]	{Fresh graduate}	=>	{Group 2 – Center for Teacher Education Program}	82.09%	85.94%	6.1071	1564	80.82%
[3]	{The inspection passed}	=>	{Group 2 – Center for Teacher Education Program}	60.96%	83.72%	4.5051	1809	80.66%
[4]	{Check first, then practice}	=>	{Group 2 – Center for Teacher Education Program}	43.17%	60.19%	1.4380	1842	75.23%
[5]	{Number of times to participate in the teaching and inspection_ once}	=>	{Group 2 – Center for Teacher Education Program}	22.39%	53.49%	1.0843	2417	70.42%

School with Teacher Education Program$D_{\boldsymbol{Tt-d}}$A total of 11 rules were generated, including 4 positive association rules ($\boldsymbol{D_{Tt-d}}$*lift*(X,Y)>1), as shown in Table 5. Continued with association rules to support the degree of 06 (20%) or more, so the positive correlation rule ($\boldsymbol{D_{Tt-d}}$*lift*(X,Y)>1) and the support is 0A total of 3 rules with 6 or more.

$\boldsymbol{D_{Tt-d}}$Positive correlation rule (*lift*(X,Y)>1) with 0 A total of 3 rules with 6 or more (inclusive), the characteristics of the rules are listed in descending order of support: "fresh, age = 20-24 years old, gender = female; Among them, there are 3 importance indicators greater than 80%, which are fresh graduates, age = 20-24 years old, and gender = female.

Table 5. D_{Tt-d} *Positive Association rules for Department/ Graduate School with Teacher Education Program.*

No.	LHS	=>	RHS	Supp	Conf.	lift	count	Imp.
[1]	{Fresh Graduate}	=>	{Group 3 – Department/ Graduate School with Teacher Education Program}	81.94%	83.14%	2.0512	15117	82.26%
[2]	{Age 20-24}	=>	{Group 3 – Department/ Graduate School with Teacher Education Program}	81.23%	81.43%	1.8531	9159	81.63%
[3]	{Gender=female}	=>	{Group 3 – Department/ Graduate School with Teacher Education Program}	61.27%	80.44%	1.5656	8324	80.88%
[4]	{Check first, then practice}	=>	{Group 3 – Department/ Graduate School with Teacher Education Program}	34.26%	51.02%	1.2110	5473	60.92%

5. Conclusions

(1) The overall data are based on gender = female, age = 20-24 years old, [3] fresh graduates, [4] passed the education inspection, first inspection before practice, public attributes, [7]. [8] The examination is passed as the relevant rules and importance indicators.

(2) Normal/educational universities take gender = female, pass the education examination, age = 20-24, and fresh internship and examination as the relevant rules and important indicators.

(3) The teacher training center shows the public attributes, the internship and verification of the current year, and the passing of the education inspection as the relevant rules and important indicators.

(4) For the faculty training department, fresh graduates, age = 20-24 years old, and gender = female are the relevant rules and important indicators.

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DEVELOPMENT OF A DRIVING STYLE FEEDBACK METHOD AIMED AT ADAPTIVE LEARNING IN SAFE DRIVING EDUCATION

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Abstract

The aging of driver's license holders is progressing, and in order to allow elderly people to continue driving safely, license renewal periods have been shortened and license systems have been introduced that allow elderly people to drive only vehicles equipped with specific safety devices. In human factors research, it has been pointed out that the driving characteristics of elderly people are caused by a decline in cognitive function due to aging as well as a decline in judgment function, which leads to accidents. Research and development of technologies such as low driver alertness and inattentive detection is being conducted. However, it has not yet been possible to extract critical variables that lead to unsafe behavior in elderly people, which varies greatly from person to person. This research focuses on risk communication using hazard maps as a support measure to help them break away from highly unsafe driving behavior. Drivers have misconceptions about driving, habits that have become habitual through driving experience, and unconscious behaviors that belong to psychomotor skills. This study aims to develop a feedback method to link drivers' self-understanding of their driving style with the risks associated with that style. As a preliminary survey, the driving style (8 factors) of 624 men and women aged 70 or older was analyzed to compare with the driving style of 320 men and women aged 40 to 60 who have elderly drivers in their close friends, and significant differences were found in several factors. Based on the analysis results, hazard map training was conducted after presenting the self-diagnosis results of driving style to 27 drivers aged 70 or older, and a change in awareness of hazards was observed.

Keywords: *Driving style, hazard map, risk communication, adaptive learning, feedback method.*

1. Introduction

For the elderly to live an independent life, securing transportation is an issue. In Japan, in order to allow the elderly to continue driving safely, the license renewal period for those aged 70 and over has been shortened, and a license system has been introduced that allows them to drive only vehicles equipped with specific safety devices (NLI Research Institute, 2025). In human factors research, it has been pointed out that the driving characteristics of the elderly are by a decline in cognitive function due to aging, as well as a decline in judgment function, which leads to accidents. Research and development of technologies such as low driver alertness and inattentiveness detection is being conducted. However, it has not yet been possible to extract the critical variables that lead to unsafe behavior in the elderly, which varies greatly from person to person (Yoshitake, & Shino, 2019).

This research aims to develop an adaptive feedback method that utilizes the concept of risk communication as a support measure to help elderly people break away from unsafe driving behavior. Risk communication is the idea of sharing risk information throughout society, and providing hazard maps and conducting disaster prevention drills for the purpose of reducing natural disasters (earthquakes, floods, typhoons, etc.) is also part of risk communication. A hazard is a factor that may cause a risk. In risk communication in disaster prevention education, in order to increase preparedness, it is shared that the way hazards are perceived and the response actions differ depending on age and individual characteristics (Yoshitake, & Shino, 2018). When providing information on dangerous spots for accidents, etc., feedback is needed to encourage the involvement of the driver who receives the hazard information, allowing them to consider how to use the hazard information.

2. Literature review on risk communication

The 2014 Ministry of Education (Yamori, Kikkawa, & Ajiro, 2005), Culture, Sports, Science and Technology's "Measures for Promoting Risk Communication" emphasizes the importance of effective transmission of risk information and consensus building through dialogue and collaboration among stakeholders. Regarding the concept of risk and risk communication, the direction of understanding and emphasis vary depending on the individual and field of expertise. Based on previous research, this study defines risk communication as "an activity in which various levels of society share diverse information and perspectives through dialogue, joint consideration and collaboration for more appropriate risk management." Arame et al. (2012) points out the need to consider effective ways of involvement for each stakeholder when accustomed to knowledge transfer education (Arame, Hideshima, & Kanda, 2012). The purpose of risk communication is generally stated as "a. education and enlightenment, b. induction of behavioral change, c. fostering trust, and d. participation in decision-making." When developing adaptive feedback methods that apply the concept of risk communication, it is necessary to consider the characteristics of diverse drivers.

3. Research Question

Okamoto et al. (2012) point out that the safety driving education in Japan has aimed to acquire vehicle operation skills and skills to adapt to traffic conditions, and that education on hazard prediction and driving planning has not been sufficiently conducted (Okamoto, Nakahira, & Kitajima, 2012). For example, even if a person has excellent driving skills and has acquired knowledge of hazard prediction, as long as he or she drives at high speeds without properly controlling feelings of irritation and impatience, the possibility of being involved in an accident cannot be reduced. Keskinen (1996) constructed a hierarchical model of driving behavior and clarified that driving safety is not determined solely by driving skills (Keskinen, 1996). The four hierarchies are, from top to bottom, life goals and life skills, driving goals, responding to traffic conditions, and vehicle operation. Life goals and life skills are placed at the top because high-risk values and impulsive motivations induce accidents. Placing behavioral layers related to social adaptation, such as motivation and attitudes, at the top emphasizes their importance as controlling factors of safe driving.

Young drivers tend to be seen as drivers who like to drive, but some of them are eager to drive, while others would rather avoid driving if possible. For example, beginners tend to be seen as being conscious of the burden of driving, but some of them are highly conscious of the burden, while others drive without feeling much of a burden. Even if the gender, age, years of experience, and accident history are the same, the attitude toward driving and the sense of burden are different. This study investigates whether there are changes in driving style as well as vehicle operation skills depending on the age group. In this study, in order to investigate the perceptions of various people involved with drivers, we will investigate the differences in perceptions of driving style by age group and the perceptions of people close to the driver other than the driver himself.

4. Method

This study used survey data from two groups conducted online in 2024. The first was survey data from 624 elderly drivers (hereafter, the self-group) and the second was survey data from 360 people who have elderly drivers aged 70 or older in their close circle (hereafter, the close relatives' group). The first data consisted of 208 people by gender and age. The survey included their own driving frequency, driving scenes, driving purposes, driving style, and the timing of voluntary return of their driver's license. Given the current situation, it is believed that the older the person, the more likely they are to have a psychological dilemma regarding securing transportation and maintaining safe driving, so it is thought that there are differences in how people of the same age perceive the timing of voluntary return of their driver's license.

The second data consisted of 56 people by gender and age group between 40 and 60 years old. We surveyed familiar elderly drivers on their driving frequency, driving situations, driving purposes, driving styles, and when they would like to surrender their driver's license. This study used the driving-style questionnaire (DSQ) developed by Akamatsu (2001), who has a long track record of research in Japan (Akatsuka, 2011). The survey consists of the following eight factors: DSQ1) Confidence in driving skills, DSQ2) Passiveness in driving, DSQ3) Tendency to drive impatiently, DSQ4) Tendency to drive meticulously, DSQ5) Driving while preparing for traffic signals in advance, DSQ6) Cars are a status symbol, DSQ7) Tendency to drive erratically, and DSQ8) Tendency to be anxious. The degree of applicability to each question was evaluated on a four-point scale (4: Very applicable to 1: Not applicable at all).

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5. Analysis results

5.1. Basic data analysis results

(1) Comparison of driving frequency by age

When comparing driving frequency between the self-driving group and the close relative's group, the proportion of both groups who drive 2-3 times a week was high (Table 1). Table 2 compares the usage scenarios of the driver's license. As both groups use the vehicle most frequently for daily life (shopping), elderly drivers tend to use the vehicle more within their living area, mainly in the neighborhood, and the close relative's group also tend to recognize this.

Table 1. Comparison of Driving frequency.

	the self-group			the close relatives' group		
	70～75 N=208	75～79 N=208	80 or more N=208	40～49 N=104	50～59 N=104	60～69 N=104
1 day or less per week	25%	22%	22%	18.3%	11.5%	8.7%
2-3 days per week	33%	37%	38%	34.6%	41.3%	30.8%
4-5 days per week	17%	18%	17%	19.2%	14.4%	19.2%
6-7 days per week	25%	24%	24%	17.3%	17.3%	22.1%
Unknown				10.6%	15.4%	19.2%
Total	100%	100%	100%	100%	100%	100%

Table 2. Comparison of Driving scenarios.

	the self-group			the close relatives' group		
	70～75 N=208	75～79 N=208	80 or more N=208	40～49 N=104	50～59 N=104	60～69 N=104
Commuting to work or school	6.3%	2.4%	1.4%	6.7%	6.7%	1.9%
Pick-up and drop-off	3.8%	4.8%	4.3%	9.6%	2.9%	5.8%
Medical visits	1.4%	3.4%	8.2%	12.5%	14.4%	12.5%
Work	2.4%	6.3%	2.4%	9.6%	8.7%	14.4%
Daily life (shopping)	74.5%	75.5%	71.6%	54.8%	55.8%	52.9%
Travel, leisure, and homecoming	11.1%	6.7%	10.1%	1.9%	2.9%	3.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

(2) Timing of voluntary surrender of driver's license

Table 3 shows the timing of surrender of driver's license by age group. Although there was some variation in the driver group, it can be seen that the timing of voluntary surrender became shorter as the age increased.

Table 3. Comparison of voluntary surrender timing of driver's license.

	the self-group			the close relatives' group		
	70～75 N=208	75～79 N=208	80 or more N=208	40～49 N=104	50～59 N=104	60～69 N=104
Not considering it	43.8%	39.4%	30.3%	67.3%	77.9%	73.1%
Plan to return within 1 year	1.0%	1.4%	5.8%	2.9%	5.8%	11.5%
Plan to return within 3 years	4.3%	9.6%	14.9%	15.4%	6.7%	7.7%
Plan to return within 5 years	11.5%	20.7%	27.9%	8.7%	4.8%	5.8%
Plan to return within 10 years	26.9%	23.1%	16.3%	4.8%	3.8%	1.0%
Plan to return later	12.5%	5.8%	4.8%	1.0%	1.0%	1.0%

(3) Driving style

In the driving style scale, the higher the score, the stronger the tendency of the driving style (attitude, intention, and way of thinking toward driving) represented by that scale is interpreted as being.

Table 4. Comparison of driving style.

	the self-group			the close relatives' group		
	70～75 N=208	75～79 N=208	80 or more N=208	40～49 N=104	50～59 N=104	60～69 N=104
DSQ 1) Confidence in driving skills	3.02	3.08	3.13	3.12	2.94	3.12
DSQ 2) Passivity towards driving	2.14	2.19	2.26	2.37	2.65	2.52
DSQ 3) Tendency to drive hastily	2.37	2.34	2.32	2.64	2.76	2.66
DSQ 4) Tendency to drive meticulously	3.08	3.11	3.32	3.06	3.27	3.06
DSQ 5) Driving while preparing for traffic lights	2.13	2.12	2.26	2.70	3.00	2.68
DSQ 6) Cars as a status symbol	2.59	2.62	2.54	2.71	2.74	2.87
DSQ 7) Tendency to drive erratically	1.44	1.38	1.42	2.43	3.05	2.79
DSQ 8) Tendency to be anxious	2.14	2.03	2.13	2.84	3.02	2.80

(4) Purposes of driving by age group

Table 5 shows the results of a survey in which participants were asked to select from the following five multiple choice items regarding the purpose of driving a car. In both groups, 1 was the most common answer, followed by 5.

Table 5. Comparison of driving style.

	the self-group			the close relatives' group		
	70～75 N=208	75～79 N=208	80 or more N=208	40～49 N=104	50～59 N=104	60～69 N=104
Purpose1: Means of transportation	89.4%	82.2%	85.1%	81.7%	80.8%	82.7%
Purpose2: Maintaining independence	32.2%	39.9%	40.4%	35.6%	37.5%	38.5%
Purpose3: Maintaining a proactive attitude	23.6%	22.6%	22.1%	22.1%	14.4%	21.2%
Purpose4: Maintaining social connections	13.0%	13.5%	19.7%	17.3%	13.5%	18.3%
Purpose5: Maintaining daily life	52.9%	73.1%	68.3%	49.0%	50.0%	62.5%

5.2. Logistic regression analysis

From the responses regarding the planned time of license surrender, different trends were confirmed between the self-driving group and the close relative group. To analyze the factors influencing license surrender, driving frequency, driving purposes1 to 5, and eight driving style factors were analyzed using the stepwise method of logistic regression analysis, with the independent variables being the intention to surrender the driver's license and the dependent variable being the presence or absence of the intention to surrender the driver's license. The analysis results showed that driving frequency had an influence regardless of whether the person was the self-driving group or the close relative group, and for the self-driving group, DSQ2: Passivity toward driving, DSQ3: Tendency to drive impatient, and driving purpose (whether driving purpose is considered as purposes1 a means of transportation) influenced the consideration of license surrender. The correct answer rate for the self-driving group model was 62.0%, and the correct answer rate for the close relative group model was 61.5%.

6. Discussion

This study investigated the characteristics of various drivers in order to develop an adaptive feedback method that applies the concept of risk communication. It was hypothesized that feedback would be effective based on the gap between the elderly driver's own perception and that of the elderly driver as seen by their close relatives. Analysis demonstrated that while the two groups shared the same views on driving frequency and usage scenarios, the triggers for recognizing unsafe behavior were different. The theoretical implications of this study are as follows:

1. A high proportion of participants cited "maintaining independence" and "maintaining daily life," which are the top objectives in Keskinen's (1996) four-tier model, as their driving purpose. It is necessary to consider that driving purposes are triggers for safe driving.

2. When returning a driver's license, the driver's perception of their own driving style has an influence. More specifically, DSQ2: Passivity toward driving and DSQ3: Tendency to drive impatient may have an influence.

3. Although the elderly drivers and their relatives had similar views on driving behavior, their perceptions differed regarding license surrender, and the elderly drivers may have made decisions that took their own driving style into account more than their relatives.

4. Feedback on driving style based on a combination of self-diagnosis and the index may change the drivers' perception of their own driving style.

Based on the analysis results, this study conducted safety education (2.5 hours) for 27 drivers aged 75 years or older. In interviews after the training, many participants pointed out the effectiveness of interacting with others, and a certain degree of effectiveness was confirmed.

7. Conclusions

In Japan, the ageing of driver's license holders is progressing, and safe driving education suited to a super-aging society is required. Drivers have misconceptions about driving, habits that have become habitual through driving experience, and unconscious behaviors that belong to psychomotor skills.

This study investigated the driving behavior of elderly drivers and people who have elderly drivers in their close circle. The results showed that there is a difference in the time when elderly drivers themselves and their close relatives consider returning their licenses. Not only receiving objective feedback on their driving style through training, but also receiving feedback from people who have elderly drivers in their close circle based on their driving purpose, may deepen awareness of their own driving style and lead to improved safe driving behavior.

8. Limitations and recommendations

This study examined how to develop an adaptive feedback method in safety education. The data used in this study was limited to a small number of subjects, which is a future challenge. In addition, the effectiveness of adaptive feedback based on this survey has not been verified. It is also necessary to consider what kind of safety education and when feedback using the risk communication concept examined in this study should be provided. In addition, from the perspective of effectiveness, the study plans to verify whether it is sustainable.

In order to improve the accuracy of the logistic regression analysis, it is necessary to add data on regional characteristics that have not been used so far and change the explanatory variables. The data used in this study does not take into account regional characteristics in Japan, and does not take into account environmental factors such as proximity to public transportation.

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STUDENT TEACHERS' BELIEFS ABOUT SELF-ASSESSMENT

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Abstract

The aim of the presentation is to show the results of a longitudinal study conducted during the student teachers' long-term individual practice in a partner school. The rational of the research is to explore student teachers' beliefs related to self- assessment, which is the engine of self-regulated learning and the key of continuous professional development. Only a few empirical studies focus on student teachers' self-assessment examining mainly the accuracy of self-assessment. Some of them concluded that applying formative assessment including self-assessment in teaching practice is rather problematic, although there is much potential in applying it. The number of studies reflecting on student teachers' beliefs on self-assessment is limited. Our research tries to fill up this gap by forming the following research questions: a) How do student teachers conceptualize self-assessment? b) Which metacognitive strategies can be identified in their beliefs? c) Which factors influence extended use of self-assessment as a method in their everyday teaching practice? To answer the questions, a longitudinal action research strategy was used in the qualitative paradigm. The research took four years. The sample consisted of nine student teachers altogether, five in the experimental and four in the control group; eight of them were from Eszterhazy Karoly Catholic University, one was from Debrecen University. All the student teachers completed their one-year long teaching practice at Dobo Istvan Secondary School, Eger. The results are based on the analysis of data gained from input and exit interviews with student teachers divided into an experimental and a control group. All student teachers in the experimental group were supervised by the same mentor teacher. She supported them by carrying out self-assessment regularly. The members of the control group had different mentors and they did not do self-assessment regularly. The other sources of data were semi-structured interviews made with the members of the experimental group after each self-assessment, student teachers' written reflections and the mentor teacher's reflections after class observations. The validity of the results was provided by theoretical, data and methodological triangulation Cohen's Kappa coefficients proved high reliability of coding. According to the results, student teachers' self-assessment concept is much more complex than that one revealed by former international researches. The student teachers believe that self-assessment is crucial in in the learning process and professional development, however, they do not apply it consciously, furthermore, only a few of them uses it in their teaching practice. The student teachers' self-assessment profiles justified that each student teacher takes a different learning path during teaching practice, thus they need more personalized support implying further aspects of mentors' professional development. Self-assessment backs student teachers in identifying their strengths and weaknesses but not all of them are able to develop professional learning goals. Therefore, the mentor needs to pay more attention to help student teachers to link their needs to learning goals. The research results have also shown that effective ways of managing of emotions is pivotal in realizing self-regulation; therefore, more activities supporting self-knowledge, self-understanding would be beneficial in teacher training.

Keywords: *Student teachers, self-assessment, long-term individual practice.*

1. Introduction

Describing teacher education as a system opens new perspectives in the field of the researches (Falus & Szűcs, 2023). In this study, we are focusing on the student teachers' beliefs on self-assessment and their real-life self-assessment in the process of practice teaching. The wider context of this study is our researcher teacher program in the frame of which we explore the role of self-assessment in self-regulated learning. The theoretical background of the study is based on notions like self-regulated-learning, self-assessment, metacognition and their interrelations. Exploring the scientific literature, we can state this research is filling in a gap. Although the student teachers do self-assessment after completing certain courses and teaching activities, the number of studies focusing on their beliefs related to the role of self-assessment in their learning processes and applying self-assessment in teaching is limited.

2. Theoretical background

2.1. Self-regulated learning and metacognition

Describing teacher education as a system defining its macro, meso, and micro levels with their components helps the researchers and decision makers identify the points of possible interventions in order to develop teacher education further (Falus & Szűcs, 2023). From the point of view of the student teacher, initial education completed at the training institution and all the possibilities providing teaching practice (individual, group and individual long-turn practice) add to developing his/her beliefs on school, pupils, teachers, and teaching. This period gives opportunities to develop skills and competences supporting student teachers' life-long learning skills (European Council, 2002). Self-regulated learning is a key factor contributing to life-long learning. It is a complex system of cognitive, metacognitive and motivational processes (D. Molnár, 2014).

Different models of self-regulated learning have been described in which the researchers identified phases, strategies of the complex regulatory processes (Winne & Hadwin, 1998. 278.; Zimmerman, 2000. 15.; Pintrich, 2000, 454.; Boekaerts, 2011. 410–411.; Efklides, 2011. 8.; Järvelä & Hadwin, 2013). These models are different from one another depending on the components' role in the regulation and the number of levels of regulatory strategies but the models have some common features. The following phases and strategies appear in them: Planning (setting goals, activation), Monitoring, Controlling and Reflecting.

The phases/ strategies are interrelated with one another functioning sequentially or parallel to one another, therefore self-regulated learning is an open ciclical process within which it is not sensible to separate the phases (Panadero, 2017). The phases activate cognition, motivation, behaviour and its environmental context.

Metacognition plays a crucial role in self-regulation. It is the complex system of cognitive abilities with the help of which the learner reflects on different situations in order to develop his/her existing knowledge (Peverbly, Probst & Morris, 2002; Stavrianopoulos, 2007). Practicing planning, monitoring and assessment contribute to development of metacognition (Meloth & Deering, 1992; Schraw, 1998; Stavrianloulos 2007; Slavin, Chamberlin & Daniels 2007; Dignath & Büttner, 2008; Csíkos, 2007; Perry et al., 2019). The connection among metacognition, cognition and motivation is provided by assessment especially self-assessment. Self-assessment is closely related to monitoring. The learner compares his own learning goals to the qualitative or quantitative criteria of his learning activities (Zagyváné, 2019. 22.), and forms positive or negative judgements. Then, he performs adaptive behaviour: continues his successful learning strategies expecting further successes in learning or tries to avoid the feeling of dissatisfaction and escapes from learning (Zimmerman & Moyran, 2009. 304. Self-assessment and monitoring maintain the continuity of self-regulation, forming new learning goals and elaborating strategies to achieve them.

2.2. Examining student teachers' self-assessment

Revising the latest researches we can see, that they mainly focus on student teachers' self- assessment, how they assess themselves at the end of the courses (Kilic & Saglam, 2023; Martín-del-Pozo & Martín-Sanches, 2022) or teaching activities (Sigmon & Fogelsong, 2021; Riberio-Silva & Amorin, 2023). The number of studies dealing with self-assessment is limited and there are far fewer researches exploring student teachers' beliefs on self-assessment and its role in the learning-teaching process.

3. Research

In the research, we formed the following research questions:

- How do student teachers conceptualize self-assessment?
- Which metacognitive strategies can be identified in their beliefs?
- Which factors influence extended use of self-assessment as a method in their everyday teaching practice?

To answer the questions, we applied a longitudinal action research strategy in the qualitative paradigm. The research took four years in a secondary school in Eger, Hungary. The secondary school is one of the partner schools of Eszterhazy Karoly Catholic University with a teacher education program consisting of five years of university-based education and one year of individual long practice in the school selected by the student teachers.

The results are based on the analysis of data gained from input and exit interviews with student teachers divided into an experimental and a control group.

The sample consists of nine student teachers, five in the experimental group and four in the control group.

Figure 1. Experimental group.

Student teachers – Experimental group	University	School year	Specialization
1. Student	EKKE	2021/22	English language-Hungarian literature and grammar
2. Student	EKKE	2021/22	Biology- PE
3. Student	EKKE	2022/23	English language- Music, singing
4. Student	EKKE	2022/23	Hungarian literature and grammar- Library studies
5. Student	EKKE	2023/24	English language - History

Figure 2. Control group.

Student – Control group	University	School year	Specialization
1. Student	DE	2021/22	Hungarian literature and grammar - History
2. Student	EKKE	2022/23	Library studies- History
3. Student	EKKE	2022/23	History - Geography
4. Student	EKKE	2023/24	English language - Ethics

The same mentor teacher supervised all student teachers in the experimental group. She supported them by carrying out self-assessment regularly. The members of the control group had different mentors and they did not do self-assessment regularly.

The other sources of data were semi-structured interviews made with the members of the experimental group after each self-assessment, student teachers' written reflections and the mentor teacher's reflections after class observations.

The validity of the results was provided by theoretical, data and methodological triangulation Cohen's Kappa coefficients proved high reliability of coding (input and exit interviews: between 0.97 and 1; interviews after the observed lessons: between 0.88 and 1).

4. Results

Regarding the conceptualization of self-assessment by the examined student teachers, it is a complex process, which is present in people's life generally, but it occurs as a professional activity in teachers' everyday practice. They consider self-assessment as the engine of their own learning, personal and professional development. The concept of learning means two things for them: it refers to their development as university students and as beginner teachers. Self-assessment means development, growing and activity for them in order to succeed in their life. Student teachers also emphasize the role of self-assessment in building self-knowledge and knowing others. They conduct self-assessment considering criteria set either by others or by themselves. Some student teachers use self-assessment in their teaching practice as well. The most frequently used method is reflection as feedback from pupils in oral or written forms, which takes place during the learning process, or in its final stage. The sources of self-assessment are feedbacks from pupils, mentors, leading teachers. The members of the experimental and control groups named their strengths and weaknesses; in the input interviews, these were mostly related to their student identity and in the exit interviews mainly to their teacher identity. The members of the experimental group mentioned more job-related strengths in the exit interviews than those of the control group. Regarding the identified weaknesses, there were no differences between the two groups.

There were no differences between the two groups as for the quantity and quality of their learning goals mentioned. Dissimilarities were detected in the relation of the input an exit interviews. There was no difference between the groups considering linking their weaknesses to their learning goals referring to the existence of metacognition, self-regulation. There were students in both groups who have strong self-regulation. In the second group, the weaknesses and learning goals were not linked to each other in the input interviews but it did appear in the exit interviews. In the third group, the student teachers did not connect their weaknesses to their learning goals either at the beginning or at the end of the action research. The support used for achieving their learning goals also was identified in the interviews but this category was detected at the same student teachers in their input and the exit interviews having no difference between

the experimental and the control group in this matter.

We also examined the student teachers' self-assessment regarding the predetermined criteria describing the learning-teaching process in the classroom and the learning outcomes at the end of teacher education. In case of the earlier, the members of the experimental group gave higher evaluation to themselves than those of the control group while at the end of the teaching practice the members of the experimental group gave lower evaluation to themselves than those of the control group. These results show the role of regular self-assessment, as student teachers gained a broader view of the factors influencing the learning-teaching process, they were more critical with themselves. The mentor teacher benefitted from the results as identifying professional fields in which the student teachers required more effective support (the use of work forms, differentiation, assessment, self–assessment, time management). We could gain the same results in the case of self-assessment according to the learning outcomes; it is higher in the control group than in the experimental group at the end of the research.

All student teachers believe that self-assessment plays a very important role in teaching, but only the members of the experimental group claimed that they apply it on a regular base.

In the second phase of the action research, we described the self-evaluation profile of the student teachers of the experimental group based on the interviews and written reflections after each observed lesson and the mentor's reflections.

The profiles supported our conclusion that the student teachers were at different levels of self-regulation ranging from ones having strong self-regulation to ones having weak one. The profiles also revealed that those whose self-regulation is weaker, it is waving depending on their emotional state of mind justifying the role of emotions in self-regulation. If the student teacher is able to control his/her emotions, self-regulation is smooth (two students). Another student had difficulties with thinking over the possible solutions and it was the obstacle of setting new learning goals. One of the student teachers with strong problem-focused way of thinking and effective reactions in unexpected situations could compensate imperfect self-regulation.

5. Conclusions

All these results revealed that the examined student teachers conceptualize self-assessment as a complex system contributing to their professional development, their self-regulation supporting their pupils learning. A school-year long teaching practice effectively develops their self-regulation in which self-assessment is pivotal. The results also confirmed previous research conclusions that self-assessment supports building self-knowledge, identifying strengths and weaknesses (Kilic & Saglam, 2023; Martín-del-Pozo and at al., 2022). A new result is that the examined student teachers are at different levels of self-regulation. Although they are expected to be adults, self-regulated and responsible learners, using a wide range of metacognitive abilities, they are different from one another in this aspect, and it requires further research in the future to explore the factors influencing their self-regulation. Understanding the role of self-assessment in self-regulation requires special methodology in teacher education that includes the knowledge of wide varieties of self-assessment methods. Our research provides a support in this aspect.

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TEACHING ROMANI LITERATURES IN A GLOBAL CLASSROOM

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Abstract

This presentation focuses on the challenges and key takeaways from teaching Romani literatures in a global classroom open to enrollment to students from diverse academic backgrounds across the network. *The Literatures of the Roma* course was designed to explore works written by Romani authors in national and transnational contexts, while also examining the interrelationship between representations of "Gypsies" by non-Romani authors and questions of identity and self-representation in Romani writers' works. The course builds on the diverse perspectives and cultural capital of the students by inviting them to co-create content in the form of a class book, through activities such translating and adapting original works, as well as comparing different translations of the same text. In this presentation, I aim to illustrate a conceptual framework and approach for teaching the complex and underexplored literary output of Romani authors, alongside innovative, student-centered, project-based methods for engagement in the liberal arts classroom.

Keywords: *Romani, literature, teaching, Roma, Gypsy.*

1. Context

The Literatures of the Roma (Gypsies) course was conceived with the mission to explore works by Romani authors in national and transnational contexts and to reflect on the interrelationship between representations of "Gypsies" by non-Romani authors and questions of identity and self-representation in Romani writers' work. The course generated significant interest during its pilot phase in fall 2024. To meet growing demand, it was re-offered in Spring 2025, and will continue to play an essential role in Bard College's global network curriculum.

Part of the Open Society University Network (OSUN) curriculum, the course is open to students from across the network. Participants come from diverse academic disciplines and member institutions, with demographic makeup and institutional representation varying each semester. Over two semesters, students have joined from eight institutions, including the American University of Central Asia (Kyrgyzstan), Bard College (US), Bard College Berlin (Germany), Bard Early College in New Orleans (US), Bard Early College in Baltimore (US), Bard College at Simon's Rock (US), Central European University (Austria), and Parami University (Myanmar).

Students' academic backgrounds are broad, spanning disciplines such as liberal arts, chemistry, biology, human rights, environmental and urban studies, politics, philosophy, Middle Eastern studies, and more. Some students major in literature, while others may have never taken a literature course before. Academic levels also vary widely: students at Bard Early Colleges in 11th or 12th grade learn alongside graduating college seniors and graduate students.

2. Course definition and learning objectives

Fascination with the Roma has resulted in a large body of works produced over centuries by non-Roma authors. These works, in turn, have shaped societal perceptions and norms of engagement, playing a central role in the fictitious and exceedingly negative stereotyping and persecution of the Roma. Meanwhile, little attention has been paid to the literature and art created by Romani authors themselves—works that counter exoticized and often dehumanizing images and allow for authentic self-representation. This course provides students with the opportunity to examine stereotypes associated with the Roma and engage directly with primary sources—poetry, prose, essays, and art—produced by Romani authors, as well as collective forms of Romani art such as fairy tales and songs. Students explore themes of "the other," identity, class, race, gender, location (and dislocation), belonging, and the often-overlooked experiences of Romani slavery and the Holocaust, among others.

The course's learning objectives are to:

1. Develop the capacity to think critically about portrayals of the Roma (Gypsies) in literature and the arts created by non-Roma authors, and understand the personal, social, and ethical implications of such characterizations.
2. Acquire essential introductory translation skills.
3. Learn to work collaboratively and manage projects effectively.
4. Recognize key themes in the literatures of the Roma and place these themes in social, historical, and cultural contexts.
5. Reflect on one's own cultural conditioning and biases toward people perceived as "others", fostering a better understanding of others.
6. Apply the knowledge and skills gained in the course to broader discourses.

3. Methodology and core activities

Building on the students' diverse cultural (including linguistic), academic, and geographic backgrounds, they are given a choice of: 1) translating a text by a Romani author or a non-Romani author engaging with themes related to the representation of "Gypsies" 2) adapting such a text, or 3) comparing two different translations of the same text.

The two anthologies produced during the Fall 2024 and Spring 2025 courses reflect the diversity of the students and their choices. They include translations from Spanish, Slovak, Hungarian, Tajik, Uzbek, Burmese, Russian, French, Italian, and Arabic, representing a range of authors—many of whom are of Romani (Roma, Sinti) or Dom descent—writing across national borders.

In addition to their individual projects (translation, adaptation, or comparison), students team up in pairs to illustrate and write a one- to two-paragraph introduction to each other's work. These introductions together form the chapter titled "Introduction." By the end of the course, each student has collaborated closely with several partners by: 1) illustrating another student's work, 2) introducing another student's work, 3) working with a peer who illustrates their own work, and 4) working with another peer who writes their introduction. In other words, each student is part of four different pairs centered on producing their own content as well as two additional pieces—one introduction and one illustration—for other students' works.

This pairing system greatly increases student engagement with each other's work and fosters deeper familiarity, understanding, and appreciation of each other's choices, perspectives, and cultural contexts. Students present their projects in pairs (the creators of the written content together with their illustrators) at the end of the course. The content produced by students will be compiled into a student anthology, with the editorial decisions (title, sequence of works, layout) determined collectively.

4. Book layout and editorial choices

The book consists of four main sections: 1. a "Preface" written by the instructor, 2. an "Introduction" co-written by the students, with each student introducing another's work, 3. Individual contributions–translations, adaptations, and comparative analyses– alongside original illustrations created by the students, and 4. an "Afterword" written by the instructor. The layout of the book is determined by the students and represents the culmination of a semester-long conversation on how best curate and present the story they want the anthology to tell–through their works and based on their classroom discussions. These curatorial decisions can change from semester to semester. In Fall 2024, students opted to organize the content based on the nature of the contributions, dividing the book into three sections: 1. Translation, 2. Adaptation, and 3. Comparative Analyses, and listed the works in that sequence.

In contrast, during the Spring 2025 semester, students decided against dividing the collection by activity type or by authors' ethnic identities (e.g., Roma vs. non-Roma). Over the course of the semester, class discussions underscored the fluidity of categories such as identity, belonging, representation, and self-representation. As a result, students were cautious not to impose artificial divisions or reinforce binaries that could undermine the complexity of the texts.

Although they considered a randomized juxtaposition of texts, they ultimately rejected this approach. Such randomness, they realized, might inadvertently diminish the impact of certain works—for example, placing a poem about the Romani Holocaust by a Roma author directly beside a lighthearted pop song by a non-Roma Burmese artist likening their own life experience to the "aimlessness" of the "Gypsy" lifestyle could unintentionally trivialize the former.

The group ultimately agreed on one organizing principle that felt more neutral and less imposing: a loosely interpreted chronological order, based on the authors' lifespans. Still, they acknowledged that chronology alone does not construct a cohesive thematic narrative. Therefore, they also chose to introduce

original works (translations and comparative analyses) before adaptations, believing that adaptations have the capacity to extend and transform the original texts. As such, adaptations are placed at the end of the anthology to signal their role in sustaining and reimagining the original works.

5. Learning benefits and challenges

Centering the course content and learning process around the creation of a course book has proven to be highly motivating for students. The prospect of having their work "published" excites them, and they are inspired by the idea of seeing their texts illustrated by peers. This collaborative project not only fosters engagement but also ensures that the course content remains relevant to the students' geographic, cultural, and academic contexts. By offering students multiple options—translation, adaptation, or comparative analysis—to engage with texts, the course design accommodates diverse student backgrounds, interests, and academic strengths.

Because the student cohort varies each semester, inviting students to co-create course content ensures that the readings remain representative of their lived experiences and cultural contexts. In doing so, the course facilitates the discovery and inclusion of literary works that may not be widely known or previously translated into English, enriching the available body of Romani literature along with reinvigorating through new translations discussions of texts that engage with the Gypsy theme.

Project-based learning of this kind equips students with a variety of practical and academic skills. Regardless of whether they choose to translate, adapt, or compare texts, students are required to engage deeply with the source material. Translators must consider word choice, rhyme and rhythm, formal characteristics, emotional nuances, to name a few. Adaptors reflect on the transformation of meaning when making decisions about their word choices or adapting the text to a new medium—whether poetry, prose, song or musical arrangement. To list a few examples, students have adapted a short story to a film script, an origin myth to a sci-fi short story, a song to a musical arrangement, a poem to a coming-of-age story and a graphic novel. Those comparing two translations must analyze subtle differences in word choices, tone, and form, intended audience…and begin to appreciate the translator's creative role. The result is a richer, more immersive engagement with the text across languages and contexts.

This course design is particularly well-suited for the teaching of Romani literatures, a body of work that is inherently transnational. It allows for the inclusion of national contexts that are meaningful to the students themselves, thereby broadening the scope of the course and increasing its global relevance.

While the benefits of this model far outweigh its challenges, there are a few difficulties worth noting. One logistical challenge is that not all students are equally prepared to work effectively in teams. Because the final product—the anthology—is so interconnected, delays by a single student can affect others. Illustrators cannot begin without finalized texts; introductory pieces cannot be written until those texts are submitted; and the overall layout cannot be determined until all content is in place. This interdependence requires the instructor to monitor student progress closely and intervene when necessary to prevent bottlenecks.

A more nuanced challenge lies in the different ways Roma and non-Roma students relate to the course material. Many works by Romani authors contain traces of generational trauma, which Roma students often recognize and viscerally experience. For some Roma students, this course represents their first academic encounter with their own culture. That experience can elicit complex emotions: a renewed pride in cultural heritage, but also a painful confrontation with systemic marginalization and personal or familial trauma.

In emotionally charged moments, the classroom can become a space of vulnerability. Non-Roma students, aware of the weight of these experiences, may become cautious—sometimes overly so—in contributing to discussions. They may fear offending or misrepresenting their Roma peers or questioning lived experiences that they cannot fully comprehend. As a result, they may participate less, leading to an imbalance in dialogue. In such moments, the instructor plays a critical role in fostering a space of trust and mutual respect. It is important to acknowledge the emotional dimensions that Roma students bring into the classroom while also encouraging open, respectful, and reflective participation from all students. Careful facilitation can help ensure that the class remains both intellectually rigorous and emotionally supportive, enabling all students to learn from one another's experiences and perspectives.

Lastly, the very question whether there exists a transnational literary phenomenon that can be called *Romani literature,* or whether it is more accurate to speak of *Romani literatures* informed primarily by the authors' national contexts, remains open to debate. Regarding questions of authorial identity, some writers take pride in being identified as Romani author and actively promote writing in Romani as a means of establishing a transnational Romani literary tradition. Others, however, assert that their literary work should be considered within the framework of their national literary canon or as part of the literature of the linguistic community whose language they write in, independent from their Romani ethnic origins. The

course acknowledges the diversity of these perspectives and positions and intentionally cultivates an awareness of the heterogeneity that defines its subject matter.

6. Conclusion

The Literatures of the Roma course invites students to explore a transnational literary tradition that remains significantly underrepresented in academic discourses. By engaging students in the production of course content—through translation, adaptation, or comparative analysis—the course not only addresses the limited availability of Romani texts in English but also leverages students' cultural and linguistic capital to enrich the curriculum. This participatory model reinvigorates discussions surrounding literary representations of Gypsies and promotes the creation of otherwise inaccessible content which becomes a valuable asset for both the course and broader scholarly engagement.

While originally designed for a global classroom, the course structure is equally adaptable to local contexts, particularly in light of increasingly diverse student populations. Through its project-based approach, the course mirrors the heterogeneity of Romani literary output and the diverse traditions of literary representations of Gypsies, while encouraging students to draw from their own cultural and geographical backgrounds. This fosters deeper personal investment and more meaningful collaboration.

Although the anthology produced through the course centers on representations and self-representations of the Romani experience—or perceptions thereof—the course design offers a replicable model for engaging with the literary voices of other historically marginalized, silenced, or "othered" communities.

Acknowledgements

I would like to acknowledge the students in my Literatures of the Roma course, whose probing questions played a vital role in shaping our collective discourse and in challenging preconceived notions about identity, representation, and authorship. Through their work in translation, adaptation, and comparative analysis, they created invaluable content—much of which I, myself, had no prior access to or awareness of. This course was a truly collaborative enterprise that could not have come to life without the students' active participation, intellectual curiosity, and unwavering commitment.

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UBIQUITOUS AND LIFELONG LEARNING: A LATIN AMERICAN EXPERIENCE

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Abstract

This research aims to offer a theoretical approach, arising from an intervention with online postdoctoral students, that addresses ubiquitous learning and interdisciplinary collaboration in education. This research aims to identify and subsequently develop digital competencies that enable teachers to innovate in educational practices and adapt to technological changes in this digital age. The methodology is qualitative, based on a systematic review of the literature in repositories, as well as ethnography to identify the level of competencies related to the use of Generative Artificial Intelligence. The sample consists of Latin American teachers pursuing virtual and long-distance postdoctoral programs as part of ubiquitous and lifelong learning. Privacy, misinformation, and mental health are indicators that emerged in response to the disadvantages of technological use and appropriation, particularly in socio-digital networks. The results indicate that teachers have adopted technological tools that support flexible learning. The promotion of a culture of lifelong learning is highlighted as part of a positive impact on teachers, researchers, students, and educational institutions in their transformative role; however, they are lagging behind in the incorporation of new information technologies into everyday life.

Keywords: *Ubiquitous learning, social media, digital literacy, lifelong education.*

1. Introduction

The research focuses on the intersection between interdisciplinary collaboration and ubiquitous learning, emphasizing how these practices can be used to innovate education in Latin American contexts for lifelong learning. Convergence in the digital era has transformed the way in which technological uses and appropriations modify practices and approaches to learning and teaching in which technological and communicative practices are incorporated.

The context of this research is derived from an exercise of international collaboration and linkage, where a virtual and long-distance course for a group of Latin American teachers who are in the last semester of their postdoctorate in Didactics and Educational Technology is involved.

Throughout the interaction of the seventeen weeks, a session is combined every fourteen days in a synchronous online class using zoom. In this space, the findings or results of the material worked on during the two weeks in the Moodle platform are socialized asynchronously. In the plenary, which lasts 3 hours, a master class is held as an introductory topic to the new thematic unit. The interaction allows the incorporation of various technological resources to achieve meaning and encourage attention for the session, which has been so indicated by the Latin American educational institution.

This raises concerns about the level of use and appropriation of technology, the perception of privacy when browsing, being a prosumer in digital environments, the position they have as adults on misinformation or "infodemia" and the central question about mental health in this era of digital convergence and in the globalized world that we face every day with the so-called "digital revolution".

2. Methodology

General objective: To conduct a systematic review that integrates ubiquitous learning and interdisciplinary collaboration in education, in order to identify digital competencies that allow teachers to innovate in their educational practices and adapt to technological changes, thus promoting meaningful and continuous learning in the Latin American context.

Specific Objectives:

- To provide a conceptual review connecting ubiquitous learning with interdisciplinary collaboration in education.
- To identify and analyze the digital competencies that influence the ability of researchers to adapt to technological changes and promote meaningful and continuous learning in the Latin American context.

Collection instruments:

- Critical analysis of previous studies in specialized literature
- Case study: Post-doctorate in Didactics of Scientific Research and Epistemology of Education where innovative programs in "Ubiquitous and Lifelong Learning" are implemented.

3. Results

Ten studies on digital competencies, ubiquitous learning, interdisciplinary collaboration, and ICT integration in education were examined. Six studies employed systematic reviews, and most focused on higher education contexts, with five originating in Spain. In every study, technology integration capabilities appear as a key digital competency, with nine studies also highlighting online collaboration and digital literacy—and seven noting specific digital skills.

The papers document that ubiquitous learning environments, enabled by mobile resources and cloud-based tools, blur the boundaries between formal and informal learning and promote student autonomy and engagement. Reports on interdisciplinary collaboration stress that the use of social media platforms and discussion forums facilitates knowledge sharing despite challenges such as limited teacher expertise, evaluation difficulties, digital divides, and infrastructural constraints. In these studies, effective strategies include holistic digital competency frameworks that align technological tools with pedagogical goals, personalized learning approaches, and continuous professional development.

We analyzed 10 papers from an initial pool of 50, using 7 screening criteria. Each paper was reviewed for 6 key aspects that mattered the most to the research question. For all 10 studies, the research methodology in the available full texts or abstracts, were as follows: 6 were systematic reviews, one used qualitative research, one design-based research, one action research, and a case study

Context of the studies: 9 focused on higher education; 5 were conducted in Spain; 2 had an international or multi-country focus and mentions of other contexts (Latin America, primary education, secondary education, Peru, Ecuador, online education, and teacher training) in 1 study each, were found.

Key digital competencies addressed: Technology integration capabilities were mentioned in all 10 studies; Online collaboration competencies and digital literacy components were each found in 9 studies and specific digital skills were mentioned in 7 studies

Study focuses varied, including trends in educational systems, ubiquitous learning, ICT use in teaching, social media integration, virtual education, collaborative learning, and teacher training.

Concerning Digital Competency Frameworks and Implementation, we found:

- Framework Components: we didn’t find mention of specified framework components in 5/10 studies. Of those that did specify, 3 studies used comprehensive digital skills frameworks, 1 used ubiquitous learning components, and 1 focused on various areas of digital competencies.
- Implementation Strategies: the most common strategies mentioned were the use of ICT tools and social media integration, each found in 2 studies. Other strategies included teacher competencies, technology integration, connectivism approach, virtual collaboration, use of cloud and web 2.0 tools, creation of virtual environments, and use of adaptive technologies.
- Reported Outcomes: enhanced digital competency was the most frequently reported outcome, found in 3 studies. Other outcomes included improved teaching-learning processes, student protagonism, knowledge management, continuous learning, digital literacy, collaborative practices, enhanced learning, adaptation to learning styles, and autonomous learning.
- Challenges: we didn’t find mention of specified challenges in 4/10 studies. Among the challenges reported, there was a wide variety with little overlap between studies. This included lack of teacher expertise, evaluation difficulties, access disparities, attitude issues, complexity, limited ability to create digital solutions, digital divide, resistance to change, and the need for continuous technological training.

4. Discussion

Collaboration tools: We found mention of a wide variety of collaboration tools across the studies we reviewed. The most frequently mentioned tools were social media platforms (including Facebook) and discussion forums, each found in 2 studies. Video conferencing and ICTs were also mentioned in 2 studies each. Other tools such as Moodle, Flipped Classroom, email, shared zones, collaborative editors, chat, and collaborative presentations were each mentioned in one study.

Pedagogical approaches: Student-centered learning and personalized learning were the most common approaches mentioned, each found in 2 studies. Collaborative work/learning and using social media for content sharing/learning were also found in 2 studies each. Other approaches such as communication and interaction in virtual spaces, connectivist approach, affective-motivational strategies, and autonomy were each mentioned in 1 study.

Success factors: Interactive and collaborative learning environments, student engagement/participation, knowledge sharing and interaction, and virtual learning environments were each mentioned as success factors in 2 studies. Other success factors such as digital literacy promotion, improvement of teaching and professional development, enhanced competences, and organization and management of virtual spaces were each found in 1 study.

Barriers: We found limited information on barriers, with only 4 studies mentioning them. The barriers mentioned were evaluation challenges, lack of disposition towards virtual learning, digital divide, and resistance to change, each found in 1 study.

Ubiquitous Learning Environments: The concept of ubiquitous learning environments emerges as a significant theme across several studies, particularly in the context of higher education. Key findings include:

- Potential of ubiquitous learning as facilitates learning at any time and place; supported by mobile resources and connectivity; particularly relevant in contemporary educational contexts and blurs boundaries between formal and informal learning.
- Characteristics of ubiquitous learning environments: Integrate technology seamlessly into various learning contexts; Connect physical and virtual spaces; Often facilitated through mobile devices, cloud resources, and web 2.0 tools and Create flexible, accessible, and responsive learning ecosystems.
- Potential benefits: enhanced student engagement and autonomy; Improved access to educational resources; Facilitation of personalized learning experiences and Promotion of collaborative learning across diverse contexts
- Implementation challenges: Need for adequate technological infrastructure and connectivity; Ensuring equitable access to technology and addressing the digital divide; Developing teachers' competencies to effectively leverage ubiquitous learning technologies.

While the potential of ubiquitous learning environments is widely recognized across the studies, there is a need for more empirical research to evaluate their long-term impact on learning outcomes and digital competency development.

Social Media in Educational Contexts:

The use of social media in educational contexts emerges as a significant theme across several studies, with a particular focus on its potential for enhancing collaborative learning and digital competency development. Key findings include:

- Benefits of social media use in education: Enhanced student engagement; Improved digital competencies; Bridge between formal and informal learning; Facilitation of collaborative learning
- Challenges and considerations: Evaluation difficulties; Privacy and security concerns; Need for pedagogical integration and Digital divide
- Areas of digital competency improvement: Information and digital literacy; Communication and collaboration; Digital content creation
- Collaborative learning opportunities: Knowledge sharing; Peer interaction; Collaborative content creation

While the potential benefits of social media in education are evident, the studies suggest a need for more comprehensive research on long-term impacts, best practices for implementation, and strategies to address the identified challenges.

5. Conclusions

Implementation Challenges: Across the reviewed studies, several common challenges emerge in the implementation of digital competencies and technology integration in educational contexts:

1. Digital divide:

- Unequal access to technology and digital skills among students and educators
- Significant impact on the effectiveness of digital learning initiatives
- Affects development of digital competencies

2. Lack of teacher expertise:
   - Insufficient digital skills among educators
   - Significant barrier to effective technology integration
   - Suggests need for comprehensive and ongoing professional development
3. Resistance to change:
   - Noted among educators in adopting new technologies and pedagogical approaches
   - Potential factors: lack of confidence, time constraints, skepticism about benefits
4. Evaluation challenges:
   - Particularly in context of social media and collaborative online platforms
   - Difficulties in effectively evaluating student work and contributions
   - Suggests need for new assessment strategies
5. Infrastructure limitations:
   - Inadequate technological infrastructure
   - Connectivity issues
   - Barriers to implementing ubiquitous learning environments
6. Pedagogical integration:
   - Challenge of effectively integrating technology with appropriate pedagogical approaches
   - Highlights need for holistic approach considering both technological and pedagogical aspects
7. Rapid technological change:
   - Fast-paced evolution of digital technologies
   - Challenge for educators and institutions to stay current and adapt practices

These challenges underscore the complexity of implementing digital competencies and technology integration in educational settings. The challenges identified in these studies suggest complexity in implementing digital competencies and technology integration in educational settings.

Best Practices

The analysis of the included studies reveals several emerging best practices for developing digital competencies and integrating technology in educational contexts:

1. Holistic approach to digital competency development:
   - Address multiple dimensions: technical skills, pedagogical creativity, ethical awareness
   - Comprehensive and multifaceted digital competency frameworks
2. Integration of formal and informal learning:
   - Use social media and digital platforms to bridge contexts
   - Enhance student engagement
   - Make learning more relevant to students' everyday experiences
3. Personalized and adaptive learning:
   - Use technology to facilitate personalized learning experiences
   - Adapt to individual student needs
   - Enhance student engagement and learning outcomes
4. Collaborative learning strategies:
   - Use digital tools to promote collaboration and knowledge sharing
   - Implement discussion forums, collaborative editing tools, social media platforms
5. Continuous professional development:
   - Ongoing professional development for educators
   - Focus on technical skills and pedagogical approaches for effective technology integration
6. Creation of virtual learning environments:
   - Comprehensive environments supporting various aspects of learning process
   - Include content delivery, communication, collaboration, assessment
7. Ubiquitous learning approaches:
   - Integrate technology to support learning across various contexts and devices
   - Particularly promising in higher education settings
8. Focus on digital literacy:
   - Develop broader digital literacy skills beyond technical competencies
   - Include critical evaluation of online information and understanding of digital ethics
9. Alignment with pedagogical goals:
   - Ensure technology integration strategies align with clear pedagogical objectives

- Focus on learning outcomes

10. Addressing the digital divide:
    - Develop strategies to ensure equitable access to technology
    - Promote digital learning opportunities across diverse populations

These best practices provide a foundation for developing effective strategies to enhance digital competencies and technology integration in educational settings. However, the effectiveness of these practices may vary depending on the specific context.

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MODELLING AND REFLECTION ON INSTRUCTIONAL ACTIVITIES (MARIA) FRAMEWORK: THE VOICE OF PARTICIPANTS IN THE TAP-TS PROJECT

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Abstract

The EU Teacher Academy Project – Teaching Sustainability (TAP-TS), running from June 2022 until July 2025, aims to strengthen the sustainability education competences of European primary and secondary level student teachers, teacher educators and teachers, according to the GreenComp framework (Bianchi et al., 2022). This was achieved through the co-creation, piloting, and implementation of Learning and Teaching Packages (LTPs), participation in international teacher development courses, and engagement in an international community of practice. This communication presents an experimental framework developed within the project, called MaRIA (Modelling and Reflection on Instructional Activities), designed to foster a reflective approach based on experiences around teaching sustainability within the activities integrated in the LTPs. The TAP-TS MaRIA' framework includes three levels of engagement – students, schools and wider community – and seven dimensions of reflection transversal to the three levels. This framework guides the follow-up activities in each LTP to encourage a focused reflection on the learning experiences about sustainability that are provided, but can also be used in other moments of the LTP creation process. By using various data collection methods in the LTPs implementation - such as participant-produced materials and videos - reflections from teacher educators, in-service teachers, school leaders and future teachers regarding teaching sustainability were gathered. In the present communication a diversified set of reflections of participants about the TAP-TS project driven by the use of the framework will be also presented. The results of the application of the MaRIA framework within the context of the TAP-TS activities, suggest that it is a relevant tool for promoting deeply reflections across different dimensions of instructional activities for teaching sustainability. In the future, creating more opportunities to use the MaRIA framework will enhance our understanding of its impact on educational material creation and broaden leaders, teachers' and future teachers' perspectives on teaching sustainability.

Keywords: *Framework, reflection, sustainability, teacher education.*

1. Introduction

The EU Teacher Academy Project – Teaching Sustainability (TAP-TS, n.d.), running from June 2022 until July 2025, aim to strengthen the sustainability education competences of European primary and secondary level student teachers, teacher educators and teachers, according to the GreenComp framework (Bianchi et al., 2022). This was achieved through the co-creation, piloting, and implementation of learning and teaching packages (LTPs), participation in international teacher development courses, and engagement in an international community of practice. The LTPs were organized into seven themes: A Sustainable Europe; Sustainability and Digitality; Sustainability & Environmental Education; Climate Crisis Resilience; Dealing with Climate Disinformation; Green Citizenship in/for Europe; Sustainable Entrepreneurship Education (SEE). Additionally, a LTP compendium was created, with additional information about the LTPs design process, methodological underpinnings, validations processes and lessons learnt at policy, institutional and personal levels. The project partners, along with other teachers and student teachers, engaged with that set of materials during four Active Learning Events, which included both online and in-person components.

Within that project, an experimental framework called MaRIA (Modelling and Reflection on Instructional Activities) was developed and integrated in the follow-up activities of each LTP. The participants were involved in reflection moments oriented by the framework, mainly in project events for piloting the materials. This paper presents a diversified set of reflections on teaching sustainability of participants driven by the use of that framework.

2. Theoretical background

Reflective thought in education can be traced back to Dewey (e.g., Dewey, 1933). However, it was not until the 1980s that the term 'reflection' gained prominence in discussions surrounding practitioner development, including that of teachers (Anderson, 2020). Teacher reflection can be understood as the process of thinking one's professional work and engaging in self-evaluation, whether by an individual preparing for a teaching career or by an experienced educator (Wieseman, 2009). Korthagen (2010) study shows that teacher reflection can have positive outcomes on the quality of teachers' interpersonal relationships with students, adequacy of perception of these relationships, and job satisfaction.

The growing interest in teacher reflection led researchers to create conceptual frameworks designed to promote teacher reflection, in the following decades. For example, the conceptual framework proposed by Colton and Sparks-Langer (1993) is built upon four key attributes: efficacy, flexibility, social responsibility, and consciousness. Central to this framework is the professional knowledge base of teachers, which, when combined with their actions focused on planning, implementation, and evaluation, enhances the conscious process of reflection and decision-making. A significant outcome of this framework is that teachers create new mental representations and meanings as they interpret reality through the lens of their professional knowledge (Colton & Sparks-Langer, 1993).

Some frameworks for specialized teachers were also created to promote their reflection. One example is Farrell (2015)' frameworks to foster teacher reflection in second language education. This framework describes five levels of reflective practice (Philosophy; Principles; Theory-of-Practice; Practice; Beyond Practice) and specific techniques for teachers, alone, in pairs, or in a group, to implement each level of reflection in their work, using a deductive or an inductive approach. Moss et al. (2018) developed a reflective practice framework that was applied to mathematics teachers. The daily framework created was constituted by six daily reflective questions based in the mathematical meaning of the lesson, misconceptions that emerged during the process of task resolution from students, comments and reflection shared by students and lessons learners that could be applied to other classes of the same subject (Moss et al., (2018). The daily framework filled by the teacher was read and commented on by a mathematics education researcher. According to the authors, this process, in addition to promoting teacher reflection, led to other advantages, such as the reduction of the teachers' sense of isolation and the establishment of a community of practice.

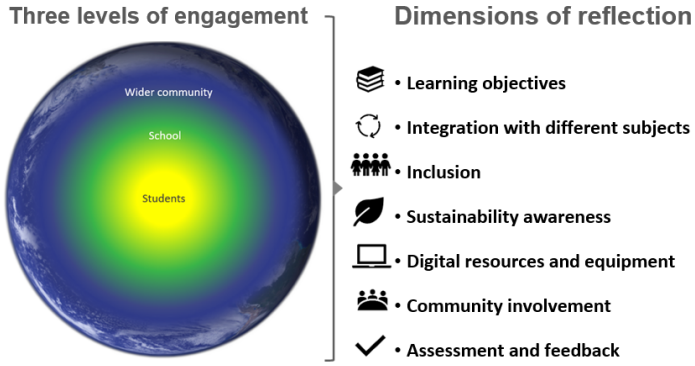
In literature can also be found frameworks to foster teacher reflection on their competences. One example is the Reference Frameworks of Competence for Democratic Culture (RFCDC) which presents a tool for teacher self-reflection (Lenz et al., 2021). This framework seeks to assist teachers and other educators in enhancing their competencies related to democratic culture and fostering a 'democratic professional ethos,' grounded in the values of democracy, human rights, and intercultural dialogue (Lenz et al., 2021). Specifically, about sustainability, Warren et al. (2014) created the Sustainability Education Framework for Teachers (SEFT) (2014). The SEFT framework aims to empower educators to grasp the broad and complex nature of sustainability, emphasizing its problem-oriented and solution-driven aspects (Warren et al., 2014). It incorporates four interconnected ways of thinking - futures, values, systems, and strategic - which can be used to help novice teachers link seemingly unrelated sustainability topics. As a self-reflection conceptual framework, SEFT provides organizing principles for addressing sustainability challenges and encourages self-reflection and independent inquiry through real-world contexts. It fosters collaboration in various interpersonal settings while prompting critical inquiries about societal values, equity, and future visions, ultimately guiding pathways toward a sustainable future (Warren et al., 2014). The GreenComp framework (Bianchi et al., 2022) was also used to foster teacher reflection on sustainability. The compendium of case studies on GreenComp by Javorka et al. (2024) presents examples demonstrating how GreenComp has encouraged teacher reflection across various educational levels, including primary and secondary education, higher education, vocational education and training, and non-formal education. Sourgiadaki and Karkalakos (2023) also used the GreenComp framework as a foundation to promote reflection and enhance VET teachers' readiness in creating learning opportunities for the green transition, while maintaining a critical perspective on its application.

3. MaRIA Framework

The Modelling and Reflection on Instructional Activities (MaRIA) framework was designed to foster a reflective approach based on experiences around teaching sustainability within the activities integrated in the learning and teaching packages of the TAP-TS project (Revyakina et al., 2024). The TAP-TS MaRIA' framework includes seven dimensions of reflection in three levels of engagement – students, schools and wider community (Figure 1). This framework was developed to assist in creating both innate or spontaneous opportunities for reflection and ex-post reflection opportunities, both of which are essential components of teacher reflection (Revyakina et al., 2024).

The three levels of engagement in the MaRIA framework progress from the micro level (reflecting on students' learning about sustainability) to the meso level (reflecting on the school's impact on sustainability learning), and finally to the macro level (reflecting on the influence of the wider community on sustainability and sustainability learning) (Revyakina et al., 2024).

Figure 1. Levels of engagement and dimensions of reflection of MaRIA' framework (Credits: Authors).



MaRIA framework comprises seven dimensions of reflection which are prompted by specific questions presented in the LTPs. The learning objectives focus on reflecting on the relationship between proposed activities and curriculum goals, ensuring alignment with the GreenComp framework for sustainability competences (Bianchi et al., 2022) and identifying gaps to enhance the integration of Sustainable Development Goals (SDGs) in education. Reflection on integration emphasizes connecting sustainability across subjects to strengthen its role as a transdisciplinary focus. Inclusion reflections aim to maximize student participation and meaningful engagement, recognizing the necessity of action to realize educational inclusion. In TAP-TS learning events, teachers reflect on how activities enhance sustainability awareness and responsibility, crucial for informing younger generations' actions. While TAP-TS isn't a digital pedagogical project, it incorporates digital resources to support meaningful learning experiences. Community engagement reflections extend learning beyond classrooms, encouraging connections with local sustainability issues and diverse community involvement. Assessment and feedback are challenging yet essential, requiring reflection on effective evaluation methods that meet both formative and summative needs. This includes monitoring students' knowledge and skills while also seeking feedback to inform teaching practices and resource use. Overall, reflective practices in TAP-TS support comprehensive teaching approaches aimed at fostering sustainability awareness, inclusion, and effective community engagement (Revyakina et al., 2024).

4. Methods

The MaRIA framework was applied in different moments of the LTPs development and implementation, allowing to collect different evidences of educators' reflections. The participants were school leaders, in-service teachers, future teachers and teacher educators that participated in the Active Learning Events of the TAP-TS project. In those Active Learning Events they experienced different LTPs and gave their contribution to their improvement. Written reflections of teachers are commonly instruments used to collect teacher's reflective thinking (Hayden et al., 2013) and were also used to collect teacher reflections during Active Learning Events. Sound and video are also popular ways to collect teachers' thoughts. Accordingly, various data collection methods in the LTPs implementation, such as participant-produced materials and videos, with reflections about teaching sustainability, were gathered. The participant-produced materials during the Active Learning Events were collected to analyse their impact in the LTPs development. Additionally, in the present work, the analysis of a set of reflections that represents the diversity of participants is presented: a school leader, an experienced in-service teacher, a future teacher. Participants were asked to reflect about the contribution of the TAP-TS project and Active Learning Events to their professional development, choosing one or more dimensions of reflection of MaRIA framework. The ideas of all participants were collected using video recording.

5. Results

5.1. MaRIA impact on LTPs development

Participant-produced materials during the LTPs piloting showed that MaRIA framework contributed to identify elements and ideas that could be improved in the LTPs developed within the project.

For example, activities designed for teaching sustainability in primary schools were refined based on the participants' reflections facilitated by MaRIA, particularly focused on the students' level of engagement, to more specifically contribute for the development of sustainability competences in young students. For instance, comparing with the first LTPs version, a teaching approach for primary school students focused on preservation of ecosystems was enhanced to incorporate different levels of analysis on human impact and prevention and protection actions. This process encouraged participating primary school students to reflect on sustainability and contributed to develop several GreenComp competencies within them.

5.2. MaRIA impact on TAP-TS participants

5.2.1. Reflections of a school leader. The school leader considered TAP-TS one of the most important projects it as participated in, focusing on sustainability and methodologies. He highlighted the importance of the project events to improve and disseminate teaching sustainability and expressed the possibility of mobilization of the LTPs resources to involve local schools and community on projects to promote sustainability competences. The value for teachers, students, and local partners was emphasized, noting the participation of teachers from local schools. He mentions the opportunity to strengthen connections between the school of education and local institutions, as well as an opportunity to internationalization and strengthen ties with European partners. The opportunity of discussion and reflection in the international network reinforce the cooperation stablished as a European learning community, that should continue beyond the project. He recognised the value of the LPTs created in the project, which will allow student teachers, teacher educators and teachers to use them in local contexts. Overall, the school leader's reflections indicated a focus on the school level of engagement and in the "sustainability awareness" and, primarily, "community involvement" dimensions of the MaRIA framework.

5.2.2. Reflections of an in-service teacher. The science in-service teacher expressed that she had no doubts about the relevance of participating in the TAP-TS project, because sustainability is a very important issue nowadays, and it was a rewarding experience. She learned new methods and activities for teaching sustainability in all its aspects. She found most of the activities to be very innovative and appealing to students, and noticed their engagement when developing them with her own students. She also noted that the sharing of ideas and progress between project participants was an added value. The in-service teacher reflections indicated a focus on the students' level of engagement and in the integration of the resources experienced in her own practice, mainly considering "learning objectives" and "integration with different subjects".

5.2.3. Reflections of a future teacher. The future primary teacher described her participation in the TAP-TS Project as a rewarding experience with a significant impact on her professional development. Through both synchronized sessions and face-to-face meetings, she expanded her knowledge of teaching sustainability. The workshops organized by the project partners allowed her to create a significant collection of innovative and reflective activities to use with her students. Por example, some activities increase reflection on the human impact on the planet, addressing common problems such as the harmful effects of digital technologies on the environment and the responsible use of natural resources. She considered the experience at the Active Learning Events in Portugal as a privileged moment for exchanging knowledge and reflection. She had the opportunity to collaboratively, in an international group of teachers and student teachers, experience and discuss some activities of LTP for primary education and also reflect about the development of the activities with students based on the MaRIA framework. She implemented one activity with students and present and discussed their work with the participants in a hybrid moment of the Active Learning Event 4. The MaRIA framework also was import for the final reflection about the contributes of the work for students' developing sustainability competences, identifying some of their ideas shared in the classroom related with raising awareness of sustainability (Figure 2). She emphasizes her commitment to working actively with students to achieve sustainable development goals by 2030, promoting concrete actions that ensure a more balanced and sustainable future for all. In summary, the future teacher reflections indicate a focus on the students' level of engagement and in the "sustainability awareness" and "integration with different subjects" dimensions of reflection.

Figure 2. Students' conclusions shared by the student teacher in the ALE4 final session (Credits: Student teacher).

6. Conclusion

The MaRIA framework facilitated the refinement of LTPs and fostered reflection to prepare educational resources. This process resulted in enhanced activities for teaching sustainability in primary and secondary schools, as well as a deeper analysis of student work and the development of sustainability competences among students. The collaborative work provided a common understand of the MaRIA framework facilitating the reflection and discussion of ideas to promote teaching sustainability. Additionally, the results of the application of the MaRIA framework within the context of the TAP-TS activities, based on three levels of engagement: students, schools, and the wider community, suggest that it is a promising tool for promoting deeply reflections across different dimensions of instructional activities and moments of teachers practice for teaching sustainability. Further application of the MaRIA framework is needed to fully understand its impact on creating educational materials and to broaden leaders, teachers' and future teachers' perspectives on teaching sustainability.

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REVIEW OF THE LITERATURE IN LEARNING SUPPORT IN STEM EDUCATION AT THE HIGHER EDUCATION LEVEL

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Abstract

Science, Technology, Engineering, and Mathematics (STEM) education has emerged as an important area of focus within the higher education system due to its potential ability to contribute to technological innovation, scientific advancement, and subsequent economic growth in society. However, higher education learners in STEM areas of study often face unforeseen challenges throughout their academic journey, requiring the presence of reliable and effective learning support structures. This review article explores, collects and presents the extensive literature on learning support in STEM education in a coherent manner, examining different frameworks, strategies, and tools used to design learning support in the STEM field of studies to enhance learning outcomes. The article explores several aspects of learning support research covering cognitive, socio-cultural, and technological factors influencing learning support and discusses the best practices for improving student engagement, retention, and performance. The review also identifies gaps in current research and delves into future directions for improving learning support in STEM education. In addition to that, the article discusses the role of assessment techniques and discusses some case studies in understanding the efficacy of learning support interventions.

Keywords: *STEM Education, learning support, learning outcomes, higher education.*

1. Introduction

STEM education plays an important role in getting students ready with the skills necessary to thrive in an increasingly innovation-led and technology-driven world. Governments, educators, and policymakers globally have recognized the importance of STEM education in solving critical societal challenges, such as sustainability, healthcare, and digital transformation. Due to the challenging and cognitively demanding nature of these subject areas, students in STEM disciplines often struggle with complex content and abstract concepts. These challenges associated with effective student learning have generated a growing interest in understanding how to provide appropriate learning support to STEM students. STEM fields are characterized by high cognitive loads, frequent use of abstract reasoning, and the requirement of procedural fluency in mathematics and computational thinking (National Research Council, 2011). This combination often leads to high dropout rates and lower retention in STEM majors compared to other disciplines. The current body of research highlights a range of approaches and interventions aimed at better student support subsequently improving student outcomes. This article offers a comprehensive review of the literature on learning support in STEM education at higher education levels, with a focus on the evolution of educational frameworks, the role of technology, and the development of strategies that address the complex and diverse needs of learners. We will examine both theoretical perspectives and practical applications in a bid to identify the most effective methods for enhancing student success in STEM fields.

2. Conceptual frameworks in learning support for STEM

2.1. Cognitive learning theories

One of the key areas of research in learning support for STEM education is grounded in cognitive learning theories. These theories explain how students process information, solve problems, and acquire knowledge. Cognitive load theory (Sweller, 1988) is one of the important pieces of work in understanding why students struggle with complex STEM topics and subject areas. It argues that the human brain has a limited capacity for processing new information, and when students are overwhelmed by high levels of

cognitive demands, their ability to learn is reduced significantly. This theory is particularly applicable in fields like physics, mathematics, and engineering, where students must simultaneously learn content knowledge and problem-solving procedures. Cognitive load theory therefore discusses the need for instructional methods that manage the cognitive load, thereby enabling a deeper understanding of the topics and subject areas and learning. In addition to cognitive load theory, other key models such as Piaget's theory of cognitive development and Vygotsky's social constructivism have significantly shaped the design of learning support mechanisms in STEM education.

2.1.1. Piaget's theory of cognitive development. Piaget's Theory of Cognitive Development talks about student's construction of knowledge through experiences and interactions with their environment. Piaget argued that cognitive development occurs in stages, and students' ability to grasp abstract scientific and mathematical concepts depends on their developmental stage (Piaget, 1972). In the context of STEM education, this theory suggests that students benefit from active learning environments where they can experiment, explore, and apply theoretical concepts. Problem-based learning (PBL) and inquiry-based learning (IBL) are frequently cited as instructional strategies aligned with Piagetian principles. These approaches emphasize hands-on, experiential learning where students are encouraged to solve real-world problems collaboratively. Research by Savery (2006) emphasizes that PBL fosters critical thinking and deeper understanding in STEM fields by encouraging students to tackle complex problems, often without a clear solution pathway, therefore mirroring the work of scientific and engineering innovation processes.

2.1.2. Vygotsky's social constructivism. Vygotsky's Social Constructivism, on the other hand, highlights the importance of social interaction and cultural context in learning, irrespective of the field of study or topics. According to Vygotsky (1978), learning is a collaborative process, and cognitive development is largely influenced by interaction with learning facilitators or even the more knowledgeable peers. The concept of the "zone of proximal development" (ZPD) is particularly relevant for learning support in the STEM field of study, as it emphasizes the value of scaffolding—providing support structures that guide students through difficult topics until they can achieve an independent understanding of it (Wood et al., 1976). Scaffolding of learning can take various forms in STEM education, including the use of visual aids, step-by-step instructions, practical demonstrations and guided questioning techniques. Peer-assisted learning (PAL) and cooperative learning methods provide natural forms of scaffolding by allowing students to benefit from the collective knowledge and problem-solving skills of their peers. The ZPD framework supports the idea that students can solve more complex problems with guidance than they could on their own, making it a powerful tool in STEM education where problem-solving skills are of utmost importance.

2.2. Socio-cultural approaches

While cognition-related theories have dominated much of the research on learning support in research across the learning support in all fields of study or topics including STEM, socio-cultural approaches have also made significant contributions. These approaches particularly stress on the role of social context, identity, and culture in shaping the learning experience, particularly in STEM education.

2.2.1. Situated learning theory. Situated Learning Theory, introduced by Lave and Wenger (1991), argues that learning is fundamentally a social phenomenon and takes place best when students participate in learning practices within a community. In STEM education, this theory has led to the development of learning environments that reflect the practices of real-world problem solving simulating the works of scientists, engineers, and mathematicians. Laboratory work, and collaborative projects in controlled environments to find solutions to real-world type problems (but may be at a much smaller scale suitable for learners) are examples of situated learning opportunities allowing students to engage in developing critical thinking and problem-solving in meaningful ways, particularly so in STEM-related fields. Wenger's concept of "communities of practice" further supports the idea that students develop expertise by engaging in shared learning activities with others who have similar interests and goals (Wenger, 1998). Communities of practice are common in STEM fields of study, where students may participate in research groups, attend academic conferences, or collaborate on large-scale engineering projects. These communities foster a sense of identity and belonging, which is important for the retention of students in STEM fields.

2.2.2. Culturally responsive pedagogy. Culturally Responsive Pedagogy (CRP) plays a crucial role in learning support for the STEM field of studies. It emphasizes the need for academics to consider the cultural backgrounds and life experiences of the prospective students when designing curriculum, learning materials and instructional strategies (Gay, 2010). In many cases, the STEM field of study has been critiqued for being culturally neutral or even exclusionary, failing to reflect the diverse backgrounds of its students. Research has shown that STEM fields of study that incorporate culturally relevant examples and

applications can increase engagement and motivation, particularly for underrepresented minorities. For example, using real-world problems drawn from students' communities or cultural contexts can help to gain clarity on STEM subjects and make them more acceptable and accessible to diverse learners. The integration of culturally relevant pedagogy into the delivery of the STEM field of study is particularly important in addressing the underrepresentation of racial and ethnic minorities in STEM fields. This helps create a more inclusive and encouraging learning environment.

2.3. Motivation and self-regulation

Another important area of research on student support in the STEM field of education focuses on motivational and self-regulatory aspects of learning in STEM. Theories such as Self-Determination Theory and Goal Orientation Theory provide insights into how students' motivation can be supported to enhance their learning outcomes.

2.3.1. Self-determination theory. Self-determination theory, developed by Deci and Ryan (1985), argues that students are more likely to succeed when their basic psychological needs for self-determination, competence, and relatedness are met. In the STEM field of study, giving students choice and control over their learning can foster their internal motivation. Project-based learning, for instance, allows students to pursue their own interests within the broader context of STEM curricula, promoting a sense of autonomy. Additionally, research by Deci, Vallerand, Pelletier, and Ryan (1991) suggests that the perception of competence in the STEM field of study is strongly correlated with persistence and success in these fields. This finding underscores the importance of creating learning environments where students can experience success, receive constructive feedback, and develop a sense of competence over the material.

2.3.2. Goal orientation theory. Goal Orientation Theory distinguishes between mastery and performance orientations, where mastery-oriented students focus on learning and understanding, on the other hand, performance-oriented students focus on demonstrating competence relative to others. Studies have demonstrated that mastery orientation leads to deeper engagement and better long-term learning outcomes in STEM, whereas performance orientation may lead to anxiety, avoidance behaviors, and disengagement (Ames & Archer, 1988). Mastery-oriented environments encourage students to see mistakes as learning opportunities rather than failures, fostering a growth mindset (Dweck, 2006). This is particularly relevant in STEM fields, where problem-solving often involves trial and error, and where persistence in the face of failure is a key determinant of success.

3. Technological innovations in learning support for STEM

The emergence of innovative educational technologies has also significantly transformed learning support in STEM education. Technological innovations such as intelligent tutoring systems, virtual laboratories, and online learning platforms have enhanced access to personalized learning experiences, offering students tools to navigate the complexities of STEM disciplines. These innovations not only supplement traditional teaching methods but also cater to a wide range of learning preferences and cognitive styles.

3.1. Intelligent Tutoring Systems (ITS)

Intelligent Tutoring Systems (ITS) have become an important form of learning support in STEM education. These systems use artificial intelligence to provide custom instruction and feedback to students. Unlike traditional educational software, ITS adapt to individual learners' learning patterns, offering appropriate explanations, hints, and problem sets that respond to their specific learning needs. Research has demonstrated that ITS can significantly improve student outcomes by adapting content to individual learning requirements, and providing immediate feedback (VanLehn, 2011).

The Cognitive Tutor system focuses on mathematics instruction and has been shown to improve students' algebra proficiency by adapting to their problem-solving approaches and providing personalized feedback (Pane et al., 2014). The system assesses students' responses in real-time and offers hints or alternative explanations when they struggle, therefore serving as a digital one-on-one tutor. Although intelligent tutoring systems have proven effective, it is important to recognize that these systems are most successful when integrated into a well thought and suitable instructional framework.

3.2. Virtual and augmented reality in STEM learning

Virtual and augmented reality (VR and AR) technologies have opened new opportunities for experiential learning in the STEM field of education. VR allows students to explore immersive environments where they can interact with abstract concepts in ways that would be difficult or impossible in a traditional classroom. For example, students can use VR to simulate chemical reactions, explore the structure of molecules, or visualize complex engineering systems. Research by De Jong, Linn, and Zacharia (2013) discusses the potential of virtual laboratories to enhance students' conceptual understanding of science through a risk-free environment for experimentation. Similarly, AR can be used to overlay digital information onto the physical world, offering interactive, real-time data that enhances understanding.

4. Gaps in the literature and future directions

Despite the significant progress made in understanding and implementing learning support in STEM education, several gaps remain in the literature. First, there is a need for more longitudinal studies that examine the long-term impact of learning support interventions. While many studies focus on short-term outcomes, such as test scores or immediate course performance, it is important to assess how these interventions influence students' career trajectories and professional success in STEM fields. Second, more research is needed on the intersection of technology and pedagogy in STEM education. While technological tools such as ITS, VR, and AR have shown great promise, research must continue to explore how technology can complement and enhance human instruction rather than replace it. Finally, the impact of learning support interventions on students' socio-emotional development, such as confidence, resilience, and identity formation, is an area that warrants further exploration. These factors play a critical role in students' long-term success in STEM fields, particularly for underrepresented groups.

5. Conclusion

Learning support is an essential component of STEM education, providing students with the tools, resources, and strategies they need to navigate the complexities of STEM disciplines. The literature offers valuable insights into a range of effective learning support strategies, from cognitive and socio-cultural approaches to technological innovations and targeted support for underrepresented groups. However, there is still much work to be done in terms of expanding research on the long-term effectiveness of these interventions and developing more inclusive and equitable learning support systems. As STEM education continues to evolve, the integration of these support mechanisms will be crucial for preparing students to succeed in a rapidly changing world.

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CONCEPT DEFINITION AND CONCEPT IMAGE OF BASIC SPATIAL GEOMETRY CONCEPTS AMONG JUNIOR HIGH-SCHOOL PUPIL

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Abstract

The main goal of this study was to discover the effect of visual elements on the students' geometrical concept formation. This study focused on three topics: visual knowledge, concept definition, and concept image, and the inclusion property for spatial shapes among middle school students. Five research questions arose: (1) To what extent did the visual knowledge of spatial shapes exist? (2) What are the concept definitions of central spatial geometry shapes that middle school students gave? (3) What are the main concept images of spatial geometry? (4) To what extent does the relation between the visual picture of spatial shapes and the definition of such shapes exist? (5) To what extent did the inclusion property exist in spatial shape groups? The editors compiled three questionnaires and analyzed the data based on cognitive methods (Tall &Vinner, 1981). According to question (1), the data analysis showed that between 53.4%-95.5% of our sample knew visually the spatial shape (Triple Pyramid, Con, Box, Cylinder, respectively). According to question (2), it turns out that ONLY 46.1% of our sample correctly defines the concept "spatial body". Data analysis according to question (3) showed that the main concept images of "spatial body" were: a polyhedron, a beautiful shape, and a tangible body. According to question (4), the data analysis showed that the relation between the visual picture of a spatial shape and its definition was low to very low and depended on the shape: 21.2%- 61.1% (Prism, Cube, Pyramid, Box, respectively). Such students recognize the shapes without any inclusion relationship to other groups of spatial shapes. According to the last question (5), it turned out that the inclusion property existed visually in spatial shapes, but in different percentages according to the shape (Box, Cube, Pyramid, and Prism). It is surprising that when the statements were given to the students verbally without a visual dimension, more students identified the inclusion relationships accurately and even knew how to explain them. In many cases, the visual properties affect the students' judgment and the classification they make. When the task is represented verbally, these properties are hidden, but when the task is represented visually these properties visually these properties become active. In summary, we have found that a low and even very low percentage of students know the formal definition of spatial shapes but do not make use of it when faced a visual presentation.

Keywords: *Concept definition, concept image, concept formation, spatial shapes.*

1. Introduction

Geometry is one of the important branches of the mathematics curriculum, as it constitutes an important and vital part, as it constitutes a model and a real link to mathematics with the real world because of its association with the ability to think, and it is a vital and enjoyable subject in its characteristics, as it is related to the reality of life, and occupies an important space in the study program for all stages of education from kindergarten to twelfth grade (Usiskin, 1997).

All mathematical concepts except the primitive ones have definitions. Many of them are introduced to high school or college students. However, the students do not necessarily use the definition to decide whether a given idea is or is not an example of the concept. In most cases, they decide based on their concept image, that is, all the mental pictures, properties, and processes associated with the concept in their mind. (Tall & Vinner, 1981; Rasslan & Vinner, 1997).

Through the experience of the author of this project in teaching mathematics in primary and preparatory schools, and through her study of the master's degree in educational mathematics, she found that there are many difficulties in teaching and learning geometry for students and teachers alike. Her readings of literary narrative related to teaching and learning geometry and the difficulties she herself faces in the field, and mentioned in the literary narrative proved this. What was said earlier was true for planar geometry. As for spatial geometry, the experience of the author of this project also indicates many difficulties in teaching and learning this subject. Due to the lack of literary narrative in teaching and learning spatial geometry in general and in the Arab sector in particular, the author of this project, in coordination with the project guide, decided to examine the extent to which these difficulties exist in Arab schools. Specifically, examine the understanding of central terminology in spatial geometry among middle school students.

Important studies in this context are those of Haj Yahya and Hershcowitz (2013), where these researchers examined the relationship between visual comprehension and its effect on mental images, definitions and proofs of forms in plane geometry among secondary school students. It was found that these students have great difficulties in understanding geometric definitions, which affects the proof process and thus the ability to demonstrate.

2. Research questions

To what extent the inclusion property existed visually in spatial shapes (Box, Cube, Pyramid, and Prism)?

3. Methodology

This study was designed using a quantitative method.

3.1. Participants

The study sample consisted of 90 seventh-grade students from four schools in the Arab Sector: two from the Murooj region and two from the north of Israel.

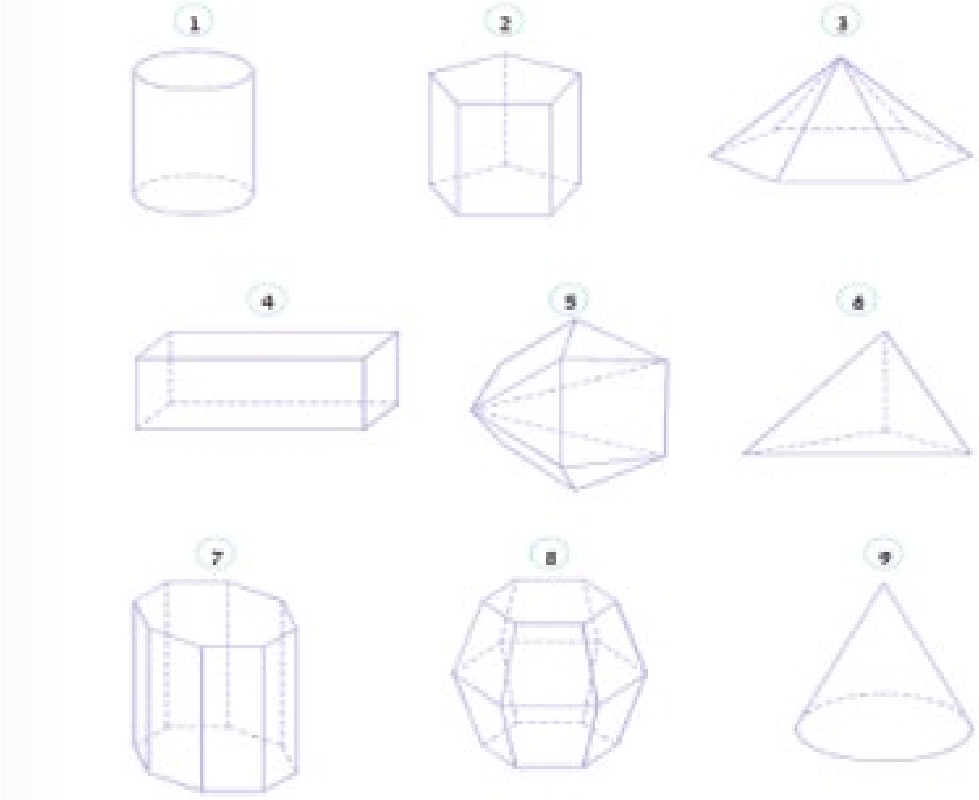
3.2. Instruments

In this study, the following instruments were used:

1. A questionnaire (Figure1) related to the “length measurement” content. The questionnaire aims to get a real picture (through the students' answers) to answer the research questions.
2. A semi-structured interview. The interviews aim to clarify vague answers that were not clear enough, as they were received through the answers of some students, as contained in the various forms.

Figure 1. The Questionnaire.

Student Name: _____ Grade: _____ School: _____
Gender: Male/Female
In front of you a group of shapes:



1) Record shapes representing a box: _____
2) Record shapes representing a pyramid: _____
3) shapes representing a prism: _____
4) Record shapes representing a cube: _____

4. Results

In the following table we will present the distribution (number and percentage) of the answers of the students who answered question number 1 in the questionnaire that was presented.

Table 1. Inclusion a Box in other groups of bodies. (N=85).

	Shape / Category	1 Tetra pyramid	2 Cube	3 Box	4 Polyhedron	5 Cylinder	6 Trian gular Prism	7 Trian gular Pyra mid	8 Penta gonal Prism	Total
BOX	I		√	√						52 (61.1%)
	II		√							1 (1.2%)
	III			√						21 (24.7%)
	IV	√	√	√						1 (1.2%)
	V		√	√						2 (2.4%)
	VI		√	√						2 (2.4%)
	VII		√	√	√				√	1 (1.2%)
	VIII		√							1 (1.2%)
	IX								√	2 (2.4%)
	X								√	2 (2.4%)
Total		1.2%	70.6%	92.9%	1.2%	2.4%	2.4%	4.7%	7%	85 (100%)

It is clear from Table 1 that the overwhelming majority of students participating in the sample of this research 92.9% diagnosed the box correctly, but only 24.7% (category III) had diagnosed the box without any relationship containing other models.

Similar analysis according to questions 2, 3, 4 in the questionnaire 1 (pyramid, prism and a cube respectively) the results show that (94.1%, 70.5% and 95.3% respectively) diagnosed them correctly, but only 16.4%, 25.9% and 63.5% respectively) without any relationship containing other models.

5. Discussion

This article discusses five research questions presented in the abstract. An analysis of the results of the questions clearly shows that the percentage of correct answers to the five questions was low, and some of them were very low, especially in question 2, where it turned out that only 46.1% of all the students who participated in this study correctly defined the concept of "spatial body".

In the present article, we focused on a question related to the "inclusion property", in particular, on the question:

To what extent the inclusion property existed visually in spatial shapes (Box, Cube, Pyramid, and Prism)?

The results shows that only 24.7% had diagnosed the box without any relationship containing other models. The rest, which is 75.3% of the responses of the students who participated in this study, associated the Box with the other bodies: Cube, Pyramid, and Prism. This result is also considered low.

In our opinion, the reason for the unsatisfying and very low results of the students in our sample of both the five questions and the last research question is probably related to each other, i.e., to the definitions of these concepts and the concepts images discussed in this study and to the learning and teaching spatial shapes.

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EXPLORING MENTORSHIP EXPERIENCES OF BACHELOR OF EDUCATION STUDENT TEACHERS DURING TEACHING PRACTICE: PERSPECTIVES ON CONFLICT OF MENTOR AND MENTEE ROLES

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Abstract

Lack of understanding of the roles in a mentorship process can be detrimental. During their teaching practice, student teachers are assigned mentors for guidance. Both the mentor teacher and the student teacher have specific mandatory responsibilities that make this relationship work. There is however a pertinent conflict of roles that usually results in the collapse of the relationship. This empirical study aimed to delve into the lived experiences of student teachers and explore these students' perspectives on their understanding of the roles of both the mentor teacher and the student teacher during teaching practice. This study is couched in Kolb's Experiential Learning Theory which emphasizes learning by doing. The study adopted a qualitative approach, employing interviews and focus group discussions to gather data from 20 purposively selected student teachers. The results highlight the critical issues of poor communication and misunderstanding of the role of the mentor. Identifying these as key factors in the breakdown of the mentor-mentee relationship provides useful ideas for teacher training programmes. In light of the findings the study argues for a more intense training of both mentors and mentees on their roles in the mentorship process.

Keywords: *Mentor teacher, student teacher mentee, mentorship process, conflict of roles.*

1. Introduction

During Teaching Practice, sometimes refered to as teaching practicum (TP), students are placed in suitable educational settings that will showcase various types, methods, and forms of learning. Teaching practice provides a chance for students, as future educators, to gain hands-on experience in a real school setting. This experience allows them to merge theoretical knowledge with practical application, assess their skills as potential teachers, address urgent classroom issues, and learn from their errors (Ploj Virtič, Du Plessis, & Šorgo, 2023). Consistent and effective communication occurs between the university, the student, and the work-integrated learning (WIL) site. A mentoring system allows the student to engage with a range of well-structured teaching methods. Faculty members collaborate with relevant individuals at the sites to develop a shared understanding of the roles and responsibilities of everyone involved in the student teachers' experience and assessment of their teaching abilities in a manner that fosters professionalism. The practical learning component of WIL for teacher education qualifications primarily occurs in classroom and school environments.

The mentoring theory developed by Kram (1983, 1985) and later expanded by Ragins and Kram (2007) serves as the theoretical framework for this study. According to Kram's theory, mentors fulfill both career-related and psychosocial roles, and she categorizes the mentoring process into four stages: the initiation phase, the cultivation phase, the separation phase, and the redefinition phase.

The mentoring relationship

McHugh and Gruppen (2021) define the concept of relationship as how people connect with each other. They argue that a mentoring relationship can range from informal and brief to formal and lengthy, where mentors with valuable experience, knowledge, skills, and/or wisdom provide advice, information, guidance, support, or opportunities to mentees to aid in their professional growth., The relationship, according to Williamson, Lawrence, Lyons, and Deutsch, (2020) that develops between mentor and mentee

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is often considered essential for realizing positive developmental outcomes.They further describe a mentoring relationship as a primary driver of change in the mentoring intervention.

Sanyal (2017) identifies factors that play a significant role in the effectiveness of the mentoring relationship. First, the affinity between the mentor and mentee will impact on the effectiveness of the relationship. This is referred to as ‘rapport’ or ‘rapport building’. Second, both mentors and mentees must be clear about the ‘purpose’ of the mentoring. This will guarantee that every interaction between mentor and mentee provides maximum benefit for both parties involved. Third, the progress through the stages or phases of the mentoring relationship is likely to be dependent on the ‘intensity of learning’ that is, the quality of the learning.The mentee ought to acquire knowledge or at the very least obtain pertinent information that enhances their understanding or directs them to additional resources or networking possibilities. The mentor should feel assured that they are playing a significant role in the mentee's education and growth. Finally, successful mentoring is a two-way, dynamic process where the functions of both the mentors and mentees are equally important.

During teaching practice mentoring from experienced teachers (mentor teachers) can contribute immensely to the success of practical phases.

The mentor’s role

Maria-Monica and Alina (2014) identify the following mentor teacher’s responsibilities in relation to the student teacher: Manages the student’s activities; Supports the use of curriculum documents; Supports the design and implementation of lessons; Provides feedback for each task in the design phase and after implementation; Develops self-reflection and self-assessment of students; Draws up an evaluation report which mentions the evolution of students.

Mentors play a crucial role in facilitating the self-growth of pre-service student teachers, a process that relies on relationship building; therefore, their practice and connection with the mentee significantly impact the overall experience. The mentor's attitude and level of experience are essential for the pre-service students' mentoring journey as the mentor is required to provide support, which is challenging to achieve without a constructive mindset (Ploj Virtič, Du Plessis, & Šorgo, 2023).

The mentee’s role

In addition to gaining professional knowledge, the mentoring process will teach mentees how to effectively communicate with various educational process participants, manage their time effectively, and become proficient with contemporary educational technologies (Shvets, Kuzmenko, Motuz, Moiseienko, & Pasichnyk, 2024). Mentees have an obligation to set their own personal goals; be open to communication with the mentor and learn from the mentor: skills and knowledge about the day-to-day work of a teacher.

2. Problem statement

Kang (2020) has emphasized the significance of the mentor's support for the mentees' improvement of their classroom teaching, while Hobson and Maxwell (2020) discovered that clarity and expectations regarding the roles are vital for the effectiveness of the mentoring and lack thereof may result in the collapse of the mentoring relationship. When a relationship fails, mentors and mentees may share some of the blame. While the most prevalent negative traits of an ineffective mentor include neglect, a lack of training in mentorship, inaccessibility, and a lack of interest in a mentee's work, Negative mentees are typically characterized as possessing a sense of entitlement and lacking drive, aptitude, and experience.

3. Methodology

The study adopted a qualitative approach, employing interviews and focus group discussions to gather data from 20 purposively selected student teachers. In order to inform this qualitative study, a semi-structured focus group interview was developed by the researcher. The final interview was composed of the following open-ended questions:

(1) How do 4th-year pre-service teachers perceive their mentoring experience during their Teaching Practice?
(2) What do you regard as the most critical roles of the (a) mentor teacher and (b) the mentee in the mentoring process?
(3) How satisfied were 4th-year pre-service teachers with their mentors?

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4. Results and discussion

On how fourth year pre-service student teachers perceived their mentoring experience. Most student found the experience positive and enriching as reflected in some of the responses below:

> *The experience was incredibly enriching to be able to apply theory into practice with guidance from someone who has years of experience, especially because my mentor was my former teacher and I've grown to see her teach me throughout my whole high school life, then get to work in the same space as her, it was an honor indeed. In my experience, the mentoring journey was shaped not only by the mentor's teaching ability, but also by their willingness to engage with me as a learner, a future colleague, and a professional-in-progress.*

Another student had this to say:

> *As a fourth-year students I perceive mentoring experience as a journey to grow and learn, simply because during my first year I overcome a lot of challenges such as poor speech because of the belief that learners do not take me as a teacher, poor classroom management because I was not trained enough how to prepare appropriate lessons and employ appropriate discipline. Four years later here I am walking tall and confident that I am a teacher all because of my teaching practice and the way I was mentored.*

The above responses indicate that mentoring is a critical part of teacher training that is both enriching and helps in building confidence to student teachers. Student teachers also perceived mentoring process to have contributed in their personal development as future teachers. This notion is strengthened by De Ossorno Garcia and Doyle (2021) who maintain that mentoring passes on knowledge of subjects, facilitates personal development and encourages wise choices. In order for the mentor to provide assistance and encourage the mentee to shift context and envision a positive future or outcome Sanyal (2017) identifies seven types of mentor assistance – mentor's ability to help the mentee to shift context and envision a positive future or outcome; listen and be a sounding board when the mentee has a problem; pick up on underlying feelings related to the mentee's issues/problems; confront and challenge when appropriate; offer relevant information or suggest possible solutions; encourage explorations of options and bolster the mentee's confidence by delegating authority and providing new opportunities.

On what student teachers regarded as the most critical roles of the mentor teacher and the mentee, student teachers exhibited their knowledge of the important roles that both mentor-teachers and mentees play in the mentoring process. Regarding the role of the mentor teacher these were the responses:

> *"The most critical role of a mentor is giving feedback which can be done through observing, constantly following up and raring the student teacher. The most critical role of a mentee is communicating effectively with the mentor and being open to feedback"*

> *"The most critical role of the mentor teacher is to guide, support, and model best practices. This includes giving unfiltered constructive feedback in a timely and respectful manner, helping the mentee set goals, being available to answer questions—it can be about learners, since the mentor knows them best, classroom, staff, school environment, policies—and creating an environment where learning is encouraged."*

Responding to their perceived roles of the mentee student, teachers maintained that mentees also have an important role in the mentoring process.

> "*As a mentee, it's essential to be an active participant in the process, be open to feedback, proactive in asking questions, and reflective in my teaching. A step to being a good prospective teacher is to take criticism, knowing to put your feelings aside and see growth in your feedback, which in the end will lead to a good reflection in your teaching. Mentees should show initiative, professionalism, and a willingness to learn. It's not enough to just follow instructions—you also need to observe, adapt, and take responsibility for your growth. Being respectful of the mentor's time and classroom expectations is also key to maintaining a good relationship."*

> *"The most critical role of a mentee is communicating effectively with the mentor and being open to feedback"*

De Orsono Garcia and Doyle identify three main educational tasks of these mentoring roles: (1) sharing knowledge and experiences related to their field of expertise; (2) providing advice on recurring dilemmas and strategies that require knowledgeable understanding of the issues involved; and (3) exposing mentees to the social networks of mentors.

Results also reveal that student teachers as mentees experienced conflict of roles with their mentors as expressed in the following responses:

> "*My mentor expected me to manage the class fully, including admin and discipline, without really offering guidance. On that day, I was not given any resources to conduct a class. I understand that student teachers need to develop independence, but the sudden transfer of responsibility felt more like being "thrown into the deep end" than supported growth. I felt like I was being treated more like a substitute teacher than a student learning through mentorship."*
>
> *"Yes, I was one student teacher who believed I have the right to be at the school and to be mentored the way I want to grow in the profession, so I would ask my mentor to observe and rate me in every lesson I present then we would quarrel a lot because they just want to send me in the classroom and sit in the staffroom."*
>
> *"I experienced the conflicts mostly when you come up with the simplest way of making the learners to understand the certain concept then the mentor will be like you are spoon feeding the learners and a you act like you know better than him or her as he or she is more experienced than you as a mentee."*

Conflict of roles often leads to the collapse of the mentoring relationship. The relationship that develops between mentor and mentee is often considered essential for realizing positive developmental outcomes (Williamson, Lawrence, Lyons, & Deutsch, 2020).

When asked how satisfied they were with their mentors, responses show that student teachers are generally not satisfied with the conduct of their mentors as reflected in the responses below:

> *"On the other hand, several student teachers—myself included—faced challenges like minimal feedback, lack of communication, and limited support. For example, some mentors would disappear for hours, leaving us alone with learners without discussing it first. Others were openly critical without offering suggestions for improvement. This led to feelings of frustration and anxiety, and in some cases, discouraged student teachers from seeing teaching as a sustainable career."*
>
> *"I am partially satisfied, however my mentors could have been more effective to my growth and to the feedback they gave."*

5. Conclusion

The overarching aim of this research was to examine and delve into the lived experiences of student teachers and explore these students' perspectives on their understanding of the roles of both the mentor teacher and the student teacher during teaching practice. From the results it can be concluded that inasmuch as students find the whole experience of teaching practice as enriching and bolstering confidence, there are however instances where there is a conflict of roles as a result of poor communication. This is mainly due to lack of understanding of mentor teachers as to what is expected of them during the teaching practice period. In some cases, student teachers were left out to fend for themselves while mentor teachers abandon their responsibilities. To remedy this occurrence of conflict of roles, it is thus recommended that the University should invest in training the mentor teachers before the teaching practice session

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EXAMINING THE EFFECT OF LEARNING MANAGEMENT SYSTEMS (LMSS) ON PART-TIME LECTURERS' TEACHING PRACTICES AT A SOUTH AFRICAN UNIVERSITY OF TECHNOLOGY

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Abstract

The growing adoption of learning management systems (LMS) in higher education institutions has profoundly influenced teaching and learning practices. This study aims to investigate the impact of LMS on part-time lecturers' teaching methods at a South African University of Technology. It will explore the challenges and barriers that these lecturers encounter when integrating Learning Management Systems (LMS) into their teaching, as well as the benefits and opportunities that these systems afford. This research investigates the influence of constructs from the Technological Acceptance Model, specifically Perceived Usability (PU) and Perceived Ease of Use (PEOU), on the adoption and effectiveness of Learning Management Systems (LMS) in educational settings. Employing a qualitative research methodology, the study conducted focus group interviews to examine part-time lecturers' perceptions regarding the use of Learning Management Systems (LMS) within the university. Data was collected from a purposive sample of eight participants. Preliminary findings suggest that part-time lecturers view the Learning Management System (LMS) as a valuable tool for enhancing course content management, facilitating communication, and providing timely feedback to students. The insights gained from this research will contribute to a deeper understanding of the role of learning management systems in enhancing the teaching practices of part-time lecturers and guide the effective implementation of these systems in South African higher education institutions.

Keywords: *Learning management systems, teaching practices, part-time lecturers, technological acceptance model, university of technology.*

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1. Introduction and background

Over the past decade, the educational landscape has undergone a significant transformation, with e-learning emerging as a fundamental component of contemporary pedagogy. The integration of technology into teaching and learning has revitalized traditional methodologies, creating a dynamic and adaptive platform that transcends geographical boundaries (Al-Chalabi & Hussein, 2020). In this context, part-time instructors play a crucial role in delivering high-quality teacher education at universities of technology. However, the implementation of Learning Management Systems (LMS) presents new challenges that can impact instructional efficacy and overall satisfaction among educators.

Key impediments to successful LMS implementation include limited professional development, insufficient institutional support, and the difficulties educators face in balancing teaching responsibilities with other obligations. Consequently, lecturers must cultivate a robust understanding of educational technology tools to enhance the quality of online course delivery. This study seeks to investigate the following research questions: RQ 1: What challenges do part-time lecturers encounter when utilizing LMS? RQ 2: In what ways can part-time lecturers effectively adapt to and utilize LMS?

Learning Management Systems are designed to address contemporary educational demands by providing both asynchronous and synchronous learning opportunities within an information-centric culture. Features such as enhanced communication (Llamas-Nistal et al., 2011), accessibility, flexibility, self-directed learning, interactivity (Abdous, 2013), skill enhancement, and increased content availability considerably improve the educational experiences and motivation of students. Recent research has thoroughly examined the potential of Learning Management Systems (LMS) to revolutionize instructional practices, particularly through case-based and gamified learning methodologies (Palahicky & Halcomb-Smith, 2020).

Moreover, scholars advocate for a comprehensive deployment strategy to optimize the educational benefits of LMS (Mohamed & Vengrasalam, 2022). The Technology Acceptance Model posits that factors such as system quality, perceived self-efficacy, and supportive conditions significantly influence the adoption of Learning Management Systems (LMS) by higher education lecturers (Fearnley & Amora, 2020). Specifically, both system quality and perceived self-efficacy have a notable impact on perceived usefulness, which subsequently influences attitudes toward technology and behavioral intentions, as well as perceptions of ease of use and system quality (Fearnley & Amora, 2020).

The onset of the COVID-19 pandemic necessitated a rapid shift to online instruction, as governments worldwide enacted lockdowns to curb the spread of the virus (Maharaj, 2023). This abrupt transition posed substantial challenges for universities, particularly as many educators were inadequately prepared for these pedagogical shifts (Guillén, Cuellar & Alfaro, 2020). As Mollo (2022:8) asserts, higher education institutions face challenges in integrating these technologies, as remote teaching and learning require proficiency in online, blended, e-learning, mobile platforms, Learning Management Systems, Open Educational Resources (OER), and Internet usage. Therefore, substantial support is imperative to enhance online teaching methodologies, which can be utilized beyond the pandemic in various forms of digital pedagogy.

2. Theoretical framework

This research adopts the Technology Acceptance Model (TAM) as its foundational theoretical framework, specifically focusing on its two critical components: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), as outlined by Davis (1989) and Davis et al. (1989), not Wahdain and Ahmad (2014). Originally introduced by Davis in 1985, the Technology Acceptance Model was designed to clarify and predict the behavioral intentions of new end-users when interacting with computer-based information systems, highlighting how these users come to accept and effectively utilize technology.

The versatility of TAM enables its application across a wide range of disciplines, underscoring its robustness as a theoretical tool. For instance, research by Mathieson (1991) demonstrated that implementing the Technology Acceptance Model is more straightforward than implementing the Theory of Planned Behavior, suggesting that TAM may offer more immediate insights in certain contexts.

Furthermore, a recent investigation by Al-Emran and Granić (2021) rigorously evaluated the continued relevance and validity of the Theory of Acceptance and Use of Technology (TAM). Their findings reaffirmed that the model remains a valid and widely applicable framework across numerous applications and fields, thereby reinforcing its significance in understanding technology adoption.

In the context of this study, the Technology Acceptance Model (TAM) is particularly relevant, as it will provide valuable insights into how part-time lecturers at a university of technology (UoT) perceive the ease of use (PEOU) and the utility (PU) of technology. Utilizing a qualitative research approach, this study aims to delve deeply into these perceptions, thus illuminating the factors that influence the adoption of technology in educational settings among this specific demographic.

3. Methodology

Qualitative data gathering is used in this interpretive study. Eight part-time lecturers were interviewed for the project. Purposive sampling ensured that participants had experience teaching with Learning Management Systems (LMSs). The small sample size enables in-depth interviews to yield rich data, particularly in terms of experience with using Learning Management Systems (LMS) for course material distribution, student feedback, and communication. Participants were willing to participate in a focus group interview to gather data. Interviewing involves the exchange of ideas among individuals regarding a shared topic, highlighting the importance of human connection in the development of knowledge (Sahoo, 2021). Because focus groups allow people to communicate, exchange experiences, and debate LMS themes, they were chosen. The researcher took notes of participants' responses for analysis. The popular qualitative data analysis approach, thematic analysis, was employed. The process comprised finding, evaluating, and reporting data themes. Consent to participate was considered before conducting the study. Alphanumeric codes were used to protect participants' confidentiality throughout data processing and reporting. Participants could leave the study at any time without penalty. Lastly, all data was securely saved and only the researcher will have access to it. After the study, participants were notified for verification.

4. Findings and discussion

These findings are organized according to the major themes identified during the analysis: the perceived benefits of LMS usage, the challenges faced by part-time lecturers, and suggestions for enhancing LMS adoption and effectiveness.

4.1. Challenges associated with the use of LMS by part-time lecturers

4.1.1. Perceived Ease of Use (PEOU) challenges. *P1: "No one gave us training. I felt completely lost at the beginning."*

P6: "Using the LMS takes a lot of time, and with multiple jobs, I don't have time to experiment with it."

P7: "The LMS is difficult to navigate, and there's no proper guide. You have to figure it out yourself."

Part-time lecturers face specific usability challenges. Participants reported a lack of confidence due to inadequate training and the perceived complexity of the Learning Management System (LMS).

4.1.2. Perceived Usefulness (PU) barriers. *P2: "I use WhatsApp and email more than the LMS. Students don't even log into it unless I insist."*

P4: "I don't see how the LMS improves my teaching. It just adds another platform to manage."

The LMS has poor Perceived Usefulness since many participants said it didn't help their teaching. When tools are incompatible with their methods or ineffective in improving student learning, educators are less likely to use them. Lecturers often migrate to email or chat apps when they view Learning Management System (LMS) systems as administrative burdens (Bervell & Umar, 2018).

4.1.3. Institutional and technological constraints. *P3: "There is no tech support when I need it- usually evenings or weekends."*

P8: "We sometimes use our own devices and data. The university does not provide data to part-time lecturers."

Part-time instructors face significant barriers to implementing Learning Management Systems (LMS). These barriers include delayed access, insufficient technical support, poor internet connectivity, and limited institutional resources. Part-time workers often find themselves marginalized in academia due to institutional neglect and digital isolation.

4.2. Mechanisms that can be put in place to support part-time lecturers with the adoption and effective use of LMS

4.2.1. Enhancing Perceived Ease of Use (PEOU). *P1: "Short video tutorials showing how to upload content or set quizzes would be very helpful."*

P7: "Hands-on sessions, not just manuals, would work better for most of us."

P3: "A basic training session at the start of the semester would make a big difference."

The findings suggest that accessible, user-centered training improves Perceived Ease of Use. Participants preferred scenario-based learning, which included brief video instructions, live demonstrations, and ongoing assistance. Simpler onboarding, tailored assistance, and clear, multimodal learning tools can boost digital trust in instructors of all technological abilities (Al-Azawei et al., 2017).

4.2.2. Increasing Perceived Usefulness (PU). *P4: "We need templates or modules that match our subject areas—it saves time and makes it relevant."*

P6: "Show how LMS can improve interaction, not just post notes. Like forums or online quizzes."

Participants stressed that the LMS must be educational to be beneficial. Creating discipline-specific templates or toolkits to modify the LMS for course content and pedagogy is recommended. In part-time settings, explicitly displaying these qualities with examples and success stories can boost LMS engagement and perceived usefulness.

4.2.3. Strengthening institutional support. *P8: "Give part-timers access to devices or data bundles like you do for full-time staff."*

P6: "Have a dedicated point of contact or coordinator for part-time lecturers' digital support."

P7: "Consider incentives for those who use LMS effectively—some recognition would help."

The data indicates that part-time teachers are often neglected by educational institutions. To ensure digital inclusion, it is essential to provide timely access to Learning Management Systems (LMS), dedicated support staff, and necessary instructional materials, including devices and internet connectivity. Acknowledging the efforts of part-time instructors through incentives or professional development opportunities may enhance their engagement with the Learning Management System (LMS) (De Brún & McCarthy, 2021).

5. Conclusion

Several barriers exist to the effective use of Learning Management Systems (LMS). Among these are a lack of extensive training and technical support, system-related issues, and time constraints faced by part-time instructors. Additionally, some lecturers prefer traditional teaching methods over utilizing the LMS. These obstacles significantly diminish the effectiveness, satisfaction, and adoption of LMS among part-time faculty. The study recommends that universities invest in targeted training programs, provide accessible technical assistance, and design a user-friendly LMS interface to fully harness the potential of their systems. Moreover, incentivizing the integration of LMS within performance assessments could enhance engagement. By improving these aspects, part-time lecturers can more effectively integrate Learning Management Systems (LMS) into their teaching practices, ultimately leading to greater teaching efficiency and enhanced student learning experiences. Furthermore, the study suggests exploring students' perspectives to assess how the use of LMS by part-time lecturers impacts their learning outcomes. Future research could also investigate the effects of LMS training programs on the adoption and satisfaction levels of part-time lecturers across various departments and institutions.

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THEORETICAL LESSON FRAMEWORK OR DESIGN ORGANIZATIONAL CHART

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Abstract

Design organizational chart are visual depictions of information that offer all elements in a unified perspective. This assists educators in developing a coherent mental framework that elucidates their concepts and establishes a shared lexicon for comprehension within the classroom. The lesson, as an educational endeavor, resembles a puzzle with innumerable answers. The puzzle, as a toy, possesses a singular answer, akin to the lesson of attaining objectives. Design necessitates a meticulous approach to information documentation. The design organizational chart facilitates the reconstruction of alternative iterations of the puzzle. The lack of standardization is intentional. These dimensions are selected to facilitate the systematic documentation of creative concepts. Employing a lesson arrangement chart helps facilitate the transformation of intricate concepts into accessible alternatives. They not only promote collaboration but also offer essential clarity for complex interrelated concepts. From a managerial perspective, the course delineates the dimensions of planning, organization, control, and restructuring. Theoretical lesson framework entails converting the lesson into a conceptual framework featuring interrelated components. Modeling guarantees the recognition of all advantageous or detrimental elements, as well as the interdependencies that elevate a basic framework from a mere learning tool to a comprehensive methodology. This paper outlines the principles of building a theoretical lesson model to facilitate continuous self-regulation, along with specific examples derived from empirical practice.

Keywords: *Design organizational chart, lesson framework, lesson management.*

1. Introduction

Pedagogical design is defined as a complex process consisting of actions and operations carried out within the general education activity, in accordance with the objectives assumed at the level of the system and educational process. These actions lead to the concrete interrelation of objectives, content, learning and evaluation strategies.

The pedagogical design activity involves the planning, programming, concretization of education through the optimal use of real time for formal or non-formal learning. This differentiates – **the global design specific to** a level or cycle of education, materialized by the elaboration of the curriculum and the general criteria for the elaboration of analytical programs and **the staggered design** specific to one year of education, semester, lessons, materialized in the outline of projects and criteria for the operationalization of the framework and reference objectives specified in the program. „We need our students to pay attention, be involved, ask questions, try out ideas, and share their mental journeys" (Beere & Gilbert, 2015).

2. Design

The tasks of a manager are multiple. It must set objectives, select ways to achieve them, seek the necessary resources, select and train the personnel involved, develop mechanisms for monitoring and coordinating activities, assess the results of activities and draw up intervention measures in the necessary situations. In order not to be redundant, they can be synthesized into three main functions:

1. „planning and organizing function;
2. the function of guiding/guiding the educational process;
3. Peak, intermediate or basic regulation and self-regulation function" (Dragu & Cristea, 2003, p. 135)

The planning and organization function involves actions to prospecting the level of psycho-physical development of students, actions to inventory and analyze the available resources, actions to relate them in the perspective of the proposed goals. Planning reflects future action and has a dual purpose: Prospective and improving. Design is a broad action involving several stages:

- criticism of previous work;
- definition of goals;
- setting objectives;
- setting specific responsibilities.

These steps must be observed both in the implementation of the lesson plan, but also for the other situations: The development plan of the institution, the tuition plan, the methodical commission plan, etc. The organization of activities is a complementary action that by involving existing structures (pyramidal hierarchical structures, or linear structures) facilitates the efficient execution of the activity.

The orientation/guidance function of the educational process takes into account the systemic nature of education. The transition from the longitudinal vision of the educational process to the transverse one is achieved. Emphasis is placed on the teacher's ability to identify the structural elements throughout the educational process, the lines to be preserved during the training of students.

The peak, intermediate or basic self-regulation and regulation function has two perspectives: to the students, through methods, strategies and evaluation techniques, and to the teachers through continuous improvement and continuous research, conducted at micro and macro structural level, for opening to the vertical, but also on the horizontal of the education system and process.

In addition to these main functions, other functions derived from management have been identified:

1. *supervision function* – the functioning of the system, but also of the subsystems and the educational process. The more complex it will be, the fewer possible disturbances, dysfunctions and deviations from the route established by decision and organization will be.
2. *reverse connection function* – providing managers with information on how to receive and apply different decisions and corresponding plans.
3. *the function of preventing the occurrence of potential deviations from* the *established path* leading to the proposed objectives.
4. *The correction function* (Dragu & Cristea, 2003, p. 135) – of the activity even of the decisions that led to the activity being carried out wrongly.

These functions interpenetrate and complement each other, ensuring the optimization of the educational process and the achievement of performances.

The design of the lesson complements the project of the lesson system, bringing clarifications regarding the elements involved in the teaching activity and especially the teaching learning processes. The required operations are:

- logical ordering of content;
- identification of competences;
- prefiguring the structure of the lesson, its sequences. The construction of each sequence implies the specification of several elements – the objective, the content, the didactic task, the way of working with students, methods, procedures, means of education;
- the composition of materials for the personal activity of students, for the evaluation test.

As can be seen, most components of the teaching process are developed and organized in the context of the design of the lesson system.

3. Objectives

The main problem that training management raises is related to the fundamental function of the educational system. It consists in *organizing training so that learning is carried out as effectively as possible* (Cristea, 2008, p. 198). In order to analyze the efficiency and effectiveness of the proictation, it is necessary to conceptually delimit the terminology:

- „effectiveness – the extent to which an action or activity achieves the proposed objectives;
- educational effectiveness – it can be understood as the extent to which the activity in the educational field has achieved all the proposed objectives (...)
- efficiency – means achieving goals with a low consumption of resources;

Educational efficiency – represents the achievement of expected results at the level of the educated one (in correlation with educational goals in the conditions of a low consumption of resources*"* (Gherguț, 2007, p. 151). Defining the concept of school effectiveness is difficult, but the basic notion is that of added value in the designed activity, an added value in the training of students. This added learning plus consists of:

- Functional knowledge – KNOWING;
- Intellectual work skills – KNOWING HOW TO DO SOMETHING WITH WHAT YOU KNOW
- Skills, abilities, skills development – KNOWING HOW TO BE;

- Developing personality traits – KNOWING HOW TO BE AND BECOME.
  In order for the design to ensure the winning of this plus, the main functions must be observed:
- planning basic activities – effectiveness;
- organization of resources – efficiency;
- the process itself – effectiveness and efficiency.

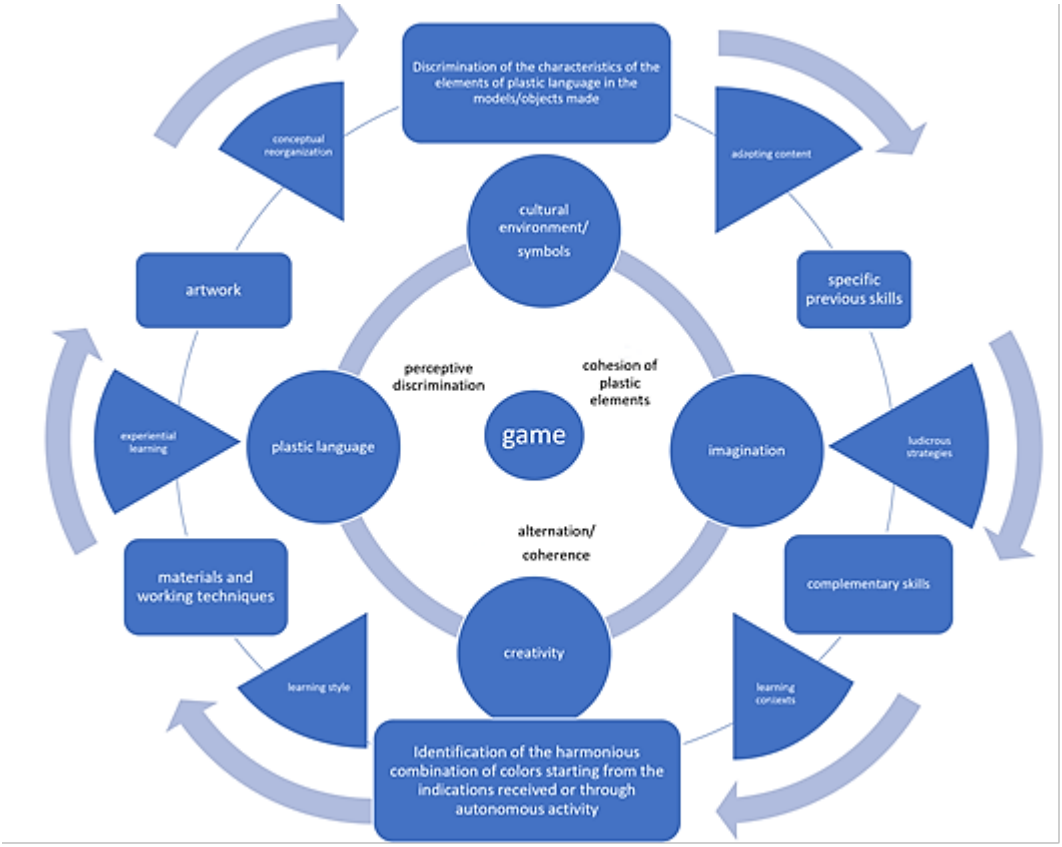
It should be noted that the implementation of the activity is carried out in an open context, the development (plus) means the adaptation of the design to the context itself. Thus, the teacher is the organizer (manager) of learning conditions, a complex, multilateral role, exercised through two actions that include verbal communication and the content – the stimulus of the learning situation.

The construction of a theoretical lesson framework of the functioning structure of a lesson highlights the necessary correlations between the components. These are reported "normative to the principles of curricular design", "to the external and internal context in which any education/training activity takes place" (Cristea S., 2017, p. 104).

4. Methods

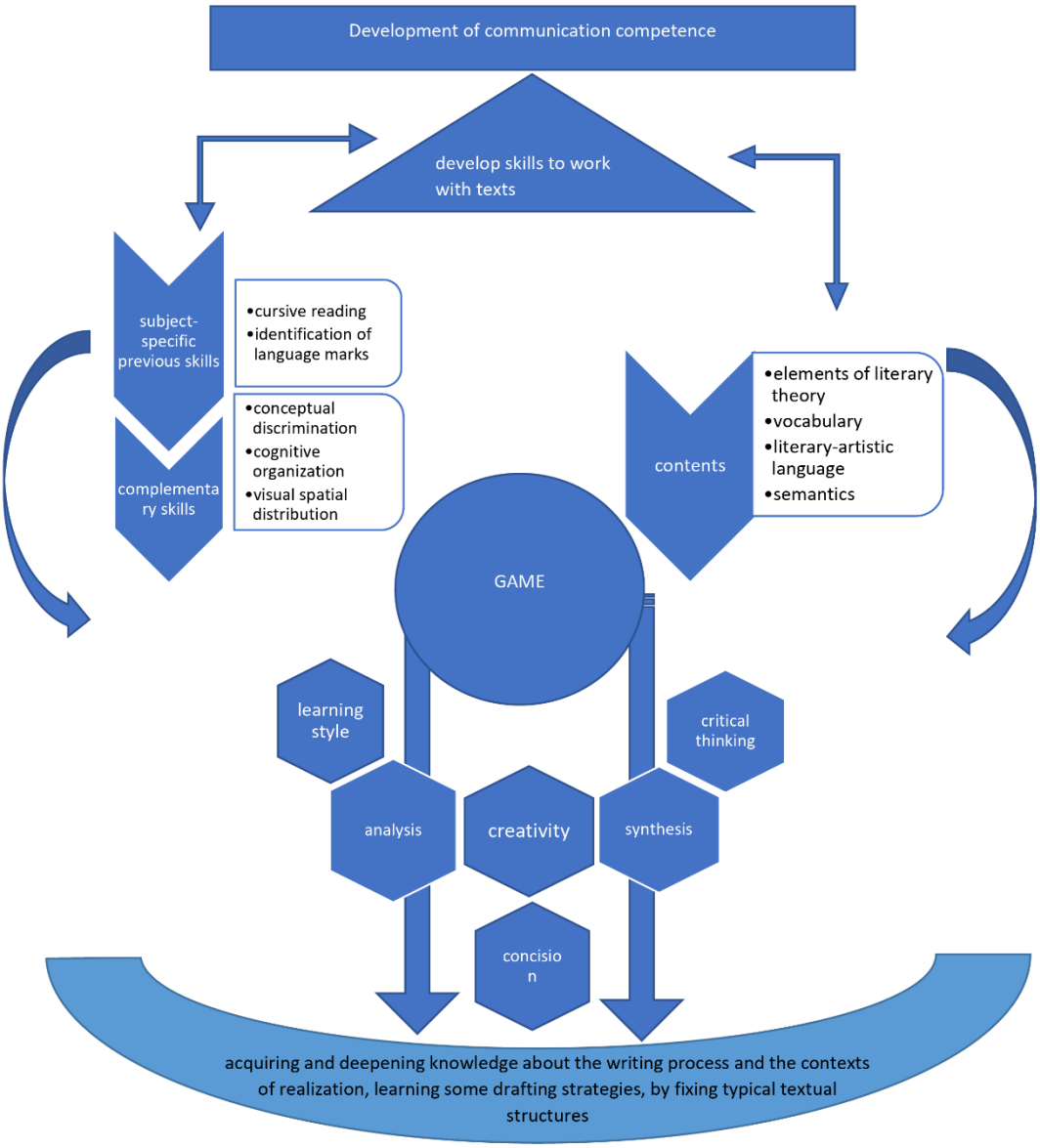
Thus, within the framework of the applied-experimental research of the ludic in the training of the pupils of the primary classes of the artistic-aesthetic culture, we developed three theoretical models specific to the fields of applicability: concentric, cyclic and open.

Figure 1. The concentric theoretical lesson framework.



The theoretical lesson framework proposed in the design proposes an organization of learning that focuses on the activity specific to the child's age, familiarize him with the process of scientific knowledge and develop skills and attitudes that allow him to be actively involved in building his own knowledge. The concentric theoretical lesson framework is based on the default playful specificity of the discipline and is based on it. All components specific to the scientific field of the discipline require the approach of certain didactic strategies, which also respect the specifics of the age and psychological development of the target group. Thus, we can develop this model for other disciplines based on a complex analysis of the discipline - didactic strategy - learning typology: Science - experiment - curiosity, Mathematics - exercise - experiential learning.

Figure 2. The cyclic theoretical lesson framework.



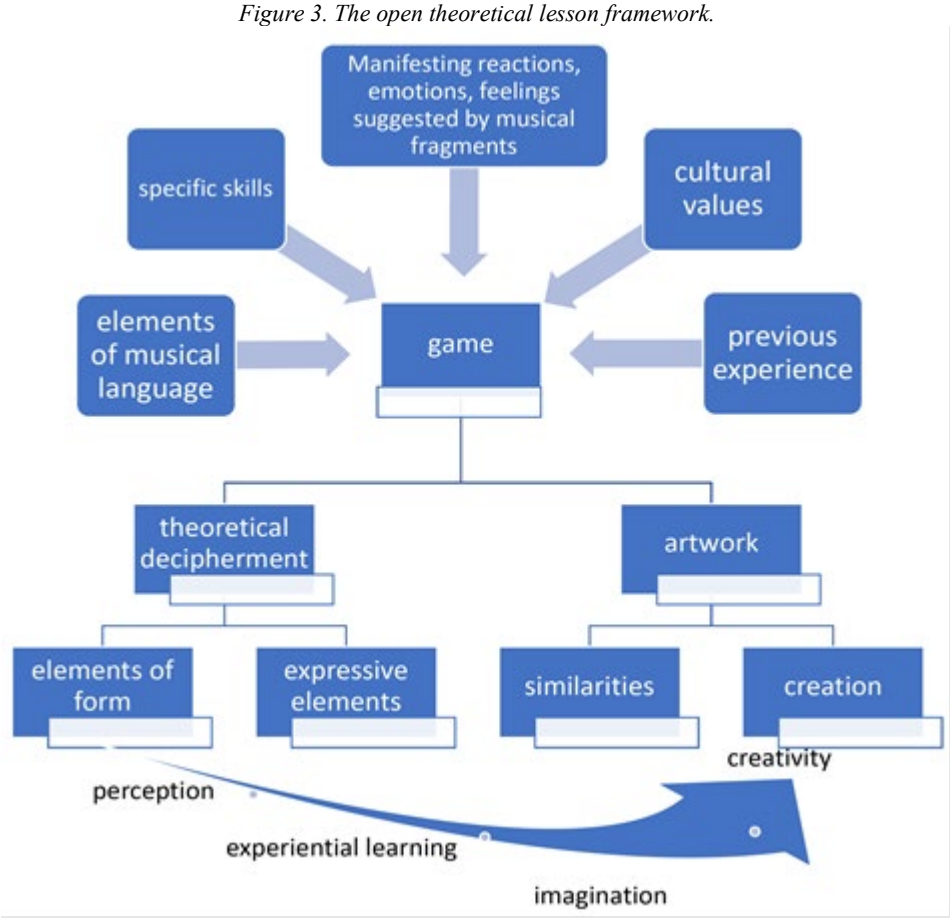
At the pedagogical level, the cyclical theoretical lesson framework highlights the necessary relationship between the stage of training and development of mental action, defined in terms of competence and the means of achieving it (defined in terms of content and didactic methodology), argued by a detailed knowledge of the child and the specific learning environment.

The cyclic theoretical lesson framework is based on extensive repetitions and deepening of a content for the purpose of transitioning from ability to performance. It is especially suitable for the primary cycle - where the level of development of psychic processes is relative - based on content replays and repetitive activities. The teaching staff will organize the activity starting from the proposed target, but the task varies each time depending on the specificity of the psyche and the needs of the children. Every learning purchase becomes a premise to repeat old content in new contexts.

The exemplified model centers the game as age-specific activities, but the dynamics of relationships polarize towards acquiring a new competence - the psychological specificity of the child - the need to form a new competence. As a detail of conception is based on the principle „of the proximity development area" proposed by Vîgotski.

Organizing learning experiences involves anticipating effective training/self-training paths, possible through different didactic methods and diversified forms of organizing the – training activity adaptable depending on the context, the concrete situation existing or appeared/created along the way.

Figure 3. The open theoretical lesson framework.



The open character proves the ability of the curriculum to be realized-developed according to the resources and pedagogical conditions existing in the internal context - the educational process - and externally - dependent on the social system: economic, political, cultural, community, natural. The quality of any curricular project - is dependent on the openness of the proposed structures towards permanent education and self-education. The open theoretical lesson framework is designed in the perspective of permanent education integrates into its structure of realization-development of the general contents of education: moral – scientific/intellectual – technological/applied – aesthetic – psychophysical, reported to all general forms of education: formal – nonformal; informal, capitalized on short, medium and long term.

This theoretical lesson framework centers not only on the formation of a skill, but on the development of children's psychic processes.

5. Discussion

For a quality didactic design, it is essential to know in detail the profile of the student made up of competences, character traits, behaviors and skills, which are revealed both by direct observations and by questions, aptitude tests, intelligence tests, questionnaires, etc. The time resources directly influence the didactic strategy designed and realized and provide us with useful information for capitalizing on the bio-psycho-sociocultural traits of the students. The proposed models bring modernity to the design and align this difficult but important process with the tendency to visual concentration of concepts.

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STRATEGIES TO IMPROVE STUDENT ENGAGEMENT: COMPARISON OF ASSESSMENT RESULTS AND STUDENT FEEDBACK

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Abstract

Enhancing student participation and performance in first-year engineering courses is a recurring challenge in higher education. This study analyses the results of a student survey carried out to evaluate the effectiveness of various teaching strategies implemented in a first-year Calculus course. The course integrated group work, peer assessment, interactive participation through Vevox in lectures, online tests and a final written exam. The survey collected students' impressions of the impact of these strategies on their learning experience, motivation and understanding of fundamental mathematical concepts. The results indicate that students valued collaborative activities, such as group work and peer assessment, for promoting deeper understanding and active participation. The use of Vevox was particularly appreciated in the theory sessions, as it promoted real-time interaction and immediate feedback. In addition, the online tests and group work provided opportunities for continuous assessment, allowing students to track their progress throughout the semester. A comparative analysis of student performance revealed a 14 per cent increase in the pass rate compared to the previous academic year, which suggests a positive impact of these methods on student success. The qualitative responses also emphasised greater commitment and a more structured learning experience. These findings highlight the importance of diverse, student-centred learning strategies to improve outcomes in basic engineering courses. The study provides information for educators seeking to optimise teaching methodologies in STEM education, particularly in mathematically intensive subjects such as Calculus.

Keywords: *Active learning, survey, calculus, engineering.*

1. Introduction

At our university, four distinct Calculus courses are offered, each tailored to degree programs that share similar academic requirements and disciplinary focuses. In our study, our course is intended for degree programmes that focus on Physics and around 500 students are enrolled. In the academic years 2023/24 and 2024/25, the latter with significant improvements, we implemented an instructional design to engage students in their learning.

At the end of the course, students were invited to complete an anonymous online questionnaire aimed at collecting feedback on their learning experience. The questionnaire included both closed-ended and open-ended questions. In addition to assessing various aspects of the course through Likert-scale items, students were asked to identify up to three aspects of the course they found particularly positive and to explain their reasons. They were also invited to indicate up to three aspects of the course they found less satisfactory, along with the reasons for their dissatisfaction. This combination of quantitative and qualitative items enabled a more comprehensive understanding of students' perceptions and areas for potential improvement.

2. Instructional methods applied

The Calculus course includes four weekly contact hours divided into two blocks, focusing on theoretical concepts, examples, group work and interactive discussions using Vevox. Besides teaching Differential and Integral Calculus in one variable, the course aims to promote relationships among students, encourage group work, develop work habits, foster discussions and hold students accountable for their learning.

Students are randomly assigned to different groups throughout the semester to enhance interaction and communication skills. Weekly group tasks are submitted on Moodle for teachers' evaluation using

rubrics, which provide clarity and fairness in grading. Peer assessment is conducted three times during the semester, where students evaluate themselves and their peer using rubrics. Continuous assessment includes assignments (12%), peer and self-assessment (8%), two online tests (15% each) and a written test (50%). Online tests use multiple-choice questions, while the written test includes open-ended questions to assess deeper understanding. The detailed explanation of these instructional methodology is described in Nolasco, Oliveira, & Vettori (2025).

Gamification is used to create a stimulating learning environment, with various games designed for group play to promote teamwork and communication. These games help enhance learning by encouraging active participation and collaboration among students. The games used are described in Oliveira (2024).

3. Analysis and discussion of survey results

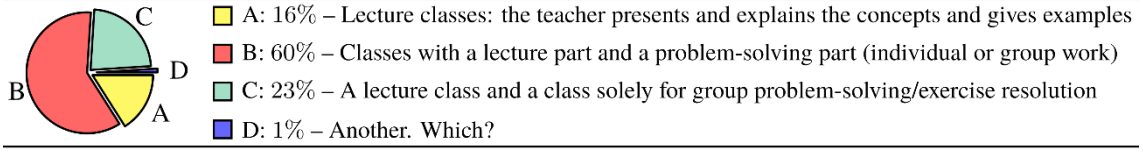
The questionnaire included 13 questions, 3 of which were open-ended questions to gather students' opinions on the positive and negative aspects of the course and a third open-ended question to understand what they would like to see changed in the course's operation.

3.1. Closed questions

The population of the study was around 500 students and 128 responded to the questionnaire, 76% of whom were attending the course for the first time and 24% were repeat students.

Regarding the kind of lectures they preferred, the answers are summarised in Figure 1. There is still a significant number of students, 16%, who prefer traditional classes, but 60% of them want hybrid classes.

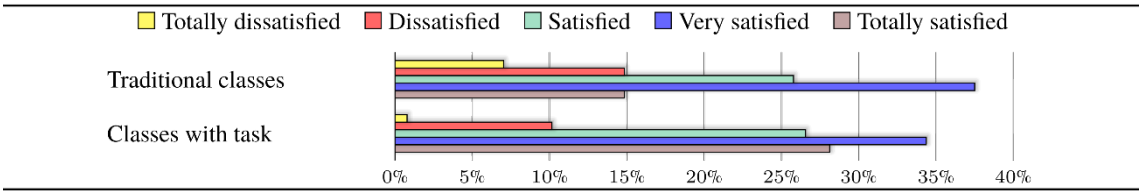
Figure 1. What type of classes do you prefer?



It is worth noting that this type of teaching methodology has increased class attendance, even those classes that did not have group assignment. 75% of students attended almost all no-assignment classes and 91% attended the assignment classes.

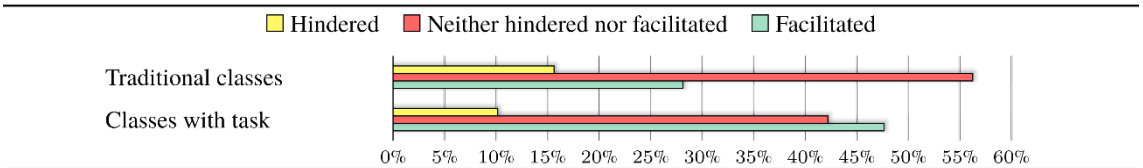
Closed-ended questions regarding the students' level of satisfaction with the methodology used were included in the questionnaire since they facilitate the analysis of responses and because we feared that students might not respond to open-ended questions (which did not happen). In general, students were satisfied with the different types of lectures, but in particular more students were "very satisfied" with traditional lectures than with classes with task.

Figure 2. Degree of satisfaction with the different types of lectures that took place in the course.



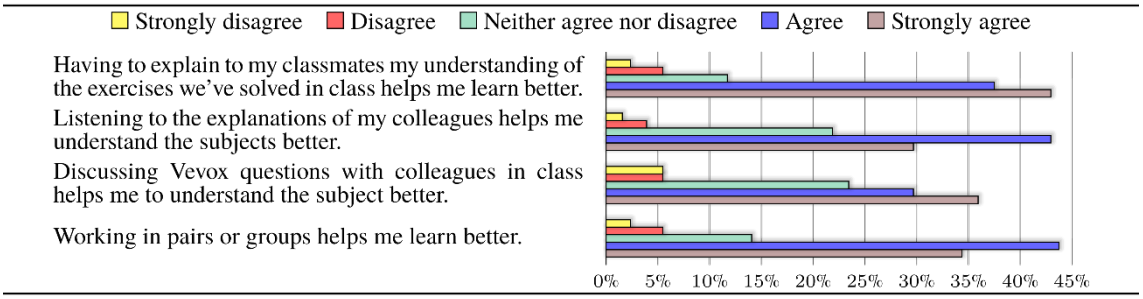
One aspect we were curious about was the effect of the different lectures on their learning. Surprisingly, it does not seem that the different classes have a big impact on students' learning (see Figure 3).

Figure 3. About the teaching environment on learning.



What were the features of this instructional design that helped students to “learn better” was another question we were very interested in. So, we asked them to classify in a 5-point Likert scale – 1 totally disagree to 5 totally agree - four statements. The answers are given in Figure 4.

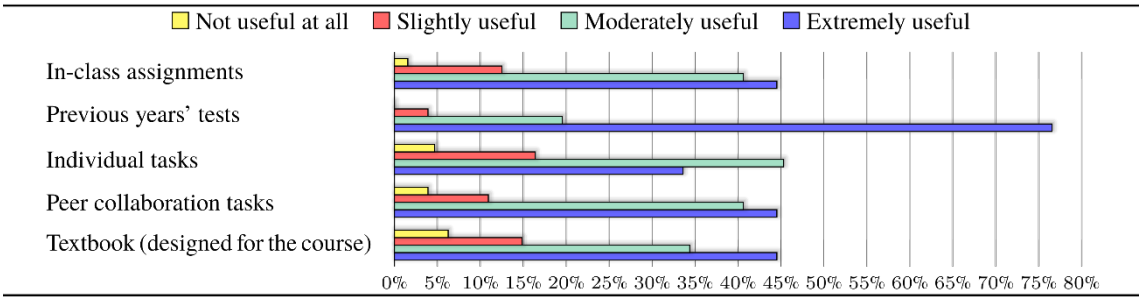
Figure 4. Classification of 4 instructional features used.



“If you want to go fast go alone, but if you want to go far go together,” is a common saying, that is reflected in these students’ opinions. We also believe that engaging students in lectures, making them think together to find solutions for the problems/exercises they must solve, is one of the best ways of learning.

Several resources were available through Moodle platform, as the textbook designed specifically to this course, including several examples, worked out exercises as well as proposed exercises (instead of separate worksheets), tests/exams from previous academic years, slides, etc. We asked which tools were useful for their learning.

Figure 5. Which of the following resources do you find useful for your learning?



The most useful resource is Tests from previous academic years, with 76% of the students rating them as Extremely useful. All the other resources have roughly the same ratings, being considered useful or extremely useful by more than 78% of the students.

One other question was related to the use of online platforms for studying/learning: 40% answered they did not use any platform to study and almost all the others utilised YouTube.

3.2. Open questions

In addition to completing Likert-scale items related to various dimensions of the course, students were invited to provide qualitative feedback by identifying up to three aspects they considered particularly positive, accompanied by a brief justification. They were likewise encouraged to indicate up to three aspects they perceived as less satisfactory, explaining the reasons for their assessments. This feedback was collected with the aim of gaining deeper insights into students’ perceptions and informing continuous pedagogical improvement.

3.2.1. Positive aspects/Strengths. A predominant theme in the feedback was the implementation of group assignments (TPAs), which were highlighted in approximately 56% of the responses. Students emphasised that these activities fostered key soft skills such as communication and teamwork, while also reinforcing the understanding of course content. Weekly group tasks encouraged consistent engagement and facilitated peer learning through discussion and collaborative problem-solving.

The course's assessment design was positively mentioned in about 35% of responses. Students highlighted the distribution of assessments throughout the semester, noting that it helped reduce exam-related anxiety, and provided a more balanced reflection of their ongoing effort and learning. The continuous nature of assessment was widely considered effective and motivating.

Approximately 48% of respondents valued in-class activities such as guided exercise resolution, practical tasks and immediate feedback. These activities were perceived as essential for encouraging

consistent study habits, enabling the immediate application of theoretical content and facilitating a better grasp of complex topics through practice.

Around 26% of students expressed appreciation for the clarity, structure and organization of the lectures, particularly the approach of introducing theory followed by illustrative examples. This methodology was considered effective in promoting conceptual understanding and logical progression of mathematical topics.

The use of interactive digital tools, such as Vevox, to promote engagement during lectures was referenced in 22% of the responses. These tools were praised for increasing student participation, offering real-time feedback and enhancing the overall classroom experience.

Lastly, 19% of students highlighted the assertive and approachable teaching style, often commending teachers for their clarity, availability to answer questions and to clarify doubts, and ability to foster a positive learning environment.

3.2.2. Less satisfactory aspects/weaknesses. One of the most reported issues was the excessive theoretical content with limited practical application during lectures. 30% of students frequently noted that classes were overly expository, with insufficient time allocated for problem-solving and hands-on practice. There was a marked demand for more classroom exercises, especially ones reflecting the difficulty level of actual exams, to better support conceptual understanding and retention.

A second major theme was the pacing of content delivery. 25% of students felt that the volume of material presented in each session was too dense, often delivered rapidly without adequate time for assimilation.

In terms of group tasks, while the majority of the students appreciated the collaborative learning opportunities, 17% of students criticised the lack of balance in group workload distribution and the limited time provided to complete the tasks during class.

Regarding assessment methods, many critiques were directed at the use of multiple-choice questions in online tests, which were perceived as inequitable. 18% of students argued that this format penalised minor mistakes disproportionately and failed to adequately assess reasoning skills. Some suggested reverting to written tests, where partial credit for valid reasoning could be awarded, fostering a fairer evaluation process.

Lastly, access to learning resources — such as solved exercises, example sheets and previous exams — was reported as insufficient by 9% of the respondents. Students emphasised the need for greater availability of supportive materials, including solutions to group tasks, to facilitate independent study and exam preparation.

This feedback underlines the importance of maintaining a pedagogically diverse and student-centred approach in STEM education, where regular evaluation, group engagement and interactive teaching methods can greatly enhance student learning outcomes and satisfaction. It is important to mention that these students are in their first year, coming from secondary education, with different work habits and teaching rhythms. Our struggle as teachers is to encourage students to understand the concepts and discuss them instead of solving a large number of exercises that allow them to memorise routines and learn only procedures (Oliveira M. d., 2023).

3.3. Assessment results

Conducting a comprehensive and rigorous analysis of the results, obtained through the application of the described strategies, and comparing them with outcomes from previous years, presents significant challenges. This difficulty arises from numerous changes: the students (naturally), the assessment style, the teaching staff and the courses involved. Nevertheless, within a more confined scope, some noteworthy observations can be made.

Table 1. Results of common courses over the last three years.

Academic Year (Students):	2022/23 (330)	2023/24 (364)	2024/25 (365)
Passed / Assessed	59.48%	58.49%	71.04%
Passed / Total	48.48%	51.10%	65.21%
Missing / Total	18.48%	12.64%	8.22%

Due to the reorganisation of the Calculus units in the academic year 2023/24, only the courses involved in this unit between 2022/23 and 2024/25 are considered in Table 1. In Table 2, all students are included, as no further changes occurred. The assessment style was quite ‘classic’ in 2022/23; in 2023/24 we began to implement the ideas presented in this paper, albeit with some flaws in organization and execution.

Table 2. Detailed results for all courses over the last two years.

Exam Season	Academic Year (Students):	2023/24 (507)	2024/25 (511)
Normal	Passed / Assessed	58.70%	59.53%
	Passed / Total	49.90%	54.99%
Resit	Passed / Enrolled after failing	12.66%	43.15%
	Improved / Enrolled after passing	36.36%	81.25%
Combined	Passed / Assessed	61.21%	72.27%
	Passed / Total	53.85%	67.32%
	Missing / Total	12.03%	6.85%

Our primary objective could be described as "convincing (weaker) students that they can learn mathematics," which can be achieved if they 1) at least try and then 2) succeed in passing. The data shows that both objectives were met. Indeed, in both Tables 1 and 2, it is evident that the percentage of students missing any type of assessment has decreased to an optimal level, while the percentage of students passing has significantly increased.

It is important to note that the change in assessment style in 2023/24 did not simplify students' lives, as the similar percentage of "Passed/Assessed" confirms, at least in the Normal Season (cf. Tables 1 and 2).

However, this year we implemented stricter control over students' actual presence during group works. While absences from classes are not (and cannot be) considered, missing group works would proportionally lower the corresponding grade. This 'mandatory' and consistent attendance (in the last two years, we have not observed the typical decline in weekly attendance over the semester) may explain the small number of students not assessed and the unexpectedly high percentage of students who passed or improved their grade in the Resit Exam (Table 2). Observe that in this exam, students are assessed solely based on the grade obtained in a single written test. We hope that the active application of the concepts and techniques in class led the students to understand them in a manner that was perhaps not immediate, but deeper and more enduring.

4. Conclusion

The pedagogical survey conducted among students enrolled in Calculus course revealed a highly positive reception to the course's structure, particularly in relation to its interactive and diversified approach to teaching and assessment. Garcia, Pandolfi, & Morais (2023) state that "the assimilation of content when the student participates in lectures is minimal, but when he tries to explain the subject to someone else, retention and understanding are much higher," which is confirmed by our students with 80% agreeing on this point. Also, "discussion in class is one of the most common strategies promoting active learning with good reason" (Bonwell & Eison, 1991) was pointed out as one of the assets of the course.

The results obtained, both in terms of the number of students who passed the course and those who participated in the evaluations, indicate that we are on the right path.

Acknowledgements

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INCLUSION OF LEARNERS WITH BARRIERS TO LEARNING IN MAINSTREAM SCHOOLS: A PSYCHO-SOCIAL SUPPORT INTERVENTION

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Abstract

The South African education white Paper 6 (EWP6) emphasises the importance of access, equity, and inclusion of all learners in the education system as a social justice agenda. The inclusion of learners with barriers to learning in mainstream schools becomes a serious challenge and such learners with emotional, behavioural, or cognitive challenges often face difficulties in mainstream settings. This presentation examines the role of psycho-social support interventions in enhancing these learners' social integration, emotional well-being, and academic engagement. This study generated qualitative data through interviews with 15 Grade 9 teachers from mainstream schools in Gauteng Province, South Africa. Thematic data analysis was employed to analyse the data. The findings of this study highlight effective strategies, including counselling, peer support, and teacher training to foster a supportive inclusive environment. The study concludes that psycho-social support interventions are an enablement of effective inclusion of learners experiencing barriers to learning in mainstream schools. This study recommends continuous training of in-service teachers in inclusive policies that aim to support the well-being of learners and the exposure of learners to counselling services that are offered in schools. This research provides practical insights for educators, school administrators, and policymakers on implementing psycho-social frameworks that facilitate successful inclusion, thereby promoting a more accessible and equitable education system.

Keywords: *Barriers to learning, inclusion, intervention, mainstream schools. psycho-social support.*

1. Introduction and background of the study

According to the Department of Education (DoE, 2001) White Paper 6:Building and inclusive Education and Training System access, equity and inclusion are the core principles with which the South African education system aligns itself (DoE, 2001). The main directive of this policy document is to advocate for the inclusion of all learners in mainstream schooling. According to Serero (2021), all learners should be the recipients of quality education regardless of any underlying disability or challenges. However, even with progressive policies such as the EWP6 outlining practical methods of implementing inclusive education, often practice tends to be a step behind theory when coming to the implementation (Walton & Engelbrecht, 2024). According to Cele (2023) lack of resources, skills and support within mainstream schools remains to be major obstacle standing in the way of the implementation of inclusive education. Moreover, challenges around the practical implementation of the inclusion of learners with diverse learning needs, tend to perpetuate the exclusionary values experienced within their social settings (Mhlolo & Ntoatsabone, 2023). Both global and local studies have demonstrated how learners with cognitive and behavioural emotional difficulties often struggle with being accommodated in mainstream educational settings (Hind, Larkin & Dunn, 2019; Serero, 2021).

On the other hand, teachers are unable to meet the needs of learners with barriers to learning due to not having been adequately trained to handle such specific educational tasks (Mahmood, Huang & Rehman, 2024). With no availability of resources and non-functional to absent psycho-social support structures in place, teachers have always reported performing their duties with great difficulties (Ludago, 2020). Such challenges often result in the deterioration of learners' overall emotional, educational and social well-being which at times accounts for higher school dropouts (Deli, Kaur & Hashim, 2021).

2. Inclusion of learners with barriers to learning in mainstream schools

Inclusion is one of the principles and values of an inclusive education system. The inclusive education approach is based on the premise that all learners who are diverse in terms of gender, sexual orientation, ability, age, religion, language race, socioeconomic background, and all other aspects that make them different should be accommodated in mainstream schooling. According to UNESCO (2005), the inclusive education approach prescribes that learners of all kinds of needs and barriers should receive education in the same schools for their social, psychological, and educational growth. Mainstream schooling is beneficial because learners with various barriers to learning learn in the same classroom. Florian (2015) opined that mainstream class teaching for learners with learning barriers may have benefits such as increased participation by all learners in the learning process and decreased exclusion in the curricula.

Teachers are paramount to ensure that learners with barriers to learning are included and accommodated in mainstream schools. However, the study findings by Adewumi and Mosito (2019) reported that some teachers mentioned that they were trained in inclusive education approach but were not trained to implement inclusion for learners with barriers to learning. This is because supporting learners with barriers to learning requires the appropriate skills such as observations and counselling. Nevertheless, another piece of the literature revealed that Life Orientation teachers provide psychosocial support to all learners in schools (Mahwai & Ross, 2023) even though they are not adequately trained through the in-service and pre-service teacher education programmes.

3. Psycho-social support interventions

Regional Psychosocial Support Initiative (REPSSI) defines psychosocial support as "a continuum of love, care, and protection that enhances the cognitive, emotional and spiritual well-being of a person and strengthens their social and cultural connectedness" (2013). According to the Department of Basic Education (DBE, 2017), Care and Support for Teaching and Learning (CSTL) programme, the lack and insufficient provision of psychosocial support is a barrier to learning that has a ripple impact on learning outcomes (DBE, 2017). Psycho-social support interventions can serve as an engine that enables the inclusion of learners with barriers to learning in mainstream schools (Sharma, Ashokan & Kurian, 2024). This may consist of several strategies that may focus on fostering continued teacher training on how to adequately respond to learners' specific educational learning needs (Madiba, 2021).

DBE's (2020) guide for Learner Support Agents and Schools on Providing Psychosocial Support to Learners indicates that psychosocial support includes counselling, changing the environment of the school, and the policies and practices that are not conducive to teaching and learning. In addition, the guide further stipulated that psychosocial support in basic education aims to provide a suitable environment for children to learn and develop, support optimum learning, retention, and achievement in school, enhance resilience, and promote early identification of vulnerable children and provision of support. Psychosocial support interventions in the classrooms should be evidenced by learners feeling welcome, happy, safe, actively participating in the learning process, and having opportunities to develop meaningful relationships, which in turn allow them to reach their full potential (Noble & McGrath, 2015).

4. Purpose of the study and research question

This study aimed to examine the significance of psycho-social support interventions in enhancing the inclusion of learners with barriers to learning in mainstream schools. The main research question that assisted in generating the findings is: ***How can psycho-social support interventions enhance the inclusion of learners with barriers to learning in mainstream schools?***

5. Theoretical framework

This study grounds itself within the biopsychosocial model proposed by Engel (1977). This theory holds a central postulation that biological, psychological, and social factors need to be considered for understanding the individual's functioning. Furthermore, all the factors should be understood to function interdependently. In 2021, Hay and Joubert (2021) proposed the education of educational factors to this model. In applying this model in this study, teachers should ensure that they have a better understanding of the biological, psychological, social, and educational factors for them to adhere to inclusive practices. According to Taukeni and Mollaoğlu (2025), the biopsychosocial model serves as a guiding framework for achieving quality education and cultivating a more equitable educational space. Therefore, if teachers can embrace the significance of the interplay of biological, psychological, social factors, and educational factors, they may be in a better position to propose psychosocial interventions that can enhance inclusion at mainstream secondary schools.

6. Methodology

This study is qualitative. The interpretive qualitative paradigm was used in this study to get a deeper understanding of how psycho-social support interventions enhance the inclusion of learners with barriers to learning in mainstream schools. According to Denzin and Lincoln (2003), an interpretive qualitative paradigm involves studying things in their natural settings, attempting to make sense of or to interpret phenomena in terms of the meanings people bring to them. A substantial amount of time was spent in the field having conversations with the teachers interacting with learners experiencing barriers to learning, how they were managing their interventions, and how they collaborated with other teachers within an inclusive school environment. Purposive sampling, which is mainly utilised in qualitative research (Ames, Glenton & Lewin, 2019), was used for the selection of information-rich participants who are working at mainstream secondary schools.

Semi-structured interviews were used to generate data. Maree (2013) explains that the semi-structured interview is widely used in research to validate data emerging from other data sources. To gain sufficient data, a series of semi-structured interviews were held with the 15 Grade 9 teachers from mainstream schools in Gauteng Province, South Africa. These interviews were conducted in the school staffrooms. Thematic analysis was used to focus on identifying and describing implicit and explicit ideas within the data through themes. All the data was transcribed, coded, categorised, and sorted into themes. Ethics clearance was obtained at an institutional level as well as from all relevant authorities and participants before the commencement of the research. This included obtaining informed consent from teachers and principals. The consent forms were clear about the focus of the study and what the procedures of the study were. Confidentiality and anonymity of the participants were maintained. Participation in this study was completely voluntary, and the participants had the right to withdraw from the study at any stage.

7. Findings and discussions

The findings of this study are reported in this section. Only three themes are reported in this paper, namely; the provision of counselling, peer support strategies, and Specific teacher training. The findings are reported using codes to protect the identity of the participants.

7.1. Provision of counselling services

Teachers mentioned that counseling services should be provided in mainstream schools to promote the inclusion of learners. See below-sampled experts by teachers.

> *Counselling services should be offered in mainstream schools just like in inclusive schools. (T1)*

> *Most learners in mainstream schools experience emotional and behavioural challenges therefore they can benefit from counselling services. Schools should have in-house Social workers or Psychologists who can assist learners in mainstream schools. (T7)*

These findings show a great need for counselling services to be offered in mainstream schools due to the prevalence of emotional and behavioural challenges learners display. This therefore presses upon the DBE to ensure that there is functionality of psycho-social support services in schools. According to Teschers (2020), inclusive education practices in principle should advocate for holistic well-being as an overall practice that guides every learning process. From the findings, it is understood that there is a need for mainstream schools to have designated social work and psychological services instead of commonly used referral-based methods. Thus, based on Alexander (2010) stationed counselling services in schools can support the learning of learners with learning barriers by fostering resilience in them. Counselling services can help to break barriers standing in the way of learners' learning process and socio-emotional well-being.

7.2. Peer support strategies

Teachers mentioned that learner-centred learning strategies such as peer support can be beneficial to learners with barriers to learning. See below the excerpt from the teachers:

> *Learners should be encouraged to support others. For instance neh...learners master concepts differently, therefore, instead of encouraging them to compete with each other, learners can support each other during learning. (T9)*

> *As teachers, we should always encourage mixed-ability grouping and assign a buddy to learners with barriers to learning. (T2)*

As teachers, we should also support each other. Some of us have no idea on what to do to support learners with cognitive challenges. We always believe they should be sent to special schools but some teachers are trained to deal with these learning difficulties hence we can collaborate. (T13)

Peer support was mentioned by the majority of teachers as a critical aspect necessary in fostering inclusive education, and where learner participation in the process of learning may be enhanced. The participants viewed the use of peer support among learners as an effective strategy leading to collaborative and collective learning instead of individualised or self-focused learning. Furthermore, participants acknowledged the method of assigning buddies to learners who are struggling as an effective support strategy which further enhanced inclusivity within mainstream schools. In addition to peer support as an effective strategy for learners, peer and collaborative support were further emphasised by teachers. These teachers mentioned that sometimes other teachers lack the competencies and confidence to cater to the learning needs of learners with barriers to learning. The findings further demonstrated that often when teachers are left to function in isolation, it becomes difficult to adequately support learners who are cognitively challenged. These findings are in harmony with that of Sheikhahmadi and Khoshnavis (2016) who in their study discovered that teachers functioning in isolation tend to be limited in their ability to support learners as they should. Further advocating for collaboration.

7.3. Specific teacher training

Teachers mentioned that they do not have the required skills to support learners with emotional, behavioural, and cognitive barriers. See below-sampled excerpts:

Learners with emotional, behavioural, and cognitive barriers should be supported in mainstream classrooms. But as teachers, we do not have the skills and knowledge to support them. (T5)

We try our best as teachers, but we have huge workloads to attend to learners with barriers. (T8) As teachers, we should be capacitated to support all learners including learners with barriers to learning. (T14)

The above findings display a significant disconnect between teachers knowing what is being expected of them in terms of supporting learners with barriers to learning, and not being capacitated to effectively do so. Excessive workload and other related hindrances such as lack of resources are mentioned as barriers preventing teachers from providing support to learners with learning barriers. The findings reveal that teachers view professional development and continued teacher training as critical aspects that can position them to adequately support learners with learning barriers. However, should there be no systematic modification focusing on lessening teachers' challenges e.g., overcrowded classrooms and work overload; then teacher professional training alone would not be sufficient to develop teachers if their working conditions are not improved. Similar to the sentiments posed by the participants, Ludago (2020) underscores the importance of improving the working environment of teachers by availing the necessary resources and teacher professional training in mainstream schools.

8. Recommendations and conclusion

This study recommends continuous specific training of in-service teachers in inclusive policies and skills that aim to support the well-being and inclusion of learners. The specific training should have a clear focus on how to support learners with barriers to learning at mainstream schools. DBE should retrain teachers on how to incorporate psycho-social support services in mainstream schools, where psychological and emotional support are offered to learners with learning barriers. Furthermore, DBE can explore the possibility of institutionalising counsellors, psychologists, and social workers at mainstream schools.

The study concludes that psycho-social support interventions are an enablement of effective inclusion of learners experiencing barriers to learning in mainstream schools. This research provides practical insights for educators, school administrators, and policymakers on implementing psycho-social frameworks that facilitate successful inclusion, thereby promoting a more accessible and equitable education system. This study has shown the important role of psycho-social intervention support in successfully including learners with barriers to learning in mainstream schools. The study further demonstrated how continued teacher training support programs and counselling services may add significant value in promoting positive inclusive education practices. Despite this, the lack of specific teacher training, peer support and collaboration among learners and stakeholders still pose as a challenge to the implementation of inclusion.

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USING CONCEPT MAPS TO ENHANCE STUDENTS' COMPREHENSION OF TELECOMMUNICATIONS

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Abstract

The article deals with the use of concept maps for a constructive overview of the telecommunications subject. The use was two-fold: at a first level, concept maps were used for the presentation and classification of core telecommunication concepts and processes such as signals, transmission techniques, links networks and services while, at a second level, parts of the individual concept maps were correlated in order to identify basic features of specific telecommunication services and applications. Regarding the first level, the overall telecommunication subject was presented as a set of layers that, from bottom to top, are (i) the signals and information representation, (ii) the transmission techniques (classified into digitization, modulation and multiplexing), (iii) the link types (that is, cable, terrestrial wireless, satellite and fiber-optic links), (iv) the networks and services (classified into dial-up, data and broadcasting) and (v) the telecom market (mainly, involving standardization and regulation issues). At the second (and more constructive) level, students were asked to correlate elements of the individual concept maps in order to identify specific telecommunication applications. For example, the amplitude modulation (AM) and frequency modulation (FM), that are elements of the concept maps regarding transmission techniques, were associated with the terrestrial wireless links (element of the concept maps for links) for the radio broadcasting service while the phase shift keying (PSK) modulation technique combined with satellite links refers to satellite TV broadcasting. Other examples were the association of certain transmission techniques (e.g. digitization and amplitude shift keying –ASK–) and certain link types (cable and fiber-optic) with telephony and data services as well as the association of requirements for basic transmission parameters (such as bit rate, bit error rate –BER– and transmission delay) with telecommunication services such as telephony, data transmission and broadcasting. The presentation took place during a two-teaching-hour lecture in the framework of the "Telecommunication Systems" course (an introductory semester course on communication principles) towards the end of the course in order students to have already encountered essential telecommunication concepts and processes. The active participation of students was encouraged particularly at the second level (correlation of the individual concept maps). The whole process was evaluated by means of a short questionnaire which included questions on whether concept maps had helped students improve their general knowledge of the telecommunications subject as well as their ability to associate basic concepts and elements in order to identify features of actual telecommunication services and applications. The above-mentioned course is offered at the Department of Electrical & Electronic Engineering Educators of the School of Pedagogical & Technological Education (ASPETE), a tertiary educational institution, located in Athens Greece.

Keywords: *Engineering education, electronic engineering education, telecommunications, concept maps.*

1. Introduction

Telecommunications is a very broad multiple-topic subject intersecting with scientific fields such as mathematics, physics and informatics (e.g., Taub & Schilling, 1986) and students often feel confused when it comes either to define telecommunication sub-fields or identify possible relations between its numerous individual topics that are often overlapping and/or interrelated.

With the aim to address the above issue and help students develop a clearer and well-structured overview of the telecommunication domain, a layered structure has been proposed (Pagiatakis, 2005) that, from bottom to top, it includes six modules with the lower-layer modules serving as the background for the higher ones with the latter providing the former with application examples. Those modules are: basic

concepts, signal basics, transmission techniques (digitization, modulation and multiplexing), link types (cable, wireless, optical), telecom networks and services (telephony, data networks, audiovisual services and broadband networks) and market issues. For example, each link type can be combined with specific transmission techniques while a network/service (e.g. telephony) usually employs all types of links (for example, the conventional telephony network consists of cable, optical and terrestrial/satellite wireless links).

A concept map, on the other hand, is a diagram that illustrates relations between concepts. As a notion, concept maps were first introduced by J. D. Novak in the early 1980s based on the idea that meaningful learning is greatly influenced by students' prior knowledge (Novak & Gowin, 1984; Novak, 1991; Stoica, Moraru & Miron, 2011). One common form of concept maps is the one that includes a hierarchical organization of concepts with the more general concepts placed at the top and the more specific ones at the bottom of the diagram. Another form (the one used here) presents the concepts from left (more general ones) to right (more specific ones).

In this article, concept maps were used for a constructive overview of the overall telecommunications subject. The use of concept maps for teaching telecommunications was described by Pagiatakis et al (2024) but that use was limited to signal transmission techniques. Besides, Freeman & Urbazewski (2002) used concept maps in a rather different context that of assessing students' understanding of telecommunications. In this article, the use of concept maps was extended to cover additional core topics such as signal types, telecommunication links and telecommunication network and services. The work also proceeds beyond the conventional use of concept maps in that it proposes individual elements of concept maps to be properly correlated in order to identify features of specific telecommunication services and applications.

2. Objective

The objective was to use concept maps to present a well-structured overview of the overall telecommunications subject. At the first level, the aim was to use concept maps in a rather conventional way regarding core telecommunication concepts and processes such as signals, transmission techniques, links, networks and services. At the second level, individual elements of the above concept maps were properly correlated and connected with the aim features of specific telecommunication services and applications to be identified.

3. Method

The applied approach in using the concept maps anticipated two levels:

At the first level, concept maps were used in a rather conventional way for the presentation of the overall telecommunication subject. More specifically, concept maps were used to illustrate the various types of signals, transmission techniques, types of links and communication network and services. The main aim was the students to outline the telecommunication subject which is broad and with several overlapping and/or associated topics.

In the second (and more constructive) level, students were asked to correlate elements of the individual concept maps in order to identify specific telecommunication applications. This was the level where active participation of students was sought.

4. Design

The use of concept maps in the relevant two-hour lecture included two parts:

In the first part, concept maps were used in order to outline the telecommunication subject as a whole. More specifically, the overall telecommunication area was depicted as a set of layers that, from bottom to top, were (i) the signals and information representation, (ii) the transmission techniques (classified into digitization, modulation and multiplexing), (iii) the link types (that is, cable, terrestrial wireless, satellite and fiber-optic links), (iv) the networks and services (classified into dial-up, data and broadcasting) and (v) the telecom market (mainly, involving standardization and regulation issues) (Pagiatakis; 2005). Special care was taken for telecommunication networks and services that were classified with regard to the kind of information (voice, data, video) and the switching technique (circuit switching, packet switching, no switching).

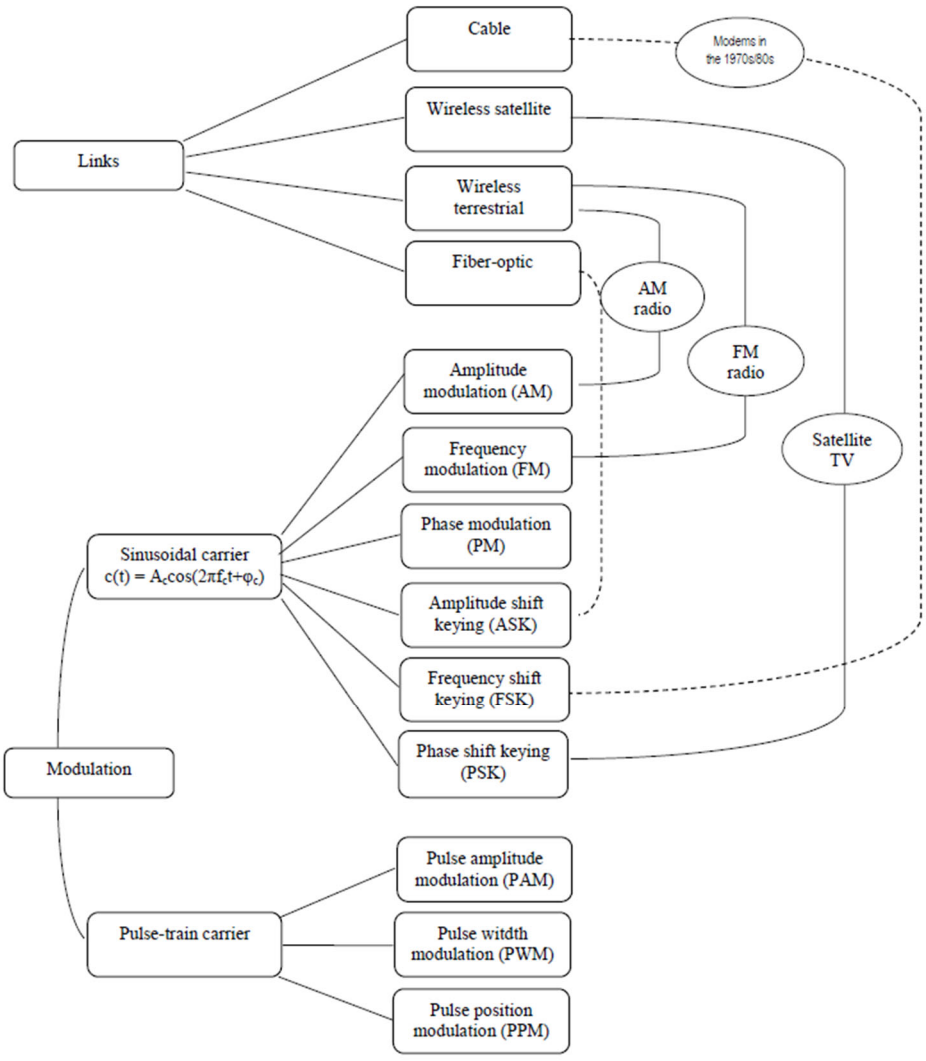
In the second part, students were asked to correlate elements of the individual concept maps in order to identify specific telecommunication applications. For example, the amplitude modulation (AM) and frequency modulation (FM), that are elements of the concept maps regarding transmission techniques, were associated with the terrestrial wireless links (element of the concept maps for links) for the radio

broadcasting service while the phase shift keying (PSK) modulation technique combined with satellite links refers to satellite TV broadcasting. Other examples could be the association of certain transmission techniques (e.g. digitization and amplitude shift keying –ASK–) and certain link types (cable and fiber-optic) with telephony and data services as well as the association of requirements for basic transmission parameters (such as bit rate, bit error rate –BER– and transmission delay) with telecommunication services such as telephony, data transmission and broadcasting (figure 1).

The presentation took place during a two-teaching-hour lecture in the framework of the 5th semester "Telecommunication Systems" course (an introductory course on communication principles) in autumn 2023. The course is offered at the Department of Electrical & Electronic Engineering Educators of the School of Pedagogical & Technological Education (ASPETE), a tertiary educational institution, located in Athens. Greece. A unique feature of ASPETE is that its graduates, apart from working as engineers in their respective field, can also be employed as teachers in technological secondary schools, that is why students attend courses on pedagogy and didactics in parallel with their engineering courses. The potential employment of ASPETE's graduates as educators is an essential reason why particular emphasis should be given to the students developing a conceptual, and not just procedural, understanding of the concepts and processes of their field. This was the second time that concept maps were used in the context of telecommunications and the lecture took place at the end of the above-mentioned course in order students to have encountered basic telecommunication concepts and processes.

Following the lecture, and with the aim to evaluate the effect of using concept maps for enhancing students' comprehension of telecommunications, a short questionnaire was distributed to students that should be answered by means of a 5-grade Likert scale ("1" strongly disagree, "2" disagree, "3" neither disagree nor agree, "4" agree, "5" strongly agree).

Figure 1. Concept maps regarding the layers of transmission techniques and links.



5. Discussion

There is no doubt that the use of concept maps assists educators in conveying a clearer picture of the presented notions and facilitates students' understanding by helping them create a well-structured overview of the taught topics. Regarding telecommunications, concept maps also help students outline the subject of telecommunications (and its individual sub-areas and topics) and, at the same time revise basic telecommunication concepts. Moreover, the interrelation of the concepts maps, as described in the present article, can help students associate essential notions and facts with actual telecommunication services and applications which is compatible with students' participation and active learning.

Students' answers to questions 1, 2 and 3 (with averages 4.056, 4.222 and 4.000, respectively and a small m/s ratio) illustrate the fact that students generally agree that the use of concept maps had a positive effect on their comprehension of telecommunication issues (table 1 and figure 2).

The aim of question 4 was to evaluate the intention of the participating students to use concept maps as future educators. This question was included in the questionnaire given the fact that the department's graduates have the option to be employed as teachers of electrical and/or electronic engineering in technological high schools. It is encouraging that the majority of students would agree that the use of concept maps should be part of their teaching practice.

Within the described approach, the use of concept maps regarded the Content Knowledge (CK) and Pedagogical Knowledge (PK) parts of the TPACK framework (Mishra & Kohler 2006). The aim was the students to develop Pedagogical Content Knowledge (PCK) in view of their possible future employment as secondary school teachers. Regarding Bloom's revised taxonomy (Armstrong, 2010) the presentation mainly covered layers 2 and 3 (understand and apply) and maybe layer 4 (analyze). A future presentation could anticipate the formation and elaboration of concept maps with the use of computer tools that would also add the Technological Knowledge part (TK) and also enhance layer 4.

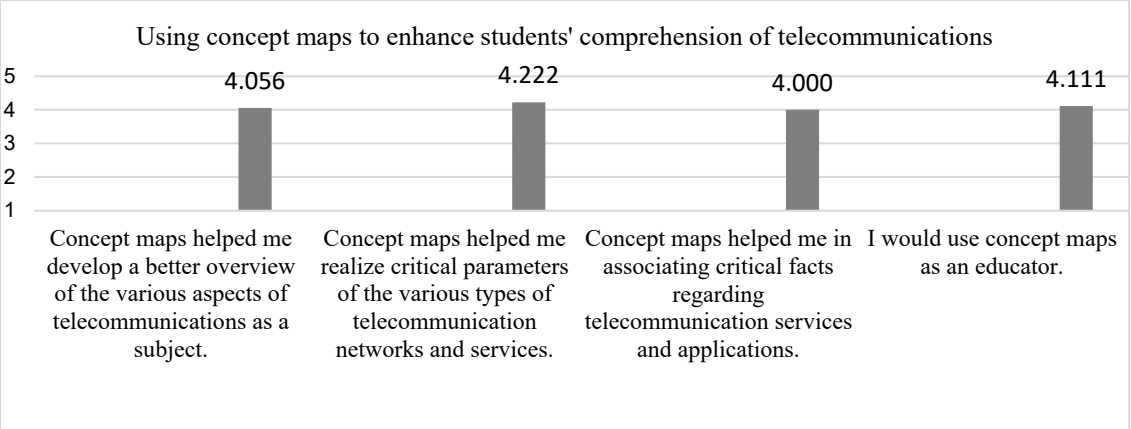
Though the described use of the concept maps regards an overview of the telecommunication subject in a pilot-like manner, concept maps could be also applied for the teaching of individual telecommunication topics, particularly those for which classification is necessary for students' comprehension (a characteristic example could be the modulation and multiplexing techniques where correlation of individual concept maps would be helpful if not necessary). To enhance the effect of the associated teaching approach, concept maps could also refer to essential relevant information (for example, regarding modulation, concept maps could include information such as the signals involved, the spectral requirements, the modulation and demodulation arrangements etc.). Active participation of students could be accomplished by asking them to create particular concept maps or develop alternative concept maps by applying different classification criteria. Students' participation could be also assisted by interrelating individual concept maps as proposed in this article.

Concept maps could also help students regarding the literature review of individual telecommunication topics. Finally, the students could incorporate the use of concept maps in their teaching of electricity- and electronics-related topics in technological secondary-school classes in their potential future capacity as educators.

Table 1. Questions and answers regarding the use of concept maps to enhance students' comprehension of telecommunications (participation: 18 students).

Question	Average (m)	Standard deviation (s)	Ratio m/s
1. Concept maps helped me develop a better overview of the various aspects of telecommunications as a subject.	4.056	0.639	0.16
2. Concept maps helped me realize critical parameters of the various types of telecommunication networks and services.	4.222	0.808	0.19
3. Concept maps helped me in associating critical facts regarding telecommunication services and applications.	4.000	0.639	0.16
4. I would use concept maps as an educator.	4.111	0.471	0.11

Figure 2. Questions and answers regarding the use of concept maps to enhance students' comprehension of telecommunications (participation: 18 students).



6. Conclusions

The article proposes the use of concept maps with the aim to assist and enhance students' comprehension of telecommunications. Apart from the conventional use of concept maps (which, anyway was extended to cover the whole of the telecommunication subject), the article proposes a more advanced use in that individual map elements could be properly correlated in order to identify and illustrate features of specific telecommunication services and applications. Given that telecommunications are a vast subject with numerous topics and sub-areas that may overlap with each other and/or intersect with fields such as mathematics, physics and informatics, concept maps can assist students in defining and comprehending telecommunication topics and dissolving relevant misconceptions and missing points. This could be particularly helpful for graduates who would be employed as teachers and educators. Students' answers to the distributed questionnaire were a strong indication that the described use of concept maps had a positive effect on their comprehension of telecommunications and it was also encouraging that students were eager to use concept maps as future educators. A future presentation of concept maps could anticipate their formation and elaboration with the use of computer tools.

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REDEFINING STEM EDUCATION: INITIATING AND DEVELOPING A PRE-COLLEGE AEROSPACE TEAM

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Abstract

Many researchers forecast the New Space Economy to exceed one trillion dollars (USD) by 2040. To meet this need, it is vital that space-faring nations and those choosing to capitalize on this new domain embrace new strategies to enhance and further develop their STEM workforces. The answer is to educate the workforce of the future through an industry lens. Traditional educational models lead to boredom and uninspired students who can too easily lose interest in the pursuit of a long-term STEM career. Moreover, traditional STEM education churns out cookie-cutter students who may test well or have a high GPA but who have no real product to show for themselves upon graduation. As such, changing the way STEM education is defined can produce a well-trained and motivated STEM workforce of the future especially when it comes to aerospace education. A prime example of this novel educational model is the Wolfpack CubeSat Development Team (WCDT) located in South Florida, United States. Operating as part of the Aerospace and Innovation Academy, the mission of the Wolfpack is to design, build, test, and fly CubeSats as early as middle and high school. In general, the model of the Wolfpack best positions students to remain in the STEM pipeline through their college years and more must be done to reshape traditional STEM education to reflect an industry connection. Although the WCDT continues to grow, there remains insufficient aerospace resources and access for all students who may want to learn through an industry lens; however, individual members have begun creating school-based teams that collaborate with the WCDT. This paper will look more closely at The Greene School Aerospace Team, based at a private school in Palm Beach County, Florida, US, of which the authors are a part. The teammates who participate in this fledgling program undertake real-world aerospace work in the form of aerospace policy advocacy, international mentorship for a team in Japan, and CubeSat design. This paper will also explore the successes and failures that are associated with starting brand-new experiential teams.

Keywords: *New space economy, STEM education, Wolfpack CubeSat Development Team, mentorship, experiential learning.*

1. Introduction

The New Space Economy, expected to surpass one trillion dollars by 2040, presents vast opportunities for economic growth and technological innovation (Cheng et al., 2019). To capitalize on these opportunities, the U.S. must reshape its STEM education strategies, ensuring a workforce equipped with both the technical and soft skills needed for the rapidly evolving aerospace industry. Traditional STEM education, with its emphasis on theoretical knowledge and standardized testing, is not enough to meet the demands of this growing sector (Coulter & Herman, 2020). Students need hands-on experience, early engagement, and industry connections to thrive in fields like aerospace. Traditional STEM education in America is often criticized for its lack of engagement and practical application. In many schools, the focus on textbooks and exams leaves students without the real-world skills required for problem-solving in STEM fields. The absence of industry-connected mentorship, practical training, and funding for innovative programs exacerbates this issue. To combat this, it is essential to foster early engagement in STEM, offering students the opportunity to build technical skills and a STEM identity from a young age. To solve this problem, The Aerospace and Innovation Academy, with its Wolfpack CubeSat Development Team, approaches education through an industry lens, and as it has grown, offshoots at individual teammates' schools have begun to take place in other parts of Palm Beach County, other states, and even other countries (Christenson et al., 2022). One such team is The Greene School, a small private school educating students K-12. The Greene Aerospace Team (GAT) originally began in 2022, when two educator authors both taught

at the school. With his extensive aerospace experience as founder of the AIA and WCDT, Kevin Simmons brought aerospace education to his science classrooms, while Shawna Christenson encouraged debate students to participate in aerospace legislative efforts. Initially, the team started out as a school elective, which allowed ample field experiences to take the place of regular classroom instruction.

2. Innovative models: The Wolfpack CubeSat development team

The Wolfpack CubeSat Development Team (WCDT), which operates under the Aerospace and Innovation Academy in the US, is an after-school, online program that provides middle and high school students real-world aerospace opportunities in three main areas: engineering, entrepreneurship, and policy. The group began after COVID, when Simmons saw a need to create the experiences he had done with his original middle-school team who no longer had access once they matriculated to high school. The Wolfpack's mission is to design, build, test, and fly CubeSats—small, affordable satellites—which help students to gain hands-on experience in engineering (Grainger Engineering Office of Marketing and Communications, n.d.). At publication of this paper, the team has successfully launched three CubeSat missions and is currently working on their fourth, a biological payload that seeks to investigate the ability of bacteria to break down PET (Christenson et al., 2022). Simmons is able to foster this high-level learning through his "BLUE-SKY Learning" philosophy, which breaks down large, complex projects into manageable tasks, fostering problem-solving and building confidence. He focuses on the building of soft skills alongside the necessary technical skills needed for STEM careers of the future. Students also engage in activities like writing technical papers, creating educational content, and advocating for aerospace policy, preparing them not just for technical careers but for leadership roles in communication and advocacy as well (Cheng et al., 2019). His success with these students has led to team mentoring for aerospace groups in Peru, India, England, Switzerland, and even Japan.

3. Expanding the model: The greene school aerospace team (GAT) efforts

The Greene School in West Palm Beach, Florida, continued after the educators left the school as the two student authors, among others, are members of the Wolfpack. The GAT has participated in various aerospace competitions and experiences including High Altitude Balloon (HAB) missions. This model of experiential learning fit well with the school's original focus on a unique Passion Pathways Project, which helps students identify their interests and develop a specialized portfolio over four years prior to graduation. This model not only builds skills but ensures that students are actively engaged in learning that is both relevant and inspiring (STEM Education Data and Trends, n.d.). Since its inception, the team focus has moved to more individualized approaches as the school also has made changes in its mission for graduating seniors to move away from Passion Pathways; however, the subset of GAT as WCDT continues to thrive in the form of students who participate in research and conferences such as ISDC (International Space Development Conference) and COSPAR (Committee on Space Research), which was held in Busan, South Korea, this past summer. There, six GAT/WCDT teammates presented their research on an international scale (Service, T. N., 2022). Another way to incorporate speaking through an aerospace lens is the policy work the WCDT does each year in their home state's legislative advocacy days. Greene students participated in Florida Space Days for two years when Simmons taught at the school, and the activity continues through the policy work of one of the student authors of this paper. As co-lead of the WCDT's policy efforts, Kniskern has worked on creating a legislative appropriation that would bring the possibility of CubeSat to underserved students in schools throughout Palm Beach County. Her efforts helped to secure a previous appropriation that helped Palm Beach State College to host summer camps this past year for at-risk youth in our area. This year, the policy team seeks to expand those camps and outreach with efforts to reach even more students (Christenson et al., 2022). The work students do at the legislative level helps young people understand how the government works at the state and local level, further defining the meaning of hands-on experiential learning. In addition to the soft skills of writing and presenting, a Japanese American GAT/WCDT member connected with a school in Japan. After presenting about STEM education and his experiences as an American STEM student and WCDT team member, the student helped to coordinate a collaboration with the Wolfpack. Since this past summer, there are potentially two interested Japanese schools, some of whom will be attending a WCDT summer camp at Kennedy Space Center. The student will be learning about CubeSat basics in an effort to collaborate on a future mission with the American students. This kind of international collaboration showcases the power of integrating STEM with real-world projects that blend passion, skills, and promotes real-world aerospace education at a global level.

4. Challenges in scaling innovative models

While models like those at the Wolfpack CubeSat Development Team and The Greene School show great promise, significant challenges remain in scaling such programs across the broader educational system. One of the primary obstacles is the shortage of qualified mentors with industry experience. These mentors are crucial for guiding students through complex, real-world projects and helping them connect theoretical knowledge with practical applications (Coulter & Herman, 2020). After Simmons and Christenson left The Greene School, it was difficult for the momentum to continue, and while several students are exploring their aerospace passions through WCDT, others have dropped out. There is also a need for more funding to support project-based learning, maintain industry-standard equipment, and provide schools with the resources they need to implement these programs effectively (Cheng et al., 2019). This is especially true for public school teams, and precisely why legislative advocacy efforts are necessary. Building strong partnerships between schools and industries is another key challenge. Connections with aerospace companies, research institutions, and government agencies are essential for providing students with real-world experiences, such as internships, mentorships, and collaborative projects. These connections ensure that students understand the practical applications of their studies and can envision potential career paths in STEM fields. To succeed in the New Space Economy, the U.S. must overhaul its STEM education approach, moving away from traditional models that focus on theory and standardized testing. Instead, schools must offer hands-on, project-based learning that connects students to real-world applications and industry practices. Programs like the Wolfpack CubeSat Development Team and the Greene Aerospace Team exemplify how early, immersive engagement in aerospace and other STEM fields can foster a deep, lasting interest in these disciplines.

5. Conclusion

The potential of the New Space Economy is immense, but to fully realize its benefits, the U.S. must invest in a robust, forward-thinking STEM education system. Arguably, other nations should consider these models as well. Early engagement in STEM, particularly through hands-on, industry-connected projects, is essential for preparing students to succeed in the evolving space industry. The success of programs like the Wolfpack CubeSat Development Team and the Greene Aerospace Team demonstrates the power of innovative educational models that combine technical training with real-world applications. By addressing challenges like mentor shortages, funding gaps, and industry partnerships, we can create a generation of students who are ready to lead in the New Space Economy and beyond.

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THE EMERGENCE OF STEAM AND ITS PEDAGOGICAL IMPLICATIONS: A RE-EVALUATION OF THE PSYCHOMOTOR DOMAIN

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Abstract

The complex challenges of the 21st century necessitated the integration of traditionally discrete disciplines to form the meta-discipline of Science, Technology, Engineering and Mathematics (STEM) as a body of enquiry. However, the increasingly complex challenges of the present world have resulted in the reframing of STEM education to emphasis the enhancement of students' ability to find solutions to complex societal challenges. This new move has seen the integration of Arts into STEM to create the transdiscipline of STEAM with more emphasis on nurturing creativity and innovative competency. This paper, therefore, examines the implication of this development on the psychomotor domain of learning as well as promote psycho-productive competency as a viable domain with focus on creative competency of students. The integrative methodology for the review of literature was adopted to examine and comprehend the definitions and descriptions of STEAM education. The article highlighted the rationales, core objectives, and implications of STEAM education for the psychomotor domain. It also recommended pedagogical frameworks and required teacher competences for STEAM education.

Keywords: *STEAM, psychomotor domain, psycho-productive competency, competency-based education, design-based learning*.

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1. Introduction

The complex challenges of the 21st century have necessitated the integration of traditional discrete disciplines to form the meta-discipline of Science, Technology, Engineering and Mathematics (STEM) as a body of enquiry (Belbase et al., 2021). Such integration represents a bid to eliminate the established barriers between the disciplines of science, technology, engineering and mathematics, and foster creativity as well as the application of new and innovative practices to create solutions to complex contextual situations (Kennedy & Odell, 2023). However, the increasingly complex challenges of the present world have resulted in the reframing of STEM education to emphasis the enhancement of students' ability to find solutions to complex societal challenges. This provided the basis for an integration of the humanities (Arts) into the highly crucial domain of STEM, thereby birthing the acronym STEAM which stands for Science, Technology, Engineering, Arts and Mathematics (Land, 2013; EducationCloset, 2019).

Findings by Swaminathan and Schellenberg (2015) have demonstrated that programmes in the Arts enhance cognitive skills such as abstract thinking, spatial reasoning, divergent thinking, creative self-efficacy, openness to experience, and curiosity. Therefore, acquiring the capability to implement both sets of skills can be considered an elite requirement for the global competiveness of the modern society. For better comprehension of the creative-workforce's inspired educational and research landscape of STEAM (Katz-Buonincontro, 2018), it is essential to review the rationale for the integration of Arts into STEM, the goals of STEAM education and explore the implication on the psychomotor domain of educational objectives.

1.1. Conceptualisation of STEAM

There is no generally accepted comprehensive definition of STEAM. However, there are as varying descriptions of STEAM as there are suggestions regarding its implementation (Katz-Buonincontro, 2018). This article, therefore, would adhere to the definitions that align with the study's focus. Perales and Aróstegui (2021) defined STEAM education as a body of knowledge which proposes an integrated teaching of scientific-technological, artistic and, in general, humanistic competencies, with an integration that is understood in a progressive sense, moving from interdisciplinarity to transdisciplinarity.

2. Methodology

The integrative review of literature was adopted to examine and comprehend the definitions and descriptions of STEAM education. Studies such as Torraco (2005) and Whittemore and Knafl (2005) identified integrative review as a particular review method which analyzes and synthesizes literature with the purpose of broadly comprehending the particular topic. These methods of review are suitable for reevaluating studies on new and/or emerging topics in diverse disciplines such as STEAM education, so that robust comprehension of the discussion, analysis and application of STEAM in literature could be achieved.

3. Discussions

3.1. The rationale for the integration of arts into STEM

Several rationales have been identified by studies for the integration of Arts into STEM thereby forming the meta-discipline of STEAM. Some of these rationales include "the integration and use of Arts in the STEM curriculum to aid students' expression of STEM concepts" (Sharapan, 2012); "the integration of arts in order to enhance the involvement of students who are customarily not part of STEM" (Quigley & Herro, 2016); "a body of knowledge that underlines the importance of Arts for the engagement of more students with differing learning characteristics" (Bush et al., 2016); and "an approach for encouraging greater interest in STEM disciplines and enhancing career aspirations among secondary (K-12) students" (Kant et al., 2018).

From the pedagogical perspective, Bequette and Bequette (2012) reviewed the rationale for STEAM by arguing that "when the Arts are seen as tipping point of STEAM education, not just an initiating stage of more sophisticated STEM topics, carefully designed STEAM curricula would be capable of enhancing continuous cross-disciplinary learning within the secondary (K-12) settings".

Creative problem-solving, Creative thinking, the development of creative skills, or creativity is frequently highlighted in majority of studies as an outcome of STEAM. The conception of creativity is associated with the Arts, and it is described as a key objective of STEAM education (Tesconi & de Aymerich, 2020).

3.2. Objectives of STEAM education

STEAM educational objectives are broad, ranging from increasing academic participation, engagement, and retention through art and design thinking (e.g., creativity), to core subject mastery in STEM fields like astronomy and engineering gained through interactive multimedia projects (Clapper, Fagen, Garcia, & Lopez, 2013); and hands-on exploration in the arts (Liao, 2019). Creativity holds a central place in STEAM education, recognized as a valuable asset in a competitive society (Chen & Ding, 2024). Therefore, the development of students' competencies is regarded as the sole goal of STEAM education for both self-actualisation and as a resource for the industrial sectors.

3.3. Implications of STEAM education: From psychomotor to psycho-productive competency

The psychomotor domain of Bloom's Taxonomy focuses on physical movement, coordination, and motor-skill application, emphasizing speed, precision, and control. While it includes tasks from simple to complex, this article shifts focus to psycho-productive competency, which blends creativity with productive skills. Drawing on studies by Ombugus and Umaru (2017), Ombugus et al. (2019), and Onanuga and Banjo (2021), the article defines psycho-productive competency as the ability of students to demonstrate observable, skill-based outputs reflective of classroom instruction, under real-world conditions. Unlike traditional skill-based approaches, this article views psycho-productivity through a competency lens, integrating creativity and humanistic values. As Torres (2022) explains, competency encompasses knowledge, behavior, skills, and attitudes essential for successful task completion. Thus, psycho-productive competency refers to students' ability to produce tangible evidence of learning—demonstrating not only skills but also sound judgment, creative application, and deep understanding of concepts taught during instruction.

3.4. Challenges of STEAM education

Studies such as Quigley and Herro (2016) and Herro, Quigley and Cian. (2018) have shown how difficult it is to implement STEAM, with teachers reporting challenges such as increased workload, and understanding STEAM integration. STEAM instruction can pose pedagogical challenges, especially, as teachers attempt to move toward a facilitator role in instruction (Quigley, Herro, King & Plank, 2020). Teachers' epistemic worldview could underpin their perception and readiness to implement STEAM

instruction. Nonetheless, creative and design skills which are naturally the focus Art and design disciplines might not be of great interest to science and engineering students (Che & Ip, 2024). Another challenge is how teachers would deliver technical content in core STEM subjects such as mathematics, programming, and other related contents that are very influential to students' motivation and interest in the field. Furthermore, Che and Ip (2024) asserts that assessment of learning outcomes presents another challenge as grading creative outputs could frequently lead to subjective remarks.

3.5. Framework for STEAM education: Instructional implementation of STEAM education

The successful implementation of STEAM requires approaches with the capacity to address STEAM's particular objectives. Various approaches have been highlighted in literature.

- One consideration is Competency-Based education. According to Sullivan and Downey (2015), organisations such as the Carnegie Institute and the United Nations are increasingly placing more emphasis on Competency-Based Instruction in education reform efforts. Rajapaksha and Hirsch (2017) studied philosophy and the practice of competency-based instruction of college physics. The study emphasizes that focusing on competencies in physics enhances the development of many transdisciplinary and transferable skills that learners can employ in other fields of human endeavour, independent of the physics discipline.
- Another suggested approach for STEAM education is Design-based learning. Design-based learning combines design thinking and the design process into the instructional exercises, where the students are engaged in a real-life context (Bertrand & Namukasa, 2023). It can be described as a natural approach to STEAM, as well as a vital element of an authentic STEAM program (Liao, 2016).

3.6. Required teaching competencies for STEAM education

Based on the learning principles outlined for STEAM education, Kim and Kim (2016) categorized STEAM teaching competencies to include:

- Subject-matter cognitive Ability: This is described by the ability to comprehend and using convergent knowledge;
- Advanced thinking ability: This is defined by teachers' creative, problem-solving, decision-making and critical thinking abilities, as well as the ability to use information;
- Ability to contribute to the community: This is defined by the capacity to communicate, engage in social relationships, and collaborate with others;
- Individual emotional intelligence: This is defined as self-respect, positive emotion, consideration, and civil awareness.

Adaptive expertise is another essential teaching competency required for the implementation of STEAM educational objectives. Hatano and Inagaki (1986) recommended three factors that boost the development of adaptive expertise:

- an arbitrary context that compels professionals to adapt their skills, due to careful observation and interaction;
- an environment that is safe where rewards is not dependent on performance;
- a functioning context that values quality over efficiency.

The challenge of reconciling and integrating creative competence into STEM could be considered a complex task, making adaptive expertise a crucial skill in STEAM education.

4. Conclusion

This article underscores the need for an integrated education that advances both scientific and humanistic competencies. It explores STEAM education from two perspectives: as an extension of STEM through the inclusion of the Arts, and as a transformative framework that impacts society and the educational landscape. The review reveals that STEAM promotes principal and transversal competencies across educational levels, emphasizing psycho-productive competencies linked to creativity. Studies highlight creative thinking, problem-solving, and skill development as key outcomes of STEAM education. The article calls for a reexamination of the psychomotor domain in educational objectives, aligning with the renewed focus on creativity. However, the transition to STEAM poses challenges for instructors and students, including pedagogical, design, and assessment issues. Science and engineering educators may face difficulties in integrating technical content with creative approaches. To address these challenges, the article proposes competency-based instruction and design-based learning as effective models for developing and teaching STEAM curricula.

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RETHINKING TECHNOLOGY-DRIVEN SIMULATION IN HEALTH EDUCATION: A QUALITATIVE EVALUATION OF LOW-FIDELITY APPROACHES

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Abstract

The growing adoption of high-fidelity, technology-centric simulations in health education has raised critical questions about their effectiveness, particularly when compared to low-fidelity methods. While high-fidelity simulations are often assumed to be superior due to their immersive capabilities, this study explores whether simpler, low-fidelity approaches may be equally or more effective in developing critical thinking and foundational clinical skills. This research aimed to (1) examine staff and student perceptions of low-fidelity simulation efficacy in skill development and critical thinking, (2) understand the experiential and reflective learning processes facilitated by low-fidelity approaches, and (3) explore perceived barriers and facilitators to using low-fidelity simulations in health education settings. Using a qualitative methodology, semi-structured interviews were conducted with 8 staff members and focus groups with 60 students across health care disciplines. Thematic analysis was applied to identify recurring themes and insights. Findings revealed that both staff and students valued low-fidelity simulations for their flexibility, accessibility, and ability to foster deep reflective learning without the distractions of advanced technology. Participants highlighted that low-fidelity simulations encourage active engagement and provide a psychologically safe environment for practising skills, allowing students to focus more on clinical reasoning than on managing complex equipment. Staff also noted that low-fidelity methods are easier to adapt to specific learning objectives, promoting a more tailored and responsive approach to skill acquisition. This study concludes that low-fidelity simulations hold significant, often overlooked potential for enhancing foundational learning in health education. By prioritising the learning experience over technological sophistication, educators may better address diverse learning needs, particularly in resource-constrained settings. These findings suggest the need to re-evaluate simulation design strategies, balancing both low and high-fidelity methods to optimise educational outcomes.

Keywords: *Simulation-based learning, low-fidelity simulation, experiential learning, health education, qualitative research.*

1. Introduction

Simulation-based learning has become a cornerstone of modern health education, offering opportunities for learners to practice clinical skills in controlled environments. While high-fidelity simulations (HFS) have dominated this space due to their ability to mimic real-life clinical scenarios with advanced technology, there is a growing interest in the potential benefits of low-fidelity simulations (LFS) (Coyne, Calleja, Forster, &Frances, 2021). This paper examines the efficacy of LFS in promoting critical thinking, skill acquisition, and reflective learning among health education students and staff, challenging assumptions about the necessity of high-fidelity tools in achieving educational outcomes (Gaba, 2007).

The focus on HFS often overlooks students' foundational learning needs and the resource constraints faced by many institutions (D'Souza, Venkatesaperumal, Chavez, Parahoo & Jacob, 2017). In contrast, LFS offers a more accessible, flexible, and cost-effective alternative that prioritises pedagogical value over technological complexity. By evaluating the perceptions and experiences of staff and students, this study aims to highlight LFS's overlooked advantages and contribute to a more balanced understanding of simulation-based learning.

2. Methodology

2.1. Research design

A qualitative research approach was employed to gain an in-depth understanding of staff and student experiences with simulations in health education. This approach aligns with the interpretive paradigm, emphasising participants' subjective interpretations of their lived experiences. The study was framed within a social constructivist perspective, enabling an exploration of how simulations across the healthcare disciplines studied, facilitate skill acquisition, critical thinking, and reflective learning (Creswell, 2017). This framework was deemed particularly suitable given the focus on the experiential dimensions of simulation and its influence on educational practices (Creswell, 2014; Saleem and Khan, 2023). Motivated by the increasing emphasis on simulation in health education and its capacity to address clinical skill shortages, this study investigated simulation practices within eight disciplines: nursing, physiotherapy, occupational therapy, diagnostic radiography, therapeutic radiography, oncology, dentistry, and orthoptics.

2.1.1. Participants. Two distinct participant groups were included in this study to capture a comprehensive range of perspectives:

- **Staff**: Eight staff members from the eight health care disciplines were purposively selected based on their involvement in developing and delivering simulation-based teaching. Their diverse levels of experience with LFS and HFS contributed to a rich dataset that included novice and seasoned educators.
- **Students**
    - **Focus Groups**: a total of forty-four undergraduate and postgraduate students enrolled in health educations programmes within the eight disciplines were recruited for participation. These students were organised into eight focus groups, ensuring representation across a range of disciplines and academic levels to facilitate the collections of diverse perspectives.
    - **Live Observations**: a total of eighty-six undergraduate and postgraduate students from health education programmes were observed during live simulation learning sessions. Observations were conducted once per subject discipline to capture the unique dynamics of each area.

Purposive sampling guided the selection of participants, ensuring representativeness and focusing on individuals directly engaged with LFS in their educational contexts.

2.1.2. Data Collection. Data collection employed a mixed-methods approach, incorporating semi-structured interviews, focus group discussions, and live observations of simulation sessions to provide a comprehensive understanding of participants' perceptions and experiences (Creswell, 2017). This triangulated approach enriched the dataset by capturing individual, collective, and contextual insights into the interactions between staff, students, and simulation environments (Cohen, Manion, & Morrison, 2011).

- **Semi-Structured Interviews:** Conducted with staff members, these interviews explored pedagogical strategies, perceptions of the effectiveness of live simulation (LFS), and challenges encountered during implementation. The semi-structured format provided flexibility for interviewers to probe emerging themes while ensuring consistency across participants.
- **Focus Group Discussions:** These discussions, conducted with student participants, fostered dynamic interactions and uncovered both shared experiences and divergent perspectives. Guided by open-ended questions, the discussions covered topics such as the perceived benefits of LFS, its role in reflective learning, and barriers to its effective use.
- **Live Observations of Simulation Sessions:** Observations were conducted with 86 undergraduate and postgraduate students from health education programmes during live simulation learning sessions. These sessions were observed once per subject discipline, enabling the capture of unique insights into the interactions between staff, students, and the simulation environment, including the dynamics that influence learning and teaching practices.

All interviews, focus groups, and observations were systematically documented, with audio recordings of interviews and discussions transcribed verbatim for analysis, ensuring the accuracy and reliability of the data collected.

2.1.3. Ethical Considerations. The institutional review board approved the study, ensuring compliance with ethical research practices. All participants gave informed consent, and they were assured of their anonymity and the confidentiality of their responses. They were also informed of their right to withdraw from the study at any point.

2.1.4. Data Analysis. Thematic analysis was employed to systematically examine the qualitative data, following Braun and Clarke's six-phase framework (Braun and Clarke, 2006):

1. **Familiarisation with the Data**: Transcripts were read and re-read to immerse researchers in the dataset and identify preliminary patterns.
2. **Initial Coding**: Transcripts were coded inductively, allowing themes to emerge organically from the data rather than being predetermined.
3. **Theme Development**: Codes were grouped into broader themes, reflecting key patterns and recurring insights.
4. **Reviewing Themes**: Themes were refined through iterative discussions among the researcher and participants to ensure coherence and relevance.
5. **Defining and Naming Themes**: Each theme was defined and named to encapsulate its essence succinctly.
6. **Producing the Report**: Themes were contextualised within the study's objectives and supported by illustrative quotes from participants.

To enhance the credibility and rigour of the analysis, several strategies were employed (Castleberry and Nolen, 2018):

- **Triangulation**: Insights from interviews and focus groups were cross validated to ensure consistency.
- **Peer Debriefing**: Preliminary findings were discussed with colleagues not directly involved in the study to gain external perspectives.
- **Participant Validation**: A subset of participants reviewed the themes to confirm their accuracy and resonance with lived experiences.

This robust methodological approach ensured that the findings were grounded in participants' authentic experiences and offered a comprehensive understanding of LFS in health education.

3. Findings

3.1. Perceived Benefits of Low-Fidelity Simulation

Flexibility and Accessibility

Participants consistently highlighted the adaptability of LFS to diverse learning environments, particularly in resource-constrained settings. Staff reported that LFS could be seamlessly integrated into classroom or community-based activities, enabling frequent and context-specific simulations. This adaptability made it possible to tailor simulations to meet specific learning objectives, such as conducting basic patient assessments or improving therapeutic communication. Students noted that the absence of complex technological requirements allowed them to focus more on learning outcomes and less on navigating unfamiliar equipment.

Reflective Learning and Critical Thinking

LFS was praised for its ability to foster reflective learning and critical thinking among students. Staff described how the simplicity of LFS created a distraction-free environment where learners could deeply engage with the task at hand. This focus on core skills, such as decision-making and clinical reasoning, was further reinforced by opportunities for debriefing and feedback. One staff member shared how role-playing exercises helped students grapple with ethical dilemmas and develop a patient-centred approach, while students emphasised that the iterative nature of LFS encouraged them to refine their problem-solving abilities**.**

Psychological Safety

Both staff and students valued the psychologically safe environment provided by LFS. Unlike high-fidelity setups, which can sometimes intimidate learners due to their technical complexity, LFS offered a low-pressure platform where mistakes were seen as part of the learning process. Students reported feeling more comfortable taking risks and experimenting with different approaches, which they saw as crucial for building confidence and competence. Staff echoed these sentiments, noting that the safe atmosphere of LFS fostered open dialogue and a willingness to learn from errors.

3.2. Challenges and barriers

Perceived Inferiority to High-Fidelity Simulation

Despite its benefits, some participants expressed concerns about the perceived lack of realism in LFS. Students with prior exposure to HFS noted that LFS did not replicate the immersive experience of advanced simulations, such as real-time physiological responses or lifelike patient interactions. Staff acknowledged these limitations but argued that LFS serves a complementary role, particularly in the foundational stages of learning. They emphasised that LFS should not be viewed as a substitute for HFS but rather as an equally important component of a holistic simulation-based curriculum.

Resource Allocation and Training

A recurring theme among staff was the challenge of securing institutional support for LFS. Many felt that the focus on high-fidelity technologies diverted resources and attention away from developing robust LFS programmes. Additionally, staff highlighted the need for professional development opportunities to enhance their skills in designing and facilitating LFS. Without adequate training and resources, they felt that the full potential of LFS could not be realised, limiting its impact on student learning**.**

4. Discussion

The findings of this study highlight the need to critically assess the balance between technological sophistication and pedagogical effectiveness in health education. High-fidelity simulations undoubtedly play a critical role in preparing students for complex, real-world scenarios. However, this study reveals that low-fidelity simulations, often relegated to a secondary status, offer unique advantages that are equally essential to holistic learning experiences.

A notable insight from this research is the capacity of LFS to foster deep reflective learning. The simplicity of these simulations encourages students to engage more actively with the content and focus on core learning objectives, such as clinical reasoning and foundational skills. Unlike HFS, which can sometimes overwhelm learners with its technical intricacies, LFS creates an environment where mistakes are less intimidating, thereby promoting iterative and meaningful learning experiences.

Low-fidelity simulations provide a flexible and adaptable learning platform that can cater to diverse educational contexts. For institutions facing financial and logistical constraints, LFS offers a pragmatic alternative that does not compromise educational quality. Moreover, the accessibility of LFS makes it an invaluable tool for widening participation in health education, ensuring that students from various socio-economic backgrounds have equitable access to high-quality training.

While LFS lacks the advanced realism of HFS, this study argues that perceived realism should not overshadow the broader pedagogical value of simulations. Realism is one aspect of effective learning, but it must be balanced with accessibility, adaptability, and the ability to meet diverse educational objectives. A comprehensive simulation strategy should integrate both high- and low-fidelity methods, leveraging their respective strengths to create an optimal learning environment.

The study also highlights systemic barriers to the wider adoption of LFS, including entrenched perceptions of inferiority and resource allocation challenges. Addressing these barriers requires institutional commitment to recognising the value of LFS, alongside investments in staff training and curriculum development. Staff development programmes that emphasise the pedagogical strengths of LFS can shift perceptions and build confidence in their use.

5. Conclusion

This study demonstrates that Low-fidelity simulations (LFS) are pivotal yet often underappreciated resources in health education. This study highlights their unique contributions to fostering critical thinking, reflective learning, and foundational skill acquisition. Unlike high-fidelity simulations, which can overshadow educational goals with technological complexity, LFS centres the learning experience, allowing students to focus on clinical reasoning and iterative skill refinement in a psychologically safe environment.

The findings underscore the need for a balanced integration of low- and high-fidelity simulations to optimise educational outcomes. LFS is particularly valuable in addressing the challenges of resource-limited settings, providing a cost-effective and adaptable alternative without compromising educational quality. However, systemic barriers, such as institutional biases and limited staff training, must be addressed to fully harness LFS's potential.

Future research should explore the longitudinal effects of LFS on clinical competence and their integration into broader curricular frameworks. By prioritising pedagogical value and accessibility, health education can better prepare students for the complexities of clinical practice while ensuring inclusive and equitable learning opportunities. This re-evaluation of simulation strategies offers a pathway toward more effective and holistic health education.

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TEACHING LAW IN THE AGE OF AI: TIME FOR CURRICULUM REFORM?

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Abstract

A revolution has been introduced by the introduction of generative artificial intelligence (AI). Generative AI systems can now perform activities relating to problem-solving and decision-making. University students have started using AI tools to correct language, find information and stimulate creativity. The introduction of AI questions traditional approaches to teaching and learning. AI tools bring with it a plethora of ethical issues such as academic integrity. While many have discouraged the use of AI by university students, it is also true that AI tools have increasingly been used in the legal field for legal research and drawing up legal documents. Against the background of the abovementioned developments, it is incumbent on law faculties to think about the skills that they want to impart to students. Curriculum policy documents on legal education in South Africa outline essential skills for law graduates such as reading, writing and research skills. None of these documents speak to the ethical use of AI tools. The central question of this study is: what aspects of legal curricula in South Africa should be addressed to adequately prepare law graduates for the legal profession in the age of AI? The discussion is structured into three parts. The first part consists of a consideration of the relevant skills that are needed for law graduates in the age of AI. The second part evaluates the various quality standards documents on legal education in South Africa against the findings in the first part. The final section will propose recommendations for curriculum reform. This paper concludes that legal curricula must incorporate skills training aimed at the use of AI tools. The legal curricula should as a minimum include the use of AI tools as well as the ethical issues that presents itself with the use of AI.

Keywords: *Legal education, artificial intelligence, curriculum, ethics.*

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1. Introduction

The world has been revolutionised by the introduction of generative artificial intelligence (GenAI) to the public towards the end of 2022. What makes GenAI revolutionary is that it can perform tasks that were previously thought to only be performed by human beings, such as text and image generation, knowledge representation and text analysis, for example (Nowrozy and Jam, 2024). At universities, GenAI tools such as ChatGPT have been used for tasks such as language and grammar correction, information searches and text generation. The use of GenAI tools brings with it a host of ethical dilemmas including academic integrity, bias and privacy (Floridi, 2024; Mahmud 2024). The rapid introduction of GenAI questions the responsiveness of university curricula.

This paper focuses on legal education in South Africa. GenAI tools are increasingly being used by legal practitioners to draft documents and find relevant information (Magesh *et al*, 2024). The central question of this study is: which aspects of legal curricula should be adapted to adequately prepare law students for the legal profession in the age of GenAI?

The first part of the paper considers the context of legal education in South Africa and the requisite skills law graduates should have. Drawing from various studies, the second part of the paper considers the potential to use GenAI to develop some of the essential skills mentioned in policy documents on legal education. The last part recommends changes to legal curricula in South Africa.

2. Legal education in South Africa

The first democratic legal education in South Africa started in 1998 with the adoption of *The Qualification of Legal Practitioners Amendment Act* of 1997. The aim of democratic legal education was to provide quality legal education that was equitable and accessible (Gardbaum, 2015). Already, early on in the programme there were complaints from academics and legal practitioners that students were lacking

literacy skills such as writing and reading (Gardbaum, 2015). To address the concerns of various stakeholders a legal education summit was held in 2013 where a task team was constituted that would set up a standards document relating to skills and standard setting (Sedutla, 2013). The task team, after comment by relevant stakeholders and approval by the Council for Higher Education (CHE), set up a document that contained the required knowledge, skills and applied competencies that all law graduates should achieve at the end of their law degree. Students should have a basic knowledge of law subjects (LLB Standards, 2015). The skills and competencies, also known as graduate attributes, that law students should demonstrate include the following: critical thinking skills, research skills, ethics and integrity, communication skills and literacy, numeracy, information technology, problem solving, self-management and collaboration, transfer of acquired knowledge, agency accountability and service to the community (LLB Standards, 2015).

All LLB programs in South Africa were reviewed during 2015-2016 using the LLB standards as a guiding document. The report by the review panel found that knowledge of law was not found to be problematic (LLB Review Report, 2018). While most universities had various interventions aimed at research and writing, it did not always translate into success where students were not assessed on reading and writing in individual modules (LLB Review Report, 2018). Half of the law faculties were found to be lacking in the development of critical thinking (LLB Review Report, 2018). Instances where critical thinking was lacking the panel noted the presence of rote learning and a lack of robust class discussions (LLB Review Report, 2018). The report noted that there were no modules dedicated to computer literacy and based on the self-evaluative reports by the different faculties it was taken as conclusive that training was sufficient. Amongst the recommendations made by the panel was that more assessments should be set that assess reading, writing and research skills.

The abovementioned policies and reports indicate the essential skills for law students. The documents are close to silent on the ethical use of AI tools or other technological systems. This is understandable, as these tools have only been used in the last three years. However, given the rapid rate of change and development law schools should start thinking about how AI tools can enhance graduate attributes. Law schools should also continuously consider which skills remain relevant for the working world students will enter. The next section considers the potential of AI tools to enhance some of the essential skills of law students.

3. Potential skills enhancement with GenAI

As alluded to above, writing is an indispensable skill for a lawyer. Good writing is also part and parcel of good communication. For many years academics and legal practitioners in South Africa have lamented that the writing skills of law students are not up to standard (Crocker, 2018; Bangeni and Greenbaum, 2019). Some authors have argued that GenAI tools can be used for more routine tasks in relation to writing including drafting outlines, bouncing ideas, technical corrections, stylistic and grammar corrections (Costa *et al* 2024; Regalia, 2024; Alkamel and Alwagieh, 2024). In the South African context, most law students are not native English speakers. Tools such as Grammarly can be useful in assisting students to convey their ideas. If GenAI can be used for the routine tasks, such as language correction, more time can be freed up in lecture halls to focus on higher order skills such as critical thinking. Are there some possible dangers if we leave all our writing up to GenAI? There could potentially be. Writing is a process of editing and correcting, a first draft is rarely what any student submits for an assessment. Tu *et al* (2024) adds that writing is a creative process and students might lose out on the development of a (better) legal argument in the drafting process when using GenAI. Writing should be seen as a form of thinking (Tu *et al*, 2024). While GenAI can be used to correct grammar and stylistic errors in the writing process there might be potential harm if AI is expected to do the bulk of legal argumentation. GenAI should not be used as a substitute for the writing process but as tool to enhance the final product.

As mentioned above, law graduates need to demonstrate the ability to engage critically and analytically with law. The LLB Standards document includes under critical thinking skills the ability to 'analyse, synthesize, judge critically and evaluate problems and situations' (LLB Standards, 2015). One of the concerns about the use of GenAI tools by students is that over-reliance on it will lead to a decline in critical thinking and analytical skills (Costa *et al* ,2024; Prakasha and Nair, 2024). GenAI can be used to stimulate critical thinking. Bliss (2024) suggests asking students to prompt an answer from GenAI whereafter they are allowed to evaluate the answer given. Although GenAI is used such an assignment still develops critical thinking and analytical thinking skills. Furthermore, such an exercise acquaints students with the use of AI. Dietis (2024) suggests prompting AI to produce arguments for and against a topic and asking students to give a (substantiated) answer as to which they prefer. Youn, Park and Murphy (2024) suggest giving an article to students to read and summarise and then prompting a summary from GenAI on the article whereafter students critically engage with that summary. In this way students must evaluate the

answer given by AI. Students might also be encouraged to use AI in a socratic method (Orynnbassarova and Porta 2024). In other words, the better the quality of their questions, the better answers they will receive. Bliss (2024) suggests that law students revise and refine a draft answer produced by AI, and using AI has a debate partner rather than naively accepting the first answer given. There are some aspects to be mindful of when using GenAI tools to enhance critical thinking. Darwin *et al* (2024) note that although GenAI has the potential to enhance critical thinking, it could create 'echo chambers' as it is limited in the number of perspectives that it can produce. Other limitations identified by Darwin *et al* (2024, 15) in their study include oversimplication of concepts of AI and lack of personalisation.

There are potential benefits of using Gen AI for the development of research skills. Gen AI has been beneficial in the initial brainstorming phase of research (Songkram *et al*, 2024). An additional benefit of GenAI is that it can speed up productivity during the research process. Traditionally, a person may have to use search engines to look up literature on a topic. With the use of GenAI a person may, for example, prompt the search of the most notable works on a topic. On some search engines, Gen AI is being used to summarise key points or findings in publications. These tools can greatly assist with the initial process of finding and identifying literature. Gen AI might also be able to assist with creating an outline for a research paper. AI-powered search engines are already being used in legal practice. Examples include LexisNexis AI and Westlaw. Clearing up time with more routine tasks creates time for the actual writing process. The most significant danger in using GenAI for finding sources is that it might hallucinate and the sources might be incorrect. Sources provided by GenAI should always be verified.

Law students need to be equipped with problem-solving skills. Traditionally, clinical legal education has been used to expose students to real-life legal problems and scenarios. Moot courts and mock trials have also been used to expose students to court setups and protocols. However, law modules usually have a large amount of students and doing mock trials with large groups of students can be time-consuming. For this reason, virtual courtrooms (powered by AI) has been used by Law Faculties. The University of Johannesburg has designed a virtual courtroom that confronts students with real-life scenarios in courtrooms.

4. Ethical considerations

It is of utmost importance that law graduates conduct themselves with ethical integrity. One of the biggest challenges with GenAI is the risks it poses to ethical behaviour. The biggest risk facing students is academic integrity. It is quite easy for students to submit an assignment question into GenAI and to submit an answer as is. Plagiarism has existed even before the arrival of GenAI. However, there is no reliable tool to detect the use of AI. It should be noted that universities and institutions have differing policies on the extent to which GenAI can be used. Some universities ban it completely, while others encourage its use.

In South Africa, existing codes of conduct and policies are used to regulate unethical behaviour in relation to the use of GenAI. Two cases have dealt with the use of generative AI by legal practitioners in South Africa. In *Parker v Forsyth*, the attorney had sent a list of non-existing citations to the defendant before it was heard before a court. The citations were fictitious and it was found that Chatgbt was used. The court found that although there was no deliberate misleading of the court, that the parties were nevertheless "overzealous and careless". The matter was reported to the Legal Practice Council.

In the second matter, *Mavundla v MEC: Department of Co-Operative Government and Traditional Affairs*, one of the parties before the court presented citations that were fictitious. The court referred to the duty on legal practitioners not to mislead the court. The presiding officer in this matter emphasised that technology should be used with independent reading. The presiding officer further emphasised that it remains the responsibility of legal practitioners to verify information that is used and if this is not done it is unprofessional. The matter was referred to the Legal Practice Council.

In these two cases, the existing code of conduct was used to deal with the matter. It remains to be seen whether any specific code in relation to the use of AI will be created.

5. Curriculum reform for AI?

The discussion above, raises the question whether law curricula need to be reformed in order to deal with the challenges and risks posed by GenAI. It is a fact that law graduates will be entering a working world where AI is already being used. In addition, as with other ethical dilemmas, there is the risk of using AI in an irresponsible manner. In South Africa, the LLB standards document speaks to requisite skills and indicates the importance of ethical behaviour. The above-mentioned cases illustrate that existing principles can be used.

However, we are in the early stages of the use of AI. Law schools will have to consider the skills that are necessary for the next generation of law students. It might be less of the old skills and more new skills, such as learning how to operate AI-operated search tools.

Based on the above discussion, the following recommendations are made. Firstly, universities should have a clear policy on the use of GenAI. The policy should not simply state that GenAI should be used ethically. Ethical use should be explained. It is suggested that law schools incorporate the ethical use of GenAI into courses on academic integrity.

Secondly, all academic staff should be trained in the ethical use of GenAI. Since it is encouraged that lecturers incorporate GenAI components into their coursework, it only follows that lecturers convey the correct information to students.

Thirdly, as discussed above, there are various ways in which skills for future lawyers can be enhanced by the use of GenAI. Lecturers should, however, give clear written instructions on the extent to which AI can be used. It is also recommended that GenAI be used in real time in the classroom before students do so independently. Students should be properly briefed about assignments related to AI and the risks of using AI (Bliss 2024).

In the last instance, it is recommended that there be a variety of assessments. While it is encouraged that the ethical use of GenAI be used, other assessments such as written tests can still be utilised.

6. Concluding remarks

GenAI tools have infiltrated university and work life. In the short time that it has existed, it has been used exponentially. Law graduates will be confronted with GenAI in their professions. This paper has found that it is possible to use GenAI in a manner that enhances existing skills needs while also exposing students to the use of GenAI. It is recommended that assignments are used which are aimed at practicing skillful working rather than a blanket prohibition. Skills that can be enhanced include writing, research, problem-solving and critical and analytical thinking. It is imperative that law curricula incorporate courses that inform students of the ethical use of GenAI tools. While GenAI can perform tasks that previously only humans could do, it does not replace humans and GenAI cannot be used ethically without human oversight.

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STEM AND SPACE: ADVANCING REAL WORLD AEROSPACE TO PRE-COLLEGE STUDENTS

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Abstract

Young children have an innate interest in science. They behold the world around them, are natural questioners, and are not content to simply observe; they must utilize all their senses to make sense of what they perceive. Primary educators can and must capitalize on this interest by immersing students directly into not only hands-on applications, but also into the collaborative and communicative aspects that make up the 21st century skillset. This is particularly true if educators are to encourage and support underrepresented groups to enter STEM fields. This paper seeks to offer project-based STEM activities with a focus on aerospace to excite elementary and secondary students. Moreover, it suggests that creating a science identity early on, particularly for underrepresented populations such as students of color, lower socio-economic status, and females on whole is imperative to increase STEM career participation by using Social Cognitive Career Theory (SCCT) Additionally, there is a focus on equipping teachers to reflect on their own practices as well as offer suggestions for implementing real world STEM in their classrooms. The authors have an active and successful aerospace program and lead the Wolfpack CubeSat Development Team, which is used as a model. Teammates in the middle school level have been selected twice by NASA for their CubeSat Launch Initiative (CSLI), with a third flying last year (2024) with Firefly. Because of the work of older students, younger students are exposed to the real work of space through mentorship. While satellite teams may appear out of reach for school-aged children, there are activities to scaffold the scientific concepts associated with aerospace. Teachers should take part in learning along with their students via professional organizations and professional development.

Keywords: *21st century skills, CubeSats, experiential learning, project-based learning, social cognitive career theory.*

1. Introduction

Traditional educational models in America, particularly in the case of STEM coursework, have been notoriously lecture-based, with the focus on the instructor and/or a curriculum that may well not be keeping up emerging trends in a fast-moving industry such as aerospace and engineering. Early on, education in America was considered critical to form and sustain a democracy, creating its citizens to uphold those founding principles (Coulter & Herman, 2020); however, as early as the 1900s, theorists such as John Dewey noted a disconnect between what education was providing and what society actually looked like. Thus began of the Progressive movement, which embodied earlier educational theories like that of Socrates, who valued the role of inquiry. Inquiry can only happen when students are partnered with their teachers in a way that creates real-world opportunities. Coulter & Herman (2020) further point out that if education is to reflect society, "highly autocratic forms of education must change."

1.1. The Aerospace and Innovation Academy/Wolfpack CubeSat Development Team (AIA/WCDT)

Created by the authors, the Aerospace and Innovation Academy (AIA) and Wolfpack CubeSat Development Team (WCDT) create unique and distinctive STEM opportunities for middle- high school students through an aerospace focus. Since creating the first U.S. middle school CubeSat team in 2015, Simmons led the WCDT to design, build, and launch three spacecraft, and his Wolfpack are building a fourth to be launched in late 2025. Simmons initiated a new paradigm in traditional gifted education: blending strong connections with industry with academia. His unique philosophy, "BLUE-SKY Learning", coupled with experiential and project-based learning in a real-world setting provides students with myriad ways to communicate their extensive, complex aerospace content.

The first middle school team selected by NASA's CubeSat Launch Initiative, Simmons began in 2015 with a small group whose first mission was "to design, build, test, and fly a CubeSat to space within three years." Through a series of incremental deliverables (emulators, remote sensing tethered balloon payloads, high altitude balloons, etc.) students gained skills and confidence. The 1U WeissSat-1 investigated extremophile bacteria and was launched in 2018 as part of the SSO-A mission. ~13K telemetry packets received during its operational phase. In 2018 The second WCDT mission selected by NASA was the CapSat-1, a 1U designed to validate a capacitor-based electrical power system. Launched in 2022, this CapSat-1 was delivered to the International Space Station for deployment. In 2024 the WCDT saw their third launch with FlipSat-1, a 0.5 hosted payload in the NSL TROOP platform. This mission is evaluating bitflip mitigation strategies and employs micro:bit processors. The Wolfpack's fourth, the WolfSat-1, will launch in late 2025 aboard a Firefly Aerospace Alpha launch vehicle and will investigate the ability of the bacteria *Vibrio natriegens* to digest single-use plastic components on orbit. The authors recognize the successes their program while at the same time acknowledging there are challenges in shaking up the status quo, particularly in the American educational model.

Figure 1. Left to right: NSL's HAB EyePod, HAB launch, WeissSat-1, and SSO-A Falcon-9. Images courtesy of Kevin Simmons.

1.2. The Current State of STEM Education and its Impact on Workforce Development

In 1984, David Kolb built upon this notion with his focus on experiential learning, a method that would build the workforce of the future. A truly progressive model of education is one where innovation takes place by employing project-based learning, a growth mindset, and essentially connecting industry to the classroom. Washko, Edwards, and Washko (2019) note there is a "push to transform engineering education from its traditional roots to a more interdisciplinary approach." They go on to suggest traditional instructional models currently being utilized create "a large gap between the demand for citizens prepared to work in STEM fields and inadequate preparation in both K-12 and higher education." More and more, students report having limited life and career-related skills like creativity and flexibility, which are not taught in traditional curricula. A gap likewise exists between white students and students of color as well as rural and urban students who enter and stay in STEM fields. If more is not done to reduce these gaps, "the United States will lose quality jobs to other nations due to an underprepared workforce" (Sheffield, Morgan, & Blackmore, 2018). Sheffield, *et al* further note experiential, hands-on learning is especially helpful in impacting communities of concern. Their study focused on rural communities, but others have been done on indigenous and other underrepresented communities as well. This shift in educational approach can and should happen with a focus on experiential STEM, and, the authors would maintain, by scaffolding instruction with tools that incrementally build upon themselves to bring about larger learning opportunities. One of the best ways to do this from an aerospace educational perspective is through the use of High-Altitude Balloons (HAB) as a precursor to CubeSats. While CubeSats are a lofty goal for secondary students, lessons using emulators and HABs can scaffold student learning at a lower cost.

1.3. STEM Identity and Underrepresented Populations

There are many factors that add to the issue of underrepresentation in STEM. One area of concern is in science identity formation. In particular, people of color, those from lower socio-economic status, and women continue to struggle to form a personal science identity. These trends for underrepresented groups have been studied from several aspects to determine why students start off interested in the science and math fields but end up not following through with degrees in college, nor pursuing a career once a degree is received. In part, this retention issue is due to a lack of belonging and a lack of a science identity. Using social learning theory and social cognitive career theory, the authors observed that women's preconceived notions of gender roles or identity influence student learning, particularly with regard to what they believe women in STEM fields can achieve. They conclude that women with role models in STEM fields develop enthusiasm and confidence and no longer feel relegated to traditional female stereotypes in STEM careers.

While there needs to be a major overhaul in STEM education that addresses these issues, fostering a science identity early on will go a long way as identity formation starts as early as infancy. In early academics, interest and development are correlated with later educational pursuits. Hachey (2020) points out "schools are powerful spaces for identity work" and it is here, where students who might not experience or have reinforced a science identity at home, may be engaged. Educational reform, particularly with a STEM bent, has long been a goal particularly in the United States where student performance in STEM subjects continues to lag behind that of other countries. Now, more than ever before, there is a movement to embrace the twenty-first century skills, as opposed to the traditional passive learning approach, as an answer to America's declining STEM performance. To mitigate the issue of student passivity, it is essential to engage students early and often in real-world, hands-on learning that goes beyond the classroom.

1.4. Social Cognitive Career Theory and Experiential Learning

Social Cognitive Career Theory (SCCT) suggests that, early on, students begin to formulate an identity that ultimately is reflected in career choices. To bolster the STEM pipeline, it is imperative to continue the formation of science identity for all students. SCCT is a vocational psychology dealing with "career interests, goals, actions, and performance in relation to domain specific self-efficacy, outcome expectations, as well as contextual and background variables" (Mau, Chen, & Lin, 2019). SCCT shows that students who identify with a certain role, or who "feel" successful in a specific area are more likely to pursue careers in those fields. Erikson's theory of childhood psychology suggests that children go through several stages in developing an identity. Particularly of note for this research are the competency and fidelity stages which occur from ages 5-12 (Mcloud). Since students are developing an understanding of what they do well (efficacy) along with a sense of fealty to the identity to which they identify (belonging), it makes sense to augment classrooms to provide hands-on experiences that provide both group and personal science identity formation. Children often begin formulating identity long before they attend school based on their roles and interactions at home (Jelic, 2019). Dou, Hazari, *et al* (2019) note many scientists claim curiosity, family encouragement in STEM, and access to STEM media played an important motivating factor in how they viewed themselves as "scientists; however, many underrepresented populations do not have this luxury. Schools can help to close this gap.

David Kolb, in 1984, built upon the pedagogy of Progressivists Dewey and Erikson to create his Experiential Learning Theory, which essentially suggests students learn by "doing." Students who participate in real-world learning experiences first grasp knowledge in a concrete fashion, then reflect on connections and adjust thinking based on findings, and ultimately students can use their learning in new ways, making it their own. The Aerospace and Innovation Academy provides experiences such as those outlined in this paper through their Wolfpack and Space Clubs and offers the models herein as proven means to augment STEM applications that can also be done in general classrooms.

1.5. High altitude balloons in engineering

Before students can imagine launching satellites, a more accessible lesson comes first. The use of High-Altitude Balloons is not necessarily new to engineering programs around the United States, but they have often mostly been limited to universities and are only in recent years becoming more ubiquitous. McKaig, Caro, Hyer et al (2019) note, HABs had their start over a century ago with scientists collecting data from the stratosphere for weather and radiation applications. As time went on, HABs were viewed as an academic tool, but even then, they were somewhat limited to atmospheric science courses where students would design, launch, recover their payloads as well as analyze data and present results (Cheng, Gendron, Ziffle, Gerhard, 2019). Cheng, *et al* further note that post-secondary institutions have been implementing HAB experiments since the early 2000s. In their research, the real-world, experiential learning model engaged students beyond the lesson, and other institutions saw the value of implementing similar experiments with students as early as middle school. Now, there is a general perception that High Altitude balloon missions are reasonably accessible vehicles for younger engineering students to hone their skills related to electronics, communications, and mission planning. Not only are HABs more cost-effective, but they can also be reusable, which adds to their desirability. Additionally, HABs can be launched by individuals without much assistance, which enables more classrooms to employ this tool. Success with HABs often leads to the use of emulators and CubeSats in pre-college settings.

1.6. NearSpace education

As more organizations embrace the importance of HABs as an educational tool, there is an increase in programs that successfully use them. Providing HAB hardware and lessons, NearSpace Education (NSE) created the "Pathways to Space" (PTS) curriculum and technology to better recruit,

engage, and prepare students in the STEM pipeline. Scaffolded for ages 10-college, the PTS central theme is the tiered development of hardware culminating in either HAB missions or CubeSat launches to Low Earth Orbit (LEO). NSE, and parent company NearSpace Launch (NSL), personnel are responsible for hundreds of successful HAB and orbital missions. NSE's HAB System takes students with little to no experience to the point where they interact with their own payloads at the edge of the stratosphere. This system is ideal for training the next generation STEM workforce and can be adapted to meet the training needs of both young adults and pre-college students. NSE's Pathway To Space include the following elements: hardware, curriculum, infrastructure, and Support. Hardware consists of the EyePod element which maximizes customer recovery over 99.9% of the time, lithium batteries, and cameras. Curriculum provided by NSE is tiered and asynchronous content is both scalable for post-secondary and vocational training and aligned to 6th-12th grade Science standards. The infrastructure includes a near real-time dashboard, accessible via internet for both the development phases of hardware and the entirety of the flight. GPS coordinates, altitude, external temperature, rates of ascent and descent, battery voltages, etc. may be monitored in near real-time. NSE also provides FastBus and ThinSat spacecraft platforms which utilize the Iridium network, allowing for coverage at all orbital inclinations. These highly reliable NSL CubeSat chassis are well known for their on-orbit performance.

1.7. The A3Sat project

While the use of CubeSats is a highly effective and disruptive educational tool, the cost and training are often prohibitive. The emergence of CubeSat emulators are logical steppingstones to orbital spacecraft. One such emulator is the A3Sat from the Institute for Earth Sciences in Palmyra Cove, New Jersey. A3Sat refers to Acquire, Analyze, Apply remote sensing data, and provides students a 1U form factor containing a Raspberry Pi, cameras, Enviro+ suite of sensors, dashboard, and accompanying curriculum. The A3Sat Project was designed to broaden pre-college student participation through coding, engineering, data science, geosciences, and electronics by providing a realistic CubeSat A3Sat is also especially affordable for secondary schools, and is designed for use as a HAB, tethered balloon, kite, or drone payload. To further replicate the process of launching and utilizing a CubeSat, a ground station app/software was developed to communicate with the A3Sat while in flight. The desktop software application, compatible with both macOS and Windows, and is able to communicate and transfer various data through Python socket communication. \

2. Material and methods (PBL, experiential learning with a BLUE-SKY philosophy)

The use of HABs and CubeSats as educational tools requires a Project-Based Learning (PBL) methodology. PBL instruction encompasses a variety of elements including Role-playing, real-world scenarios, blended writing genres, multiple reading genres, authentic assessments, authentic audiences, and real-world expertise brought into the classroom (Wolpart-Gawron, 2015). Additionally, the educator authors further employ a BLUE-SKY philosophy, an extreme growth mindset, and a team built around a rigorous task to develop student resilience or grit. By doing so, younger students are prepared to be more academically risk-tolerant and creative.

2.1. HAB mission methods

The general process an HAB mission begins with posing the science question upfront. The science question posed by the students then becomes the mission statement around which all hardware and procedures are derived. The payload development step begins with identifying the sensors that will accomplish harnessing the desired science data. In our example, sensors that will measure temperature, altitude, and incident solar radiation, will accomplish the desired objective. Next the central processor is selected to facilitate connection of the selected sensors to the radio. The selection of the power source along with its control interface follows thereafter completing the payload design phase, in a rudimentary manner. Following the completion of the payload design, acquiring the payload components, building an enclosure, and placing the payload components in it, protecting them from the external environment, constitutes the HAB payload. Finalizing the payload design provided the total mass, which is needed to determine balloon lift, burst height, balloon type, etc. Choosing the flight ceiling altitude is highly mission specific, but in general, HAB missions reach 28-30 km altitudes, with nominal 5 m/s ascent and 7 m/s descent rates. On launch day the students utilize a 'Go-No Go' checklist, re-run simulation software to more accurately predict the landing site and contact the Federal Aviation Authority. Following payload recovery, students download data and analyze it according to the mission statement.

3. Conclusion

To address the "greying" of the American STEM workforce, more must be done to engage students earlier in experiential aerospace. The potential to benefit a larger number of and more diverse students is already being realized with the adoption of HAB and emulator curricula. When combined with the student's desire to build small satellites such as ThinSats and CubeSats, these systems have been very effective in strengthening student interest towards STEM careers. Ambitious student teams have demonstrated multiple successes through sustained HAB programs, and by launching SmallSats to space. One of the most educationally exciting aspects of the NewSpace Economy is the access to these authentic experiences available to middle and high school students. As industry and academia have embraced the utility, affordability, and scalability of the pico- and nano-satellite form factors, an abundance of financial investments has spawned a cottage industry capable and willing to expand their products and services to even younger student markets. Overall, the use of High-Altitude Balloons as a precursor to satellites in the classroom is exciting and increasingly accessible. When students engage in experiential learning with real-world applications, they retain more content and are more likely to identify themselves in a STEM field. Thus, it is especially important to expose younger students to this kind of learning. While the cost of CubeSats remain out of reach for most educational institutions, HABs offer more affordable but similar learning opportunities. With increased teacher training and adequate funding, these authors envision a strengthening of the STEM pipeline with a strong focus on the robust aerospace industry.

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TEACHERS' TPACK: EVALUATING THE STRENGTHS AND WEAKNESSES OF ONLINE ASSESSMENT IN K-12 SCIENCE INSTRUCTION

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Abstract

The transition to online learning has prompted a critical re-evaluation of assessment methods in K-12 science education, particularly in secondary school physics. This paper examines the evolution of online assessment, its potential benefits, and associated challenges. We provide an overview of traditional assessment methods in science education, discussing their strengths and limitations. The integrative methods for review of literature were adopted to examine and comprehend the definitions and descriptions and approaches to TPACK. Studies. The discussion then shifts to online assessment, highlighting its advantages and comparing it to traditional approaches. Various online assessment tools and platforms available to educators are explored, alongside considerations such as technical issues, academic integrity, and meaningful learning experiences. Additionally, this paper examines opportunities offered by online assessment, including leveraging data analytics, enhancing formative assessment, increasing student engagement, and enabling personalized assessments. Best practices for designing effective online assessment tasks are provided, emphasizing faculty development and training. Grounded in the Technological, Pedagogical, and Content Knowledge (TPACK) framework, this paper contributes to the growing body of knowledge on online science education assessment practices, offering insights for educators optimizing assessment strategies in digital environments.

Keywords: *TPACK, science instruction, online assessment.*

1. Introduction

The integration of Technological, Pedagogical, and Content Knowledge (TPACK) in digital-based learning is a crucial 21st-century teaching skill. Modern society's increasing reliance on Information and Communication Technology (ICT) has driven transformations in educational objectives, student learning needs, and workforce skill requirements (OECD, 2016; Freiberger, 2017). According to Santos and Castro (2021), TPACK enhances instructional delivery by integrating technology into classroom practices. The TPACK framework consists of three core components: technology, pedagogy, and content. Studies (e.g., Yeh, Lin, Hsu, Wu, & Hwang, 2015; Memiş, Et, & Sönmez, 2023) emphasize the growing importance of developing TPACK in teacher education programs. The shift to online learning environments has necessitated incorporating online assessment practices. Assessment plays a vital role in student learning experiences, instructional effectiveness, curriculum evaluation, and school performance (Brown, 2022). Effective assessments support formative improvements and summative evaluations of teachers, schools, and administrations. Given the significance of assessment, this paper explores its historical evolution, current practices, and future possibilities.

2. Objectives

This study is framed within the TPACK framework and examines the evolution, benefits, and challenges of online assessment in K-12 science education. Specifically, it addresses:

- The concept of assessment and its impact on learning objectives.
- Traditional assessment and common types used in science education.
- Online assessment, its rationale, and common tools in K-12 science instruction.
- Challenges and benefits of online assessment.
- Guidelines for designing effective online assessments.

3. Methodology

The integrative review of literature was adopted to examine and comprehend the definitions and descriptions and approaches to TPACK. Studies such as Torraco (2005) and Whittemore and Knafl (2005) identified integrative review as a particular review method which analyzes and synthesizes literature with the purpose of broadly comprehending the particular topic. These methods of review are suitable for re-evaluating studies on emerging topics in diverse disciplines such the integration of technology to instructional activities, so that robust comprehension of the discussion, analysis and application of TPACK in literature could be achieved.

4. Discussion

4.1. The concept of assessment and its impact

Assessment has been variously defined in literature. Wessel (2024) describes it as the systematic collection and analysis of data to infer student learning outcomes, instructional effectiveness, and curriculum efficacy. Amua-Sekyi (2016) considers assessment a set of activities undertaken by teachers and students to generate evidence for improving instructional practices. This includes assignments, quizzes, term papers, reports, hands-on exercises, and discussions. Yang, Chiu and Yan (2021) asserts that assessment provides immediate feedback to teachers, enabling them to tailor instruction to students' learning styles and needs. Over time, assessment has evolved from traditional methods such as pencil-and-paper tests (Atasoy & Kaya, 2022) to technologically integrated approaches. This evolution necessitates a comparative analysis of traditional and online assessment practices.

4.2. Assessment approaches in science education: a comparative analysis of traditional and online methods

In science education, assessment plays a crucial role in measuring student learning, guiding instructional decisions, and ensuring that students meet curriculum standards. Traditional assessment methods, such as standardized tests, multiple-choice exams, essays, and laboratory reports, have long been the standard in education. These assessments provide structured and reliable evaluations of students' knowledge and skills, offering several advantages, including:

Reliability: Traditional assessments, especially standardized formats, ensure consistency in the evaluation of student performance, providing comparability across diverse student populations.

Ease of Implementation: The familiarity with traditional assessment methods makes them relatively straightforward to implement. Teachers and students are accustomed to these formats, reducing the need for extensive training or resources.

Curricular Alignment: Traditional assessments are closely aligned with curriculum standards and learning objectives, making it easier to gauge whether students have mastered the material.

However, traditional assessments also have significant limitations:

Limited Feedback: These methods often result in delayed feedback, which can hinder real-time adjustments in student learning. Without timely corrections, students may continue to misunderstand key concepts.

Fixed Assessments: Traditional assessments typically follow a one-size-fits-all approach, failing to accommodate the diverse learning styles and individualized learning paths of students.

Memorization over Understanding: Rote memorization is often emphasized, which may undermine deeper, conceptual understanding and critical thinking. Students might perform well on tests but lack the ability to apply knowledge in real-world contexts.

4.3. The rise of online assessment in science education

In recent years, online assessment has emerged as a powerful alternative to traditional methods. With the integration of digital tools, online assessments offer dynamic, interactive, and data-driven evaluation systems that can enhance learning and teaching experiences. The rationale for embracing online assessment includes several key benefits:

Enhanced Engagement: Online tools, with their interactive features, create more engaging learning environments that are accessible to a wider range of students. Through gamified elements and interactive simulations, students are encouraged to participate actively in the learning process.

Immediate Feedback: Automated grading systems in online assessments provide real-time feedback to both students and teachers, enabling timely interventions and adjustments to instructional strategies.

Personalized Learning: Adaptive assessments adjust the difficulty level based on the student's performance, ensuring that the content is appropriately challenging for each learner.

Common online assessment tools used in K-12 science education include platforms like Google Forms and Microsoft Forms for multiple-choice and short-answer questions, as well as Kahoot, and Quizizz, which offer gamified assessments that boost student engagement. Learning management systems such as Moodle and Blackboard support quizzes, assignments, and discussions, while interactive tools like PhET Simulations enable students to engage with virtual science experiments and assessments, enhancing their understanding of scientific concepts.

4.4. Challenges and limitations of online assessment

Despite its many advantages, online assessment is not without its challenges. Some of the key obstacles include:

Technical Limitations: Issues such as poor internet connectivity and lack of access to digital devices can hinder the effective implementation of online assessments, particularly in under-resourced settings.

Academic Integrity: The anonymous and remote nature of online assessments raises concerns about cheating, plagiarism, and unauthorized assistance, requiring additional safeguards to maintain fairness.

Student Engagement Variability: Online learning environments require self-regulation, and not all students possess the necessary skills to stay engaged and motivated, potentially leading to disengagement and lower performance.

Assessment Design Complexity: Designing effective online assessments requires careful planning. Teachers must consider the variety of question types, the integration of interactivity, and the feedback mechanisms to ensure that assessments are both effective and engaging.

4.5. Benefits of online assessment

Despite these challenges, online assessments offer several distinct advantages over traditional methods:

Scalability: Online platforms allow educators to assess large numbers of students simultaneously, which is particularly useful in larger classrooms or remote learning environments.

Automated Grading: The automation of grading processes reduces the workload on teachers and enhances efficiency, allowing them to focus on providing personalized feedback and support.

Data-Driven Insights: Learning analytics from online assessments provide educators with actionable insights into student performance, helping them identify trends, areas for improvement, and instructional gaps.

Formative Feedback: Online assessments enable continuous, formative assessments that support adaptive learning. Students can receive ongoing feedback, which helps them improve and refine their skills over time.

4.6. Best practices for designing effective online assessments

To maximize the benefits of online assessment in science education, educators should follow these best practices:

Align Assessments with Learning Objectives: Ensure that online assessments are designed to measure the intended learning outcomes, helping students focus on mastering key concepts.

Incorporate Multiple Assessment Types: A mix of assessment formats, including quizzes, assignments, discussions, and interactive simulations, can cater to various learning styles and preferences.

Leverage Data Analytics: Utilize the data provided by online platforms to monitor student progress and adjust instruction accordingly, identifying areas where students may need additional support.

Ensure Academic Integrity: Incorporate tools like plagiarism detection software, randomized question banks, and proctoring features to maintain the integrity of online assessments.

Provide Clear Instructions and Feedback: Ensure that students understand the expectations for assessments and receive clear, timely feedback to support their learning journey.

Both traditional and online assessment methods have unique strengths and limitations, and the key to effective science education lies in selecting the right approach for the specific context and learning objectives. While traditional assessments offer reliability and ease of implementation, online assessments bring enhanced engagement, immediate feedback, and personalized learning opportunities. By carefully integrating both methods and adhering to best practices for assessment design, educators can foster a more engaging, inclusive, and effective learning environment for all students.

5. Conclusion

The integration of online assessment in K-12 science education presents both opportunities and challenges. While online assessments offer benefits such as scalability, immediate feedback, and data-driven insights, they also raise concerns about technical access, academic integrity, and engagement variability. Grounded in the TPACK framework, this paper highlights the need for professional development to equip educators with the necessary skills to design and implement effective online assessments. Future research should explore best practices for balancing traditional and online assessment methods to optimize learning outcomes.

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DIGITAL LEARNING COMMUNITIES: A STREAMLINED APPROACH TO LEARNING SUPPORT IN TECHNOLOGY EDUCATION

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Abstract

Digital Learning Communities is a flexible, real-time student learning support initiative with a digital hub in the form of an active forum hosted in MS Teams. It is also supported through the on-campus drop-in learning support sessions facilitated jointly by academics and volunteer peer mentors. This initiative aims to integrate and streamline face-to-face and digital learning support activities to address the growing need for seamless, flexible, expertly moderated learning support mechanisms. This model can be instrumental in fostering learner engagement, collaboration and academic support by using an existing learning management ecosystem that is easily accessible to the learners and academics. Microsoft Teams, which emerged as a significant learning management tool when COVID-19 struck to support the continuity of learning activities, has since established itself as a leader and enabler in providing online, flexible and real-time learning support in various learning environments, including face-to-face, hybrid and distance education. Therefore, the efficient use of Microsoft Teams and its features to host the Digital Learning Communities platform is expected to help enhance peer interaction, mentorship and real-time academic assistance. This idea paper discusses the planned initiative's theoretical framework, platform design, and expected outcomes.

Keywords: *Learner engagement, collaborative learning, learning support.*

1. Introduction

On average, UK universities have around 6% dropout rates, ranging from 1% for highly ranked to almost 12% for other universities (Bryson, 2023; Smith, 2023; Roberts, 2023). The whole higher education sector is trying to address and solve this problem. However, the answer is not one set of actions or interventions.

The rise in popularity and adoption of hybrid delivery of university programs makes this issue even more critical. When students are engaged in learning via hybrid delivery arrangements, they are exposed to even more isolation, leading to a severe lack of adequate learning support and collaboration. Active community engagement and opportunities for collaboration are vital to stimulating an excellent learning experience and ensuring greater learning support amongst learners. To better understand this issue and address some aspects of student engagement and collaboration, we plan a Digital Learning Communities initiative at Queen's University Belfast (QUB) for its Business Information Technology (BIT) program.

The initiative is at its conceptual stage. The project plan is to implement the initiative's services for learners in the next academic year, 2025/2026. Business Information Technology (BIT) program is a unique program with students from across the School of Electronics, Electrical Engineering, and Computer Science (EEECS), as well as Queen's Business School (QBS) cohorts. As a result, learners in the program experienced varying levels of student support needs and requirements, which required following the different student support mechanisms/guidelines from two separate schools. Therefore, there is a need for a platform where learners can interact and collaborate with their peers and the academic teaching team to resolve any learning support-related queries when and where they are required. This initiative offers a flexible environment to promote peer-to-peer interaction, academic performance, and community building, aligning with global trends towards digital and flexible learning (Dziuban et al., 2018).

The instantaneous shift to hybrid and online learning in the higher education sector across the world, accelerated by the COVID-19 lockdowns, brought new norms to the delivery of education flexibly. However, it also presented educational practitioners and learners with challenges, such as limited social interaction and delays in academic support (Dhawan, 2020). These issues are significant for higher

education programs where multiple skill sets must be learned and developed in interdisciplinary fields like Business Information Technology, requiring technical and business knowledge. Studies have shown that the accessibility of peer collaboration and real-time academic assistance can bridge these gaps in learning support (Hrastinski, 2009). Therefore, this initiative aims to create a structured platform that enhances students' engagement, offering peer mentoring and collaborative learning spaces.

2. Theoretical framework

The Digital Learning Communities initiative builds on several well-established educational theories emphasising the importance of social interaction and peer learning in learning support.

2.1. Social presence theory

According to social presence theory (Dziuban et al., 2018), engagement with digital platforms/interfaces positively affects the sense of being with another person. Within the context of the Digital Learning Communities initiative, any interaction or engagement the learner has with the digital learning platforms to socially engage in learning support positively impacts the learning outcomes by providing the sense of being with another learner or the academic. When the learners feel socially present in the learning environment along with their peers, learning facilitators and academics, providing them with real-time learning support opportunities can greatly enhance student satisfaction and perceived learning. The proposed Digital Learning Communities initiative aims to increase social presence by fostering interactive and collaborative learning spaces within Microsoft Teams and on the planned regular drop-in learning support sessions.

2.2. Vygotsky's social constructivism

Social constructivist theory explores the role of social interaction in cognitive development (Vygotsky, 1974). There is an argument in the theory that learning is a socially situated process, and individuals and learners receive and create knowledge through participation and collaboration in group settings. Within the context of this initiative, Vygotsky's notion is supported by the Digital Learning Communities, with the help of learner engagement in peer discussions to signpost and co-create knowledge (Vygotsky, 1974). Peer mentoring, a core feature of the initiative, aligns with this theoretical approach, as senior learners/peers help guide their junior peers through academic challenges. However, this heavily depends on the potential uptake of volunteer roles by the senior peers in the program. This will require meticulous planning and some recognition and incentives for those willing to contribute to the initiative in different ways.

2.3. Peer-assisted learning

Peer-assisted learning (PAL) has long been recognised as a practical educational approach, particularly in enhancing learners' understanding of subjects involving complex and practical components (Topping, 2005). Research sheds positive light on the learners' success in improving their academic skills and social networks and creating a better learning support environment within PAL situations (Capstick, 2004). The proposed Digital Learning Communities initiative will establish a structured PAL program where senior peers provide academic guidance and a culture of mutual support and learning to their junior counterparts.

2.4. Socio-cultural approaches

While cognition-related theories have dominated much of the research on learning support in research across the learning support in all fields of study or topics including STEM, socio-cultural approaches have also made significant contributions. These approaches particularly stress on the role of social context, identity, and culture in shaping the learning experience, particularly in STEM education.

3. Platform design and structure

The Digital Learning Communities will be based on Microsoft Teams, leveraging its existing usage and seamless integration with other QUB learning management systems (like Canvas and Outlook). The platform's design creates an accessible, structured, dynamic space for student engagement and learning support.

3.1. Platform structure

3.1.1. Course and module specific channels. Each academic stage and the core modules (e.g., Programming and System Development, Databases, Modern Web App Development, User Experience Design, and Information Systems) will have their dedicated channels. These channels will be used for module-specific discussions, resource sharing, and project collaboration (Hrastinski, 2009).

3.1.2. Peer mentorship program. Senior students (stage 2 and beyond) will be invited to serve as peer mentors for first- and second-year students. This will not be a one-to-one arrangement but rather a more prominent and active contribution to the discussion topics from an active group of students who are either top performers or from higher stages. Research shows that peer mentoring helps bridge gaps in understanding and creates an inclusive environment (Ten Cate, & Durning, 2007). This structure will ensure that junior learners receive both academic and social support.

3.1.3. Collaborative workspaces. Collaborative channels will be created for project-based learning in either group or individual settings. These workspaces encourage real-time collaboration, problem-solving, and project management, helping students build essential teamwork and technical skills (Le, Janssen, & Wubbels, 2018).

3.2. Weekly communities of learning drop-in sessions

To extend the learning support and positive engagement among the learners, especially the ones with challenges in planning and managing their studies and deadlines or who may be facing any exceptional circumstances, communities of learning weekly drop-in sessions at a designated time and venue will be organized. This will be an opportunity for the students and the program leadership to act on any issues arising to be addressed on time. This will provide proactive learning support at a module or program level, helping students develop a sense of satisfaction.

3.3. Automatic enrolments and flexible participation

The plan is that starting in 2025/2026, all Business IT students will be automatically enrolled in the Digital Learning Community MS Teams group. Students can then customize their participation by subscribing to relevant channels for their year group and semester, ensuring that learners' engagement over the platform remains relevant, flexible, and user-friendly.

4. Objectives and initiatives

The Digital Learning Community aims to achieve several key objectives for the Business IT program in the 2025/2026 academic year. This represents a significant step forward in enhancing student engagement, collaboration, and academic support within the BIT program at Queen’s University Belfast. This initiative aligns with QUB’s vision of creating a student-centered, collaborative, and digitally enabled learning experience by fostering a digitally connected, peer-supported environment. The initiative will serve as an effort to enhance peer learning and student success in the digital age through careful research, design, and data collection.

4.1. Improve student engagement

Research shows that students, irrespective of the several learning environments, such as face-to-face, online, or hybrid courses, are often and always known to struggle with engagement at some level (Dziuban et al., 2018). This platform as a Digital Learning Community in MS Teams and the weekly drop-in sessions will serve as a central hub for student interaction, improving engagement through peer discussions, mentorship, and real-time expertly moderated academic support.

4.2. Provide prompt academic support

One of the main goals of the Digital Learning Communities is to reduce delays in academic assistance and learning support by enabling real-time support through peer mentors, faculty members, and program leadership staff. Students will likely benefit from on-demand academic help, which addresses a fundamental shortcoming in traditional office hour models (Hrastinski, 2009).

4.3. Promote collaborative learning

Collaborative learning has been shown to improve academic performance, particularly in group-based or individual take-home coursework settings (Le, Janssen, & Wubbels, 2018). The platform

will provide designated channels for those types of take-home coursework assessment component management, where students can collaborate and share ideas, fostering a better understanding of course material.

4.4. Foster strong community

Building a solid sense of community has been linked to higher retention rates and academic success in various academic settings, including face-to-face, hybrid and distance (Berry, 2019). This initiative aims to foster an engaging community at the program level where students feel connected and supported throughout their educational journey at different stages as they progress.

5. Data collection strategy and plan

A comprehensive data collection strategy will be implemented to assess the impact of the Digital Learning Community initiative. This strategy will help measure engagement, the overall academic performance of the student cohorts, and satisfaction with learning support among Business IT students. The research will take a mixed-methods approach, combining quantitative data (e.g., surveys, performance metrics) with qualitative data (e.g., MS Teams data and focus group interviews). The following methods will be employed to gather data on the initiative's effectiveness.

5.1. Academic performance and student satisfaction metrics

Microsoft Teams will provide data on student participation in the Digital Learning Community Hub. Metrics such as the number of messages posted, frequency of interactions, and involvement in peer mentoring activities will be tracked. This data will help quantify students' engagement and collaboration levels throughout the academic year (Hrastinski, 2009).

5.2. Engagement analytics from Microsoft Teams

One of the main goals of the Digital Learning Communities is to reduce delays in academic assistance and learning support by enabling real-time support through peer mentors, faculty members, and program leadership staff. Students will likely benefit from on-demand academic help, which addresses a fundamental shortcoming in traditional office hour models (Hrastinski, 2009).

5.3. Focus group

At the end of the academic year, a sample of BIT students will participate in focus group discussions to gain deeper insights into the student experience. These sessions will explore students' perceptions of the initiative, including the benefits of peer support, any challenges encountered, and suggestions for improvement in the next academic cycle (Berry, 2019).

6. Data analysis plan

Survey results and academic performance metrics will be analyzed using descriptive statistics, such as mean scores and percentage changes. Inferential statistics (e.g., paired t-tests) will be used to compare pre- and post-implementation outcomes, determining the initiative's impact on student engagement and performance [Johnson, Johnson, & Smith, 2014). The qualitative data from MS Teams engagement data, focus groups, and mentor logs will be analyzed thematically. This will identify key themes related to student experiences with the platform, including benefits, challenges, and overall satisfaction (Berry, 2019).

7. Anticipated challenges and mitigation strategies

Some challenges include possible student reluctance to engage with the platform or overreliance on peer mentors for academic support. To mitigate these issues, the initiative will offer orientation sessions, provide clear guidelines on the role of peer mentors, and encourage faculty to participate in the Digital Learning Community platform to ensure a balance between peer and instructor support (Topping, 2005).

Additionally, one anticipated challenge is adequate monitoring and moderation of the communications posted within the Digital Learning Communities forum. To address this, academic teaching staff will actively participate and manage this.

8. Research timelines

Implementing the Digital Learning Communities initiative and successive data collection processes will follow a structured timeline aligned with the BIT program's academic calendar.

Phase	Timeframe	Activity
Phase 1: Pre-Implementation	August – September 2025	Getting the Digital Learning Community Hub and face-to-face drop-in student support session activity plan and scheduling.
Phase 2: Implementation	September 2025 – April 2026	Data from Microsoft Teams and student satisfaction metrics collected in real-time
Phase 3: Post-Implementation	May - June 2026	Focus groups and academic performance data collected
Phase 4: Qualitative Research and Evaluation of the Initiative	June – July 2026	Analysis of the data together to refine the process for the next academic year.

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A CONSTRUCTIVIST PATHWAY TO REFRESHING MATHEMATICAL UNDERSTANDING

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Abstract

Many people find mathematics hard or even scary. The 2012 PISA report identified that roughly a third of students around the world feel actual panic having to do math -- a ratio that seems to be in line with figures found in the 1970s. The proportion of the population who do not panic from math but still find the subject difficult or unappealing is higher still. The global pandemic and remote education further exacerbated this problem. Meanwhile the world is becoming ever more mathematical and computational, increasing the expected quantitative understanding of the people to meaningfully participate in modern society. These dual effects cause an increasingly widening knowledge and skills gap that need to be addressed at all levels of education. This paper discusses an optional workshop provided for freshmen students before starting university at a small liberal arts school. The purpose of this was to increase mathematical understanding and reduce math anxiety. The approach integrated basic programming skills in the form of block programming with a re-discovering of mathematical thinking. The class started by introducing the creativity of programming, aimed at driving engagement and excitement about the experience. The class then leveraged the simple programming understanding gained at the beginning (especially variables, loops, conditional statements and functional concepts) to re-create basic mathematical concepts, thus connecting the students' interests and majors through block programming and computational thinking to algebraic thinking. The class empowered the students by being able to "create" mathematics, leading to a more integrated understanding. The mathematics content of the course reviewed the key pre-college level quantitative skills, specifically focusing on problem areas that often arise for freshmen university students (function concept, proportions). Utilizing a constructivist approach, the students didn't simply review these topics, instead they re-discovered them through constructing them themselves: a number is just a loop, the basic operations are just loops applied in sequence or embedded in each other, the prime factors of a number are just the previously constructed division operators inside a loop, etc.

Keywords: *Constructivism, mathematics education, programming education, mathematics refresher.*

1. Introduction

This case study discusses a voluntary, three-week long intensive summer mathematics workshop titled Math Success Academy for incoming students at a small liberal arts university in the western United States. The workshop was put together to address specific student needs that arose over time, but its implementation coincided with the arrival of the students who experienced the educational challenges caused by the COVID pandemic.

2. Background and context

The mathematics readiness of university students has been a concern for quite some time, well predating the COVID crisis that caused educational difficulties. It is a problem at that seems be experienced everywhere: at American Universities (Atuahene & Russell, 2016; Bowen, Wilkins, & Ernst, 2019; Harrington, Lloyd, Smolinski, & Shahin, 2016), at American Community Colleges (Abraham, Slate, Saxon, & Barnes, 2014; Cohen & Kelly, 2020; Park, Ngo, & Melguizo, 2021), but also around the world, for example Germany (Büchele & Feudel, 2023), Italy (Di Martino & Gregorio, 2019), Australia (Robinson et al., 2019), South Africa (van der Merwe, Groenewald, Venter, Scrimnger-Christian, & Bolofo, 2020) and the Philippines (Wenceslao, 2022). While a robust mathematics understanding is a key success factor in modern society, this problem is even more critical in study areas where mathematics understanding is expected or required, like the Business and STEM fields. Studies have shown that students entering with

sub-par mathematical skills are struggling to transition in Engineering programs (Bowen et al., 2019; Hieb, Lyle, Ralston, & Chariker, 2015; Moses et al., 2011), Economics programs (Büchele & Feudel, 2023) and even math programs (Di Martino & Gregorio, 2019; Geisler & Rolka, 2021), although GPA and "Calculus readiness" might not be the best indicator to identify at risk students (Pyzdrowski et al., 2013).

Some studies have shown that the students are aware that they are unprepared (Dlouhá, Pospíšil, & Dlouhá, 2022). Universities have been acting on this understanding for quite some time, as a number of them pursued summer "gap-closer" workshops. The results from these attempts were somewhat mixed. (Harrington et al., 2016) found that a free, online summer workshop improved retention and GPA among STEM students, and (Callahan & Garzolini, 2015) report that their summer workshop not only improved retention rates but also increased participation of female students in STEM degrees. (Pierce & Kypuros, 2015) found that offering a summer online course for students who already did pre-calculus but did not qualify for calculus ensured that participants in these programs performed similarly well as students who pre-qualified for calculus. On the other hand, (Hieb et al., 2015) found that introducing a summer algebra readiness workshop for students with low Algebra Readiness Exam (ARE) scores increased their ARE scores, but did not improve the students' performance in the following Engineering Analysis course. (Robinson et al., 2019) found that their summer math workshop increased the students' subjective feeling of preparedness, but they still performed poorer both in terms of completion and grades achieved than traditional students.

3. Description and structure of the Math Success Academy

The quantitative summer workshop was created as an optional experience for the students. The primary concern was to provide extra support to those who felt they needed it, but to not alienate students who felt prepared to start college in the fall. The summer is a relatively "expensive" time for students: many have to work to financially prepare for college, while others are spending a final summer with their families and/or friends before moving away from home, so making this experience mandatory was not considered optimal.

3.1. Modality and timing

The Success Academy was designed to be as unintrusive as possible. It was delivered over 3 weeks, for 4 days a week, in a synchronous online format. The classes were held between 9:15 and 11:45 each morning Monday to Thursday, with a 15-minute break halfway through. This allowed students to work in the afternoons and have two 3-day weekends for travel. The Success Academy was delivered during the three weeks prior to the week of welcome, when the students arrive to the campus and move into the campus housing. This meant that the workshop also provided a gentle on-ramp experience from the freedom of June and July to the brand-new college experience starting in late August.

3.2. Target audience

The primary target audience of the course were the Biology and Pre-med students. These students usually want to pursue graduate education in a medical school, and their interest is primarily in getting access to the healthcare field. Many of them do not have a lot of interest or affinity in quantitative pursuits, yet they have to pass a Calculus class. To support this community, the university created a course called "Applied Math for Scientists", that re-imagined the precalculus material through the lens of science education. The summer workshop primarily aimed to help students transition to this course, but it was open to all interested students. This open access approach proved helpful, since students from all career goals (business, programming, sociology, liberal arts, etc.) participated.

3.3. Goals and needs

The explicit goal of the program was to provide the students with an opportunity to review the relevant material in the hopes of improved performance in math classes. It was, however, further hoped that through the inclusion of accessible programming knowledge the students will gain insight into the fact that math is not something that you memorize, math is something that you do. The academy also wanted to provide the students with the toolset of computational thinking: an understanding that most problems can be solved if they are properly analyzed, deconstructed, algorithmized and verified.

3.4. Success Academy Structure

To achieve the Academy's goals, the workshop was based on the already successful pre-introductory programming courses developed at the university (Magitay-Becht & Das, 2024; Margitay-Becht & Das, 2023). These classes are aimed at students who are somewhat curious about programming, but are too intimidated to take a full-on introductory class. To provide a compassionate,

welcoming introduction to programming, these courses start by utilizing Scratch, developed for middle schoolers. This accessible platform allows the students to overcome their fear of programming, and then the class can gently transition to using more complex and professional frameworks (HTML, CSS, Python, Spreadsheets, etc. depending on the professor and the student interest). Successful completion of these courses gives students a head start in the introductory programming classes, thereby improving their success and increasing their resolve.

For the Math Success Academy, the above structure was changed twofold. Firstly, the advanced topics discussed in the pre-introductory classes were replaced by mathematical content. Secondly, some of the more advanced Scratch topics, like cloning or lists, are introduced on an as-needed basis.

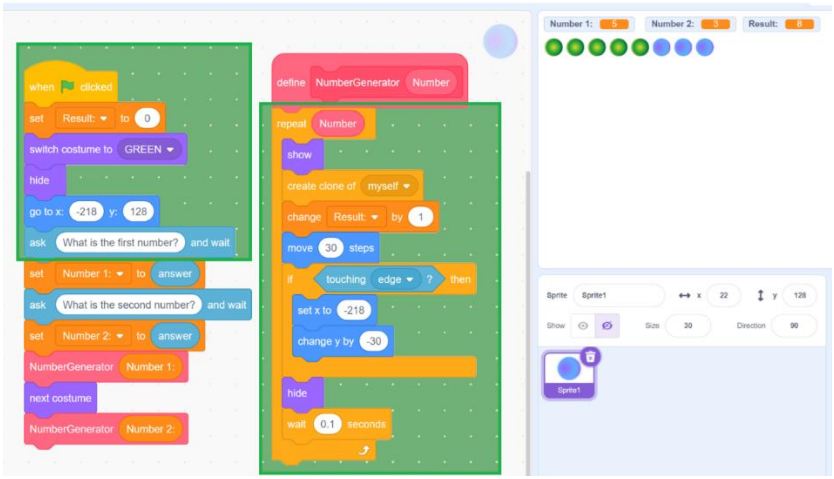
The above changes lead to the following structure (see: Table 1). The first week started with a detailed description of the class, including the constructivist approach utilized; then the students were asked to introduce themselves. As part of this conversation, the students received feedback if the Academy would be useful to them – many hard-working, conscientious students with excellent math skills appeared during this first class; and they were advised to *not* participate, as the material was in preparation for a pre-calculus level college experience. The rest of the week continued with introduction both to programming and (at this point informally) to computational thinking.

Table 1. The structure of the Math Success Academy.

	Monday	Tuesday	Wednesday	Thursday	***Summary***
Week 1	**INTRODUCTION** - Introduction to the course - One-on-one introductions, goal setting for the Academy - pre-assessment	**INTRO TO SCRATCH** - actions - loops - first ever game - multiple threads - design principles 1: prototyping - variables	**SCRATCH CONTINUED** - design principles 2: iterative improvements - branching, conditional statements - logical operators	**COMPUTATIONAL THINKING** - design principles 3: informal introduction to the computational thinking framework - apply it to game design - messages for coordination - repeat until loop	*By the end of the first week, the students are aware of most of the important coding principles and are able to create a game on their own*
Week 2	**BEGINNING OF MATH** - Review - SCRATCH: cloning - MATH: using cloing, discuss the number concept	**THE FOUR BASIC OPERATORS** Using SCRATCH, create animations for: - addition - subtraction - multiplication Discuss operator precedence	**COMPUTATIONAL THINKING** - design principles 4: Formal introduction to computational and design thinking - practice problem: guess the number game - division visualization	**PRIME FACTORIZATION** - primes - lists - program: find a list of prime factors - GCD - LCD	*By the end of the second week, the students were reminded of most of the work from grades 1-7 in math*
Week 3	**NUMBER SYSTEMS** - Review and prime factorization wrap up - Number systems - Converting numbers between number systems	**FUNCTIONS** - function reminder - three ways of describing functions - functions in spreadsheets - functions in Scratch 1: data tables	**GRAPHING A FUNCTION** - design principles reminder: decomposition of the task - math reminder: concept of proportionality - code: create a plotting function	**BRUTE FORCE INVERSE** - "capstone" experience: merging all of programming with all of math - iterative approaches in math - design the brute force inverse approach - Post-assessment	*By the end of the program, the students reviewed all of the material they would need to succeed in Applied Math for Scientists or any introductory Statistics course*

The second week started with a review, as the three-day-long weekend combined with no assigned homework made this prudent. The majority of this week focused on reviewing the first seven years of math, this time through a constructivist lens. The students were asked to re-create the four basic operators using nothing but the freshly introduced number concept and the increment-by-one operator (see Image 1 for an example). The computational and design thinking frameworks were also formally introduced here. The week concluded with prime factorization.

Image 1. The re-implementation of the addition operator using nothing but loops and the concept of increase-by-one.



The final week started with review again and rounded out the prime factorization conversation. A single hour was devoted to the number systems, to expand the students' understanding of the number concept. The rest of the week was devoted to functions, which are usually the biggest hurdle for our students in the pre-calculus classes, statistics classes and economic classes. The course concluded with a mini-capstone experience, where the students integrated their understanding of programming, their understanding of design principles, and their understanding of mathematics to create a brute-force inverse calculating method: using, for example, multiplication paired with repeated trial-and-error (implemented in a loop) to approximate the value of SQRT(2) to an arbitrary level of precision. This final class period was visibly a great a-ha moment for many students, intellectually rewarding them for their perseverance throughout the month.

4. Challenges and Outcomes

The biggest challenge facing the Math Success Academy is the fact that it is an optional opportunity, in the summer. A student needs to be extremely hard-working and be very concerned about their quantitative performance to participate in this experience. A total of 52 students applied to the program, a rather encouraging number. Before the first class period the students' records were reviewed, and students with advanced mathematics background were alerted to the educational level of the workshop. The remaining students were screened a second time during the first class period, which left the program running with 23 students. The workshop was regularly attended for the first two weeks, but for the final week many students had to leave for previously arranged activities (family vacation plans, cruises, etc.) Many of the remaining students were also unable to regularly attend the last week, which strongly undercut the learning outcomes as each class session built very heavily on the one before. Even with these difficulties, however, the program could be considered successful.

First of all, the students' self-reported experience appears to have been positive. 90% of the respondents agreed that they were glad they participated in the program, and 80% said that they liked that programming was part of the experience. A significant majority expressed that programming made understanding math "somewhat" or "greatly" easier.

Furthermore, studying the students' grades in the math classes they took following the summer workshop is also encouraging. Every student who took statistics after completing the program passed the class (although even for people who did not participate in the MSA the fail rate was below 3%). More relevantly, all the MSA students who took calculus passed the class (the fail rate for this course was nearly 18%). In precalculus (failure rate close to 20%), one of the students of the MSA program did not pass their class – but this student had incredibly irregular attendance during the final week of the MSA program (basically missing most of the functional discussion), and they failed most of their other classes in the Fall, not just the precalculus course.

Finally, it is encouraging that a number of students who completed the experience slightly changed their career trajectory and added a programming course or even a computer science certificate to their graduation plans.

5. Limitations

There are several limitations to this report. First of all, the sample size is terribly small. There are only 13 students who took a math class after completing the MSA program, and only 10 filled out the final feedback survey. It is also important to point out that since the program is voluntary, there is a very strong selection bias at play: it is likely that the students who applied tend to be better-performing, harder-working than the average, which might impact the results.

6. Conclusions and next steps

The Math Success Academy effectively introduced the students to the applied concept of computational thinking. This was married with a new-found understanding of programming to reinforce the participant's mathematical knowledge. Most of the respondents of the formal surveys expressed gratitude for this integrative experience – a feedback also shared informally by some.

The author does not claim that the constructivist approach is the only approach or even the best approach for a mathematical refresher. More iterations of the class need to be delivered, and the alumni of the academy need to be followed throughout their academic careers to understand the impact more (for example in the form of a post-graduation final interview). The author, however, believes that this case study is encouraging, and is hoping that this experience will be replicated at other institutions.

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MYSTICAL POETRY AND SPORT: AN EXPERIENCE OF DIDACTIC TRANSPOSITION BASED ON THE STUDENTS' INTEREST

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Abstract

The mystical poetry of the Spanish Renaissance is a topic included in the literature curriculum of the third year of compulsory secondary education in Spain. This subject tends to have little connection with the reality, individual interests and prior knowledge of 14-year-old Spanish students. According to interest theories, developing meaningful learning based on an intrinsic interest in this subject can be difficult if there is nothing to link the student to it. Therefore, a process of didactic transposition is necessary to transform academic knowledge into teachable and comprehensible content for students. Based on these foundations, the objective was set of designing an activity that stimulates the situational interest of a group of 25 students towards the mystical poetry of the Spanish Renaissance. Previously, sport was identified as a major interest of the students. It was then linked to mystical poetry through the devotion that some athletes arouse in young people, comparing it with the devotion felt by mystical poets, such as Saint John of the Cross and Saint Teresa of Jesus, towards God. The students read, analysed and debated the boundaries between devotion and fanaticism, as well as the risks of the latter for personal and social development. This study presents a quasi-experimental design that analyses the impact of a planned intervention on students' situational interest. During the implementation, data on the activation and maintenance of situational interest was collected through participant observation (teacher) and non-participant observation (external teacher) and a questionnaire for students. This allowed for triangulation of the information. The observation matrix, with five items, used a four-point linear estimation scale. The questionnaire included 10 items and used a four-point Likert scale. The reliability of the questionnaire, measured by Cronbach's alpha, was 0.784. The data obtained by the three means reflect that the students enjoyed the activity, interacted with each other and expressed themselves with initiative. However, while teachers considered the students' performance to be adequate, the students themselves expressed a low perception of their competence. This question raises the prospect of analysing possible factors behind these perceptions and teaching strategies that contribute to the development of self-concept in these students. Nevertheless, it is considered that the didactic transposition was significant in stimulating situational interest in mystical poetry.

Keywords: *Situational interest, mystical poetry, sport, didactic transposition.*

1. Introduction

Mystical poetry is a literary genre that conveys deep spiritual experiences (Choudhary, 2022). This genre reached a remarkable development during the Spanish Renaissance, thanks to figures such as St John of the Cross, St Teresa of Jesus and Friar Luis de León. Hence, its historical-literary relevance and its inclusion in the curriculum of Spanish Language and Literature in the third year of Compulsory Secondary Education (ESO) in Spain (Comunidad de Madrid, 2022).

Despite its relevance, mystical poetry is an unattractive content for 14-year-old students. On the one hand, it is a subject matter far removed from the everyday reality and individual interests of young people. On the other hand, its ancient and abstract language, the use of complex metaphors and its deep spirituality represent a great intellectual challenge. Engaging students' interest in this content can be fundamental to learning. However, developing meaningful learning based on an interest in mystical poetry can be difficult if there is nothing to connect the learner to the subject matter (Rotgans & Schmidt, 2018). From a psychological perspective, interest can be triggered by highly stimulating elements of the environment or qualities that a teacher can bestow on a subject, activity or object of learning. This type of interest is called situational interest (SI) (Schiefele, 2009). Stimulation of SI has two phases: activation (caused by novelty, surprise, personal relevance) and maintenance (determined by an optimal experience

of participation and perceptions of autonomy, competence, good social relations and enjoyment) (Renninger & Su, 2012).

Considering these fundamentals, the aim is to design an activity that stimulates the SI of third-year ESO students towards the mystical poetry of the Spanish Renaissance. To this end, it is considered necessary to carry out a process of didactic transposition that transforms academic knowledge about mystical poetry into teachable and comprehensible content for students (Alfaro & Chavarría, 2012).

In a previous exercise of researching interests, sport was identified as one of the themes and activities preferred by the pupils, so it could be a potential stimulator of SI towards mystical poetry. The question then was: How to connect mystical poetry and sport in Language and Literature classes? Nowadays, the fanaticism associated with sport is very significant, both towards football teams and well-known sportsmen. This kind of devotion could be compared to the spiritual fervour represented in the mystical poetry of the Spanish Renaissance and on this comparison, the activity "The spiritual journey of the sports fan" was focused.

2. Research methodology

2.1. Research design

With a quasi-experimental design, this paper presents the results of a didactic experience in the SI of students towards the mystical poetry of the Spanish Renaissance. A group of 25 students (12 girls and 13 boys) from the third year of ESO of a secondary school in the Community of Madrid took part. The activity "The spiritual journey of the sports fanatic" took place in a double session of the subject of Spanish Language and Literature and had a five-part structure (Table 1).

Table 1. Structure of the activity "The spiritual journey of the sports fan".

Parts	Description
Introduction	- Question and joint reflection: Are you a sports fan, do you have a sports idol, and what would you be willing to do to be closer to them?
The spiritual path of the Christian tradition	- Presentation of the concepts of the purgative, illuminative and unitive pathways. - Reading and analysis of poems.
Working in groups	- Identification and analysis of analogies between sports fanaticism and the ways of the mystical path.
Discussion and conclusion	- Presentation of ideas, commonalities and differences. - Risks of uncontrolled fanaticism for personal and social development.
Individual activity	- Short essay on the relationship between Renaissance mystical poetry and sports fanaticism.

2.2. Methods

The research data were collected through participant (teacher) and non-participant (external teacher) observation and an IS student questionnaire. The use of three sources allowed the information to be cross-checked in a process of triangulation.

For observation, a five-item matrix with a four-point linear estimation scale (where 1 is "not observed" and 4 is "observed") was used. One item measured SI activation (curiosity/attention) and the other four items measured SI maintenance (enjoyment, autonomy, competence, social relations). On the other hand, the student questionnaire included 10 items with a four-point Likert-type scale (where 1 is "strongly disagree" and 4 is "strongly agree"). These items provided information on IS activation (attention and personal relevance) and IS maintenance (enjoyment, autonomy, competence, social relationships and readiness to re-engage)[1]. The questionnaire obtained a Cronbach's Alpha coefficient of 0.784, suggesting that the data collected are reliable for analysis.

[1] As can be seen, there are criteria that do not coincide between the two instruments. This is because some factors of interest, such as personal relevance of the object and willingness to re-engage in a similar task, are unobservable and student perceptions can provide a deeper understanding of the phenomenon.

3. Results and discussion

Group observation and averages of student responses to the questionnaire show similar results for those criteria shared, except for competence (performance efficacy) (Table 2). This suggests a consistency between the perceptions of observers and students on most of the criteria and adds strength to the data analysed below.

Table 2. Observation and Questionnaire Data.

	IS activation		IS maintenance		
	Attention/ Curiosity	**Enjoy**	**Autonomy**	**Competence**	**Social relations**
Participant observation	3	4	3	4	4
Non-participant observation	3	3	3	4	4
Questionnaire (averages)	3,2	3,12	3,16	2,72	3,5

The indices obtained are positive, indicating that the activity "The spiritual journey of the sports fan" was effective in activating the SI (arousing curiosity and capturing the students' attention). This interpretation becomes more consistent when considering the students' mean ($\overline{x}$ = 3.16) on the items of personal relevance to the topic in the questionnaire. Regarding the maintenance of IS, the scores reflect that students enjoyed the session, showed initiative in their participation and very favourable social interaction. This is also confirmed by the mean score on the item about willingness to participate in similar activities ($\overline{x}$ = 3.32).

The main discrepancy is in the perception of competence. The students perceived themselves as less competent ($\overline{x}$ = 2.72) compared to the observers' assessment (4). This could indicate a lack of confidence in their abilities on the part of the students, even though the observers considered their performance to be effective. This result is consistent with previous research showing that academic self-concept in adolescence is dynamic and usually deteriorates between the ages of 12-13 and 14-16 (Demo, 1992; Barber & Olsen, 2004; García & Musitu, 2009, as cited in Ibarra & Jacobo, 2016).

Although the competence factor is not met, the synthesis of the results reflects the importance of didactic transposition. Specifically, the linking of mystical poetry to sport (a topic of personal relevance to students) and the opportunities to participate, exercising autonomy and interacting with the group, influenced students' SI. Results that confirm previous research on SI (Palmer, 2019; Renninger et al., 2019; Rotgans & Schmidt, 2011).

4. Conclusions

As conclusions to this work, we have obtained an activity, "The spiritual journey of the sports fan", which is the product of a didactic transposition based on the psychological foundations of SI and which links the mystical poetry of the Spanish Renaissance with sport. The results obtained show that the didactic experience was effective in activating and maintaining the students' SI in the in the topic of mystical poetry.

However, the students' perception of competence or academic self-concept presented difficulties, which raises as a prospective the design of strategies that contribute to reinforcing this psychological variable that can have significant influences on student participation and performance.

Another significant aspect is the opportunity this activity provided to reflect and debate in the classroom about the boundaries between devotion and fanaticism, as well as the risks of the latter for personal and social development. Fanaticism in any form limits the ability to understand and respect diversity of thought and culture. The creation of open and reflective learning environments is essential for the formation of critical, respectful citizens with a genuine interest in knowledge.

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WHAT HELPS YOU TO LEARN? INSIGHTS FROM UNIVERSITY STUDENTS AND FEEDBACK FROM NEUROSCIENCE

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Abstract

Declarative or explicit learning depends on several components that can be modified to achieve better learning habits and outcomes. The aim of this work was to analyze the learning strategies of Health Sciences university students and give them neuroscience-based feedback about their possibilities of improvement. Participants were students from four classes (Medicine, and Nutrition and Dietetics, years 2023-24 and 2024-25) who were following the subject "Nervous system physiology". First, the students were invited to reflect on their learning strategies with the question "What helps you to learn or to study?", through the interactive tool Wooclap. Their contributions were displayed as a dynamic word cloud in class. Next, the teacher provided scientific feedback, explaining briefly the neurophysiological mechanisms underlying their answers, and included further relevant items if they had not been mentioned. In the second phase, outside of class, the students' answers were distributed in six pre-determined categories and analyzed. 163 answers were obtained, which corresponded to 27 items distributed in 4 categories: student involvement, organization and study tools, deep learning and teacher work. Two further categories (concept association and students´ health) were scarcely mentioned. Differences between classes were detected. For example, Nutrition and Dietetics students provided more answers in the category "student involvement" than medical students, while medical students reported a higher use of technology tools devoted to time management, artificial intelligence and flashcard preparation. This work could help to improve the students´ learning process, to adapt feedback to the characteristics of each class, to help determine the teacher´s pedagogical methodology and to introduce active learning methodologies.

Keywords: *Learning, university, neuroscience, Wooclap.*

1. Introduction

Declarative or explicit learning is the acquisition of knowledge or skills through conscious, intentional and strategy-driven processing, such as that which university students apply when they study, versus non-declarative or implicit learning, which is unconscious learning developed in motor and emotional activities. Learning is based on experience-driven flexible remodeling of different neural connections (synaptic plasticity) (Freedberg, Toader, Wassermann, & Voss, 2020). In the context of university education, multiple factors should be considered in order to improve students' study habits and outcomes.

Student involvement is the cornerstone of the learning process. This is related to several factors, such as attention, which allows vast amounts of information to be filtered and prioritizes that which is the most relevant (Knudsen, 2018). A second important factor related to student involvement is motivation. It is crucial to make the effort to study in order to obtain future benefits. Motivation depends on the mesolimbic reward system, which is activated by achievable challenges (Pierce & Kumarasan, 2006; Hamid et al., 2016). It is especially relevant during adolescence since the reward system predominates over the prefrontal cortex until approximately the age of 25 (Casey, Jones & Hare, 2008).

Another fundamental feature of successful learning refers to task organization and planning, which align with the functioning of the prefrontal cortex. In addition, in order to consolidate learning it is essential to work on deep learning, or critical thinking, and concept association, which are related to explicit memory encoding by the hippocampus and its consolidation and recovery, in which the prefrontal cortex is also involved (Eichembaum, 2018; Choucry, Nomoto & Inokuchi, 2024).

In addition, students´ health must be considered, as it affects the learning capacity. Several health-related issues have an impact on brain health and therefore learning. Diet affects the brain directly or through the microbiota-gut-brain axis (Silva, Bernardi & Frozza, 2020). Physical activity improves brain

health, and specifically hippocampus function (Cotman, Berchtold & Christie, 2007). Sleep is fundamental for memory consolidation and for keeping the brain healthy (Choucry, Nomoto & Inokuchi, 2024). Meanwhile, chronic stress negatively affects the brain, altering for example the functioning of the reward system responsible for motivation (Hollon, Burgeno & Phillips, 2015) and the hippocampus involved in explicit learning and memory (McEwen, Nasca & Gray, 2016).

2. Objective

The aim of this work was to analyze the learning strategies of Health Sciences university students and provide them feedback based on neuroscience oriented to improving their learning habits.

3. Methodology

This study was carried out with 152 undergraduate students from Medicine (91 students) and Nutrition and Dietetics (61 students), who were following the subject "Nervous system physiology". Four classes were involved as the experience was developed over two consecutive years (2023-24 and 2024-25). The work was divided in two phases. The first phase took place in the classroom and the second one was devoted to the in-depth analysis of the results obtained and the extraction of conclusions.

In the classroom, as part of the subject presentation during the first session, the interactive tool Wooclap (wooclap.com) was used to invite the students to reflect upon their learning strategies. For that purpose, the question "What helps you to learn or to study?" was asked. Students´ answers were anonymously recorded and shown in real-time on a screen as a dynamic word cloud. The teacher performed a preliminary analysis in class and provided scientific feedback, briefly introducing students to the neurophysiological mechanisms underlying their answers. When relevant items were absent from the students' answers, the teacher commented on them and the mechanisms involved.

In the second phase, outside of class, the students' answers were thoroughly analyzed. Five learning categories were defined a priori according to the neuroscience mechanisms involved in explicit learning: 1) student involvement, 2) organization and study tools, 3) deep learning or critical thinking, 4) concept association and 5) student health. An additional sixth category (teacher work) was included to cover teaching tools that students might consider helpful for their learning. Students´ answers constituted items that were placed in one of these categories. These items may have been mentioned by several students. For every class, the percentage of answers in each category was calculated with respect to the total number of answers. Comparisons between the four classes were carried out by analyzing the items included and the percentual distribution of categories.

4. Results and discussion

4.1. Phase 1: In-classroom experience

When the question "What helps you to learn or study?" was displayed in the classroom, students' answers were shown as a real-time word cloud. Then, preliminary approaches detected contributions mainly related to four out of the six pre-defined categories, while no items were mentioned which were strongly linked to the categories "concept association" and "student health".

In-classroom experience was completed with feedback from the field of neuroscience that was aimed at introducing students to the mechanisms involved in items they had mentioned, and including relevant items that were absent in their contributions. As this was the first session of the subject, feedback was brief, simple, based on examples, accessible to beginners' level and linked to future topics of the subject. In the category "student involvement", the mechanism of attention was related to the functioning of the corticothalamic circuit (Knudsen, 2018) and motivation to the corticostriatal circuit and the mesolimbic reward system (Hamid et al., 2016). The category "organization and study tools" was related to functions of the prefrontal cortex. The absent category "concept association" was considered essential for learning. Therefore, it was introduced and linked to the category "deep learning" to be explained in relation to the engrams association in the hippocampus (Choucry, Nomoto & Inokuchi, 2024).

4.2. Phase 2: Data analysis

A relevant percentage of the students that were present during this experience (103 out of 152, 67.76%) participated actively providing a total of 163 answers to the question "What helps you to learn or study?". These answers corresponded to 27 items (Table 1), which were distributed in four of the established categories: 1) student involvement (4 items, 11.66% of the answers), 2) organization and study tools (16 items, 62.58 %), 3) deep learning (2 items, 10.43 %). and 4) teacher work (5 items, 14.72%).

These items were mentioned from 1 to 34 times. The most valued items were: “schema” (34 mentions, 20.86 % of the answers), “videos” (13 mentions, 7.97%) and “understanding” (11 mentions, 6.75%).

Categories were not rigid, but some items in the “organization and study tools” category could be related also to other categories. For example, “repeating / reviewing / explaining it to someone” could also be assigned to “deep learning”. Besides, items like “schematic diagrams / conceptual maps / comparative tables” although they deal with “concept association”, weren´t placed in that category, as the sense of high-level associations was not perceived in students´ answers, since they did not reflect a relationship between different teaching units or with everyday situations.

Table 1. Contributions to the question “What helps you to learn or to study?” in four classes (Medicine 2023-24 and 2024-25 and Nutrition and Dietetics (N&D) 2023-24 and 2024-25). The number of mentions that every item received is shown.

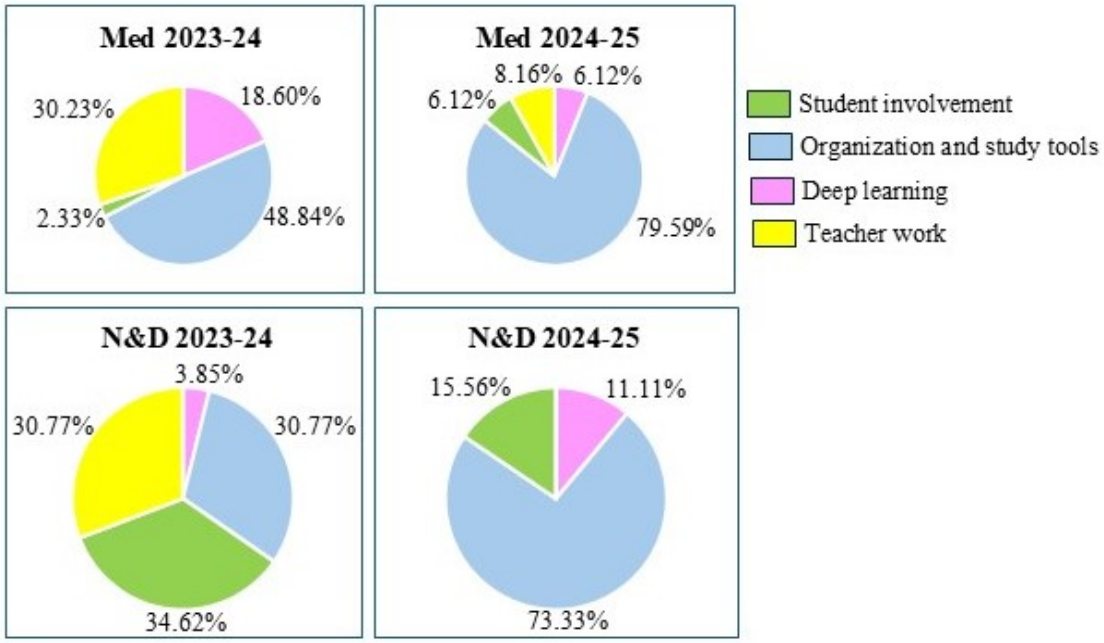
Category	Items provided by the students	Med 23-24	Med 24-25	N&D 23-24	N&D 24-25	TOTAL
Student involvement	Attending class and paying attention	1	1	4	2	8
	Taking notes		2	2	4	8
	Studying daily			3		3
	Feeling like studying (motivation)				1	
Organization and study tools	Schematic diagrams, conceptual maps, comparative tables, drawings	8	5	5	16	34
	Videos	2	6	3	2	13
	Images	1	3		5	9
	Repeating, reviewing	6			3	9
	Books		6			6
	Simple explanations, explaining it to someone, Feynman method, ELI12	1	4		1	6
	Highlighting, colors		1		4	5
	Friends	1	3			4
	Online notes		4			4
	ChatGPT		3			3
	Writing it		2			2
	Anki, Flashcards		1		1	2
	Music		1		1	2
	Pomodoro technique (time management)	1				1
	Mnemonic techniques	1				1
Deep learning	Understanding, being clear about the basic concepts	4	3		4	11
	Reasoning, explaining processes, logic among concepts	4		1	1	6
Teacher work	Summaries, a summary after a long explanation	4		3		7
	Clear and slow explanation in class	2	3	1		6
	Repeating, emphasizing important concepts in class	5				5
	Asking questions in class, review questions with solutions	2		3		5
	Examples			1		1
	Complete presentations		1			1
	TOTAL	43	49	26	45	163

Differences between classes were detected (Figure 1). In the category “student involvement” Nutrition and Dietetics students provided more contributions (34.62% of the total contributions in 2023-24 and 15.56% in 2024-25) than medical students (2.33% of the total contributions in 2023-24 and 6.12% in 2024-25). They were aware of and communicated the importance of paying attention in class, taking notes, studying daily and staying motivated.

The category “organization and study tools” had the highest total representation (61.96%) and ranged from 30.77 % of the total contributions in Nutrition and Dietetics 2023-24 to 79.59 % in Medicine 2024-25 (Figure 1). Only medical students reported the use of technology tools and their percentage of use respect to the total of tools was low (Table 1): 0.99% in 2023-24, which increased to 4.95% in 2024-25. These technology tools were devoted to time management, artificial intelligence or flashcard preparation.

The category “deep learning” was mentioned in the four classes (Figure 1) ranging from 3.85 % of the total contributions in Nutrition and Dietetics 2023-24 to 18.60 % in Medicine 2023-24. Meanwhile, the category “teacher work” had a higher representation in 2023-24 classes than in 2024-25 and was not mentioned by 2024-25 Nutrition and Dietetics students. Regarding teacher work, the most valued items were “summaries”, “clear and slow explanations in class”, “repeating and emphasizing important concepts in class” and “asking questions”.

Figure 1. Distribution of the contributions to the question “What helps you to learn or to study?” in different learning categories. Contributions were recorded in four classes (Medicine 2023-24 and 2024-25 and Nutrition and Dietetics (N&D) 2023-24 and 2024-25).



These results show that relevant information about student learning strategies can be extracted from the interactive and dynamic Wooclap cloud generated in response to the question “What helps you to learn or to study?”. This study has brought to light differences between classes. Therefore, it could help provide information about the specific learning characteristics of each particular group in the first introductory session, and to orient the teacher toward an appropriate pedagogical methodology. Also, this study may contribute to predicting the results from future word clouds.

Making students conscious of their learning process could improve their study habits, leading in the short-term to higher motivation in class and better grades and in the long-term to the acquisition of relevant tools for professional development. This experience could be transferred to different disciplines to promote student reflection and to provide them with tools to improve their study habits. It supports the use of active learning methodologies that have been demonstrated to improve learning outcomes in university students (Freeman et al., 2014). It could also be used to introduce active learning methodologies once students are aware of the importance of their involvement.

5. Conclusions

The question “What helps you to learn?” promoted student reflection about their study habits and made them aware of likely resources. The interactive tool Wooclap allowed for the management of large groups, helped to keep students engaged and promoted learning from peers. An explanation of the neural mechanisms involved in the learning process could help reinforce the benefits that students gained from reflecting on their approach to learning. Differences between classes provided valuable information about their specific peculiarities and motivations.

Acknowledgments

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EMPLOYING KAHOOT GAMING TOOL TO TEACH ELECTROMAGNETIC PROPAGATION AND SIGNAL TRANSMISSION THROUGH OPTICAL FIBERS

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Abstract

Teaching electromagnetic (EM) propagation and signal transmission through optical fibers presents several challenges to educators and students mainly due to the complicated (and time-consuming) mathematics involved as well as the difficulty in associating those mathematics with actual facts regarding propagation and transmission processes. In that respect, the Kahoot gaming tool was employed for the visualization of certain aspects of propagation and transmission with the aim students to develop a practical knowledge on those processes before encountering them in a mathematical manner. More specifically, Kahoot was used to visualize propagating modes (an essential concept of electromagnetic propagation) as well as intramodal (chromatic) dispersion (an essential impairment phenomenon) that both cause difficulties to several students. Employment of Kahoot is facilitated by the fact that Kahoot is a mobile-device application with a usable free version that can be easily embodied in an engineering course. The instruction on the above processes by means of Kahoot took about two one-and-a-half hour lectures that precede the relevant mathematical analysis. Regarding propagating modes, students were given pictures of fibers with specified core and cladding refractive indices and operating at a commonly used wavelength and were asked to include the supported modes as the diameter of the fiber core increases. Regarding intramodal dispersion, the students were given a picture of a single-mode fiber (of a specified core diameter and refractive indices) that is activated by a laser source. Two different laser sources were considered, each with a specified linewidth and the students were asked to observe views of the effect of dispersion on the transmission of a pulse-train (including possible overlapping of the transmitted pulses) and calculate the widening of the transmitted pulses for each laser source as the length of the fiber increases. An important follow-up is for the students to associate the Kahoot pictures with the mathematical analysis presented in the subsequent lecture. The whole process was evaluated by means of a short questionnaire distributed to students which shows that visualization through Kahoot helps them develop a better understanding of electromagnetic propagation and signal transmission through fibers, facilitating, at the same time, the relevant mathematical analysis (particularly regarding dispersion). The presentation took place during five two-teaching-hour lectures in the framework of the 6th-semester "Optical Communications" course at the Department of Electrical & Electronic Engineering Educators of the School of Pedagogical & Technological Education (ASPETE), a tertiary educational institution, located in Athens Greece. Future use of Kahoot could include attenuation phenomena (that are, anyway, easier for students to understand) as well as the phenomenon of polarization-mode dispersion (PMD).

Keywords: *Engineering education, electronic engineering education, fiber optics, gaming tools, Kahoot.*

1. Introduction

Teaching electromagnetic (EM) propagation and signal transmission through optical fibers presents several challenges to educators and students mainly due to the complicated (and time-consuming) mathematics involved as well as the difficulty in associating those mathematics with actual facts regarding the propagation and transmission processes. For example, EM propagation in an optical fiber requires the solution of a boundary-value problem involving the wave equation in combination with specific boundary and far-field conditions (Ming-Kang Liu, 1996). Even if a student is competent enough to follow the solution of such a problem, most probably he/she will find him/herself "lost in mathematics", unable to connect mathematical results with how an optical fiber actually supports

EM waves. A similar situation has been observed regarding signal impairment mechanisms, particularly intramodal and polarization-mode dispersion.

This article describes a teaching approach in which an attempt was made to visualize EM propagation and signal degradation phenomena, prior to their mathematical analysis, with the aim to enhance students' comprehension of the above phenomena. Visualization was achieved by using gamification (Lee & Hammer, 2011) and the Kahoot gaming tool, in particular, owing to the fact that Kahoot is a mobile-device application with a usable free version that can be easily embodied in an engineering course (https://kahoot.com/; Voudoukis, Mantzios & Pagiatakis, 2021).

2. Objective

The objective of using the Kahoot gaming tool was the students to visualize EM propagation and signal transmission through optical fibers. The basic rationale was that if students had first developed a qualitative grasp of the associated processes and mechanisms by means of a visualization tool such as Kahoot, this would help them follow the anyway complicated relevant mathematical analysis and assist them in enhancing their comprehension and practical aptitude regarding EM propagation and signal transmission phenomena.

3. Method

The basic rationale of the applied teaching approach was that if students started with a visual encounter of EM propagation and signal transmission through optical fibers, this would help them follow the complicated and time-consuming associated mathematical analysis (which is, anyway, complicated and time consuming) and develop their aptitude in the practical aspects of the processes involved which is necessary for handling actual engineering problems.

Visualization, was achieved by using the Kahoot free version since it is easily available and can be easily embodied in an engineering course. The basic aim was the students to get familiar on one hand with mode patterns and essential aspects of the waveguiding process (such as the dispersion diagram) in a rather practical manner and on the other hand with signal impairment phenomena, particularly dispersion which students usually find it difficult to comprehend. Active participation of students was sought and mainly achieved through the answering of relevant multiple-choice questions in an interactive manner.

4. Design

The content to be presented was divided into two parts, the first dealing with EM propagation (with emphasis to the notion of propagating modes) and the second dealing with signal degradation mechanisms, particularly attenuation and intramodal dispersion. Typically, the first part requires the solution of the wave equation (accompanied by the appropriate boundary and far-field conditions) in cylindrical coordinates and it is the topic that causes most difficulties and misunderstandings among students. The second part is the consideration of the fiber as a transmission medium and the analysis of processes such as the signal's attenuation and dispersion.

The presentation took place during five two-teaching-hour lectures in the framework of the 6th semester "Optical Communications" course (spring 2024) at the Department of Electrical & Electronic Engineering Educators of the School of Pedagogical & Technological Education (ASPETE), a tertiary educational institution, located in Athens Greece. A unique feature of ASPETE is that its graduates, apart from working as engineers in their respective field, can also be employed as teachers in technological secondary schools, that is why students in parallel with their engineering courses they also attend courses on pedagogy and didactics. The potential employment of ASPETE's graduates as educators is an essential reason why particular emphasis should be given to the students developing a conceptual, and not just procedural, understanding of the concepts and processes of their field.

Lectures 1 and 2 were about EM propagation through an optical fiber while lectures 3 and 4 regarded the consideration of optical fibers as transmission media and the analysis of signal degradation mechanisms that is attenuation and dispersion (table 1). To enhance students' comprehension of the associated processes, visualization was an essential element of those lectures and was achieved with the aid of Kahoot, which, all in all, took about half of the above lectures (indicative screenshots are shown in figure 2 and indicative additional questions are given in table 2). This was the second time that Kahoot was used in the context of optical telecommunications. The last lecture was dedicated to a discussion on the content of the preceding lectures.

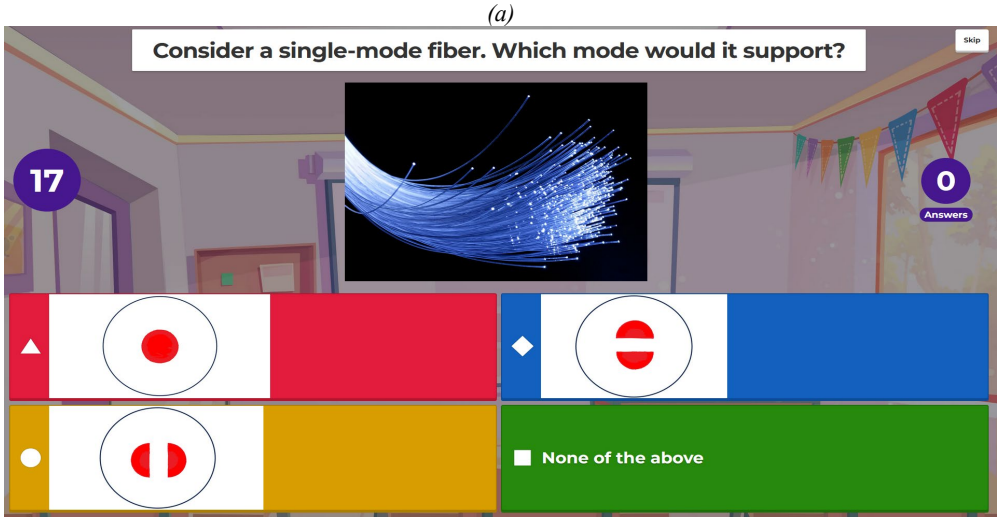
To evaluate the effect of the use of the Kahoot gaming tool on students' comprehension, a short questionnaire was distributed to students, following the lectures, that should be answered by means of a 5-grade Likert scale ("1" strongly disagree, "2" disagree, "3" neither disagree nor agree, "4" agree, "5" strongly agree).

Table 1. Lectures on the EM propagation of signal transmission through optical fibers.

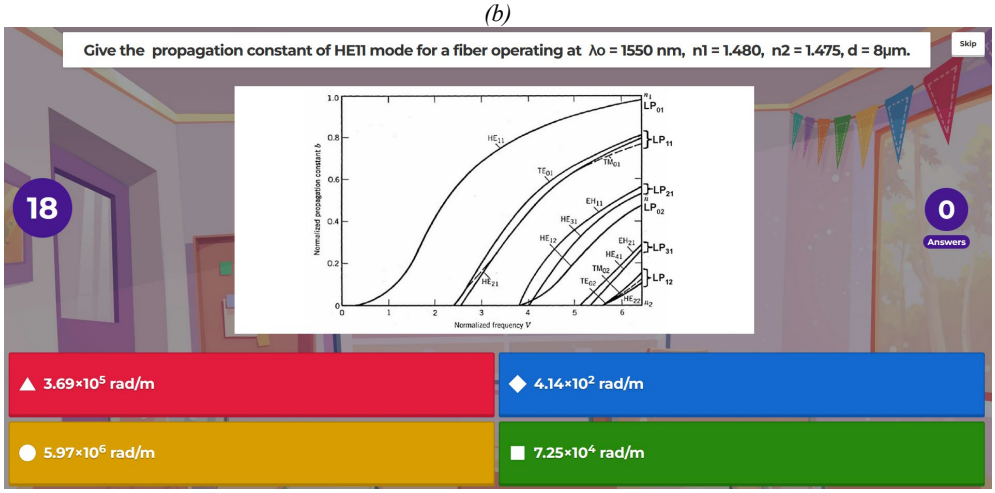
Lecture	Topic	Objective	Topics to be presented and discussed (indicative list)
1 & 2	EM propagation through an optical fiber	The students to comprehend the basic mechanisms and processes regarding EM propagation through an optical fiber.	• Visualization of the concept of propagating modes. • Visualization of the dispersion diagram. • Practical issues. • Association with the solution of the relevant boundary-value problem (wave equation combined with boundary conditions).
3 & 4	The optical fiber as a transmission medium	The students to comprehend the transmission properties of optical fibers and the phenomena and parameters regarding signal attenuation and dispersion.	• The attenuation process. • The dispersion process (with emphasis to chromatic dispersion visualized by means of Kahoot).
5	Discussion		

Figure 1. Indicative Kahoot screenshots regarding EM propagation and signal transmission through fibers.

(a)



(b)



(c)

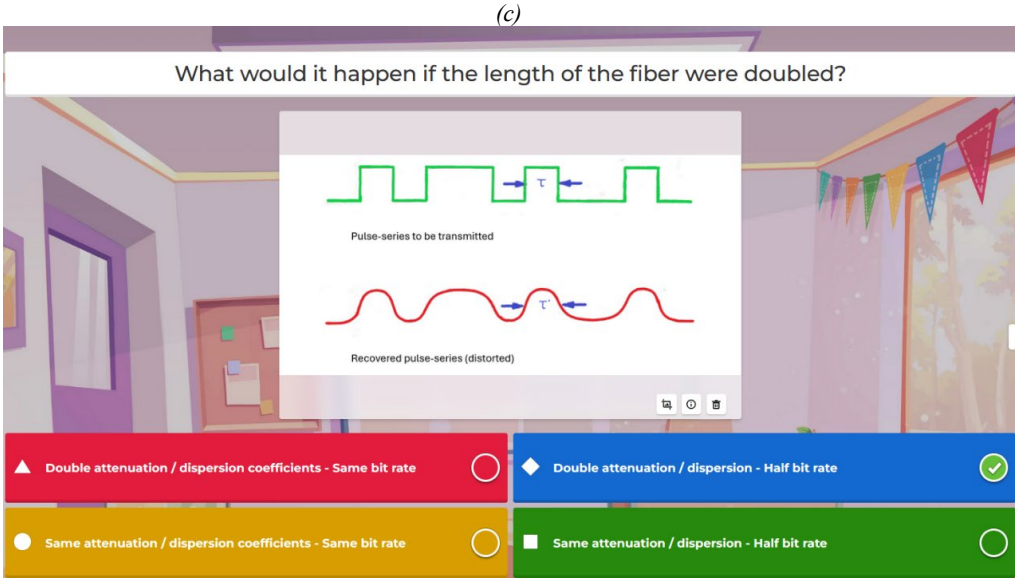


Table 2. Indicative possible additional questions.

	Question	Relevant figure
1.	What would be the profile of the LP11 mode?	1a
2.	Suppose that the picture depicts mode's profile the distribution of the optical power at a cross-section of a single-mode fiber at an instant considered as the starting one (t_o = 0). What comments can you make on the mode's profile at distances L such as $\beta L = \pi/4, \pi/2$ and π (where β is the mode's propagation constant)?	1a
3.	What would be the mathematical expression of the electric field in a fiber with indices n1 = 1.480 and n2 = 1.475 and diameter d = 12 μm operating at a wavelength λ_o = 1550 nm?	1a
4.	Could there be an optical fiber with no propagating mode?	1b
5.	Suppose we have an optical source operating at a wavelength λo = 1550 nm and optical fibers with refractive indices n1 = 1.480 and n2 = 1.475 and diameters (d) equal to 8 μm, 12 μm, 16 μm and 20 μm. Define the propagating modes supported by each fiber.	1b
6.	In what way, e.g. modes HE21, TE01 and TM01 can be considered as the LP11 mode?	1b
7.	Suppose that the figure depicts a signal with bit-rate R = 2.5 Gb/s. What will it happen if the bit-rate considerably increases (e.g. to R' = 10 Gb/s)?	1c

5. Discussion

The answers to question 1 (m = 3.632) show that regarding the usability of Kahoot by the students, there is certainly room for improvement. A possible solution would be the students to be given some time to practice with Kahoot as preparatory homework (prior to its use in the class).

The answers to questions 2 and 3 (m = 4.167 and 4.105 with a small m/s value) show that visualization through Kahoot, prior to the mathematical analysis, did help the students comprehend the facts and issues of EM propagation and signal transmission through optical fibers (table 3 and figure 2).

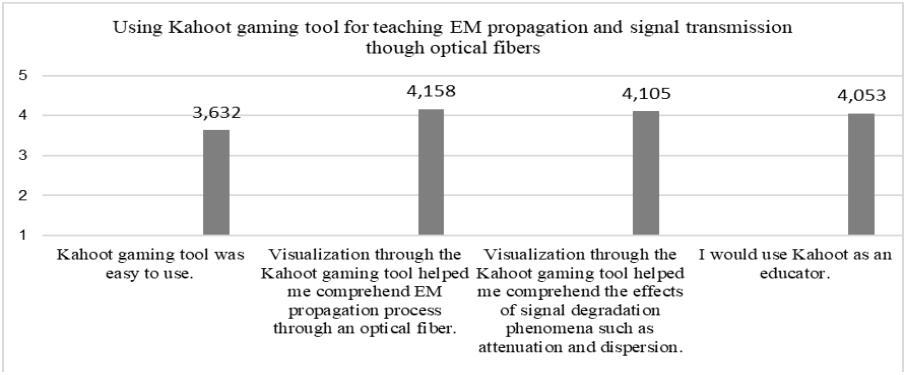
The aim of question 4 was to evaluate the intention of the participating students to use Kahoot as future educators. This question was included given the fact that the department's graduates can be employed as teachers of electrical and/or electronic engineering in technological high schools. It is encouraging that the majority of students agree or strongly agree with using Kahoot as future educators.

In the framework of the described approach, the use of Kahoot regarded the Content Knowledge (CK) and Pedagogical Knowledge (PK) parts of the TPACK framework (Mishra & Kohler 2006). A further aim was the students to develop Pedagogical Content Knowledge (PCK) in view of their possible future employment as school teachers and, by creating their own Kahoot displays to also address the Technological Knowledge (TK) aspect. Regarding Bloom's revised taxonomy (Armstrong, 2010) the presentation mainly covered layers 2 and 3 (understand and apply) and maybe layer 4 (analyze).

Table 3. Questions and answers regarding the presentation of the use of the Kahoot gaming tool for the presentation of EM propagation and signal transmission through optical fibers (participation: 19 students).

Question	Average (m)	Standard deviation (s)	Ratio m/s
1. Kahoot gaming tool was easy to use.	3.632	0.895	0.25
2. Visualization through the Kahoot gaming tool helped me comprehend EM propagation process through an optical fiber.	4.167	0.898	0.22
3. Visualization through the Kahoot gaming tool helped me comprehend signal degradation phenomena such as dispersion.	4.105	0.658	0.16
4. I would use Kahoot as an educator.	4.053	0.621	0.15

Figure 2. Questions and answers regarding presentation the use of the Kahoot gaming tool for the presentation of EM propagation and signal transmission through optical fibers (participation: 19 students).



Kahoot could be also used for the visualization of additional topics of Optical Communications, e.g., the operation of optical amplifiers and receivers or the wavelength division multiplexing technology, to name a few. Active participation of students could be enhanced by encouraging them to create their own Kahoot displays (probably with proper guidance and/or hints) in view of their possible employment as future educators. In the framework of more advanced applications, Kahoot could be used for developing self-teaching educational material, e.g. for incoming international students.

6. Conclusions

The aim of the proposed teaching approach was to facilitate comprehension of EM propagation and signal transmission through the visualization of the relevant notions by means of the Kahoot gaming tool. Students' feedback was encouraging and this could motivate further use of Kahoot to support topics mathematical analysis of which may be complicated, time consuming and with dubious results. Given the dynamic nature of EM waves and waves in general), the use of video presentations in combination with Kahoot (which, however, would require more effort and more sophisticated equipment) could be also considered as an option.

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"HOW WILL I MANAGE?" STUDENTS' PERCEPTIONS AND EXPECTATIONS BEFORE AN EXAM

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Abstract

This study explores university students' self-perception regarding their preparation and expectations for grades compared to the results obtained in an exam. Involving 134 freshmen from a bachelor's degree program, the survey compared students' predictions about their grades with those they actually achieved. The results highlighted a significant discrepancy between expectations and performance, with many students tending to overestimate their own preparation, especially those with unsatisfactory results. The analysis also revealed a relationship between the type of secondary school attended and grade expectations, with students from technical and vocational schools often having higher expectations compared to those from high schools. The study suggests that a lack of familiarity with university evaluation methods and the effects of previous school socialization could influence students' perceptions.

Keywords: *Self-assessment, grade expectations, school-university transition.*

1. Introduction

This contribution focuses on students' self-perception as they approach a university exam, comparing it to the results they ultimately achieve. The aim is to assess their awareness of their level of preparation and the resulting expectation of achieving a certain grade, examining the students' self-assessment capabilities based on the effort they believe they have put into studying, the method they adopted, and the time dedicated. Therefore, it also involves assessing the students' ability to adequately interpret the expected performance standards within the higher education system. This aspect is particularly relevant for freshmen, who face evaluation practices and reference standards that are often very different from those encountered in secondary education.

In order to improve our understanding of this issue, an exploratory study was conducted on the self-assessment abilities of first-year students in a specific mandatory course within the curriculum of a bachelor's degree program. The study took place at the University of Turin (Italy), a large institution where enrolments are steadily increasing (+5% in bachelor's degrees and +20% in master's degrees for the 2023-2024 academic year). However, the university also experiences a higher-than-average drop-out rate, with 18% of students leaving the University of Turin during their first year, compared to the national average of 10%.

2. Framework

The transition from high school to university is not only an educational shift but also a milestone in the maturation and development process of young people. With the gradual decline of the manufacturing sector, which previously encouraged more vocationally oriented high school paths, tertiary education has been increasingly excluded (with the exception of ITS programs) (Ballarino, 2013; Valero and Van Reenen, 2019; Almalaurea, 2023) or limited to certain categories of students with an academic inclination from the end of lower secondary school. Currently, post-diploma educational choices are increasingly motivated not only by professional placement, but also by the status associated with academic degrees, personal satisfaction, and interest in specific fields of study. The impact of this transformation is visible in the rising number of freshmen in all degree programs at Italian universities, with a steady trend since 2015 (Anvur, 2023). University admission for bachelor's programs is not subject to entrance selection processes, and any type of high school diploma allows students to enroll in any academic path.

The Academic success is influenced not only by cognitive factors but also by satisfaction, perseverance, the activation of motivational processes, and the ability to engage in critical self-assessment (York et al., 2015). Within this process, academic adaptation becomes essential, defined as the ability to adjust to academic challenges, understand and critically reflect on study methods, adopt effective time management, actively participate in classes, and properly decode the expectations of instructors (Floris et al., 2023). Another crucial aspect is the students' sense of self-efficacy, where a good self-assessment of one's abilities increases the likelihood of achieving good results and reduces the risk of dropout. For an individual to possess such self-assessment ability, awareness and control over one's cognitive processes—i.e., metacognition—are necessary. This manifests in the ability to select appropriate strategies for preparation and study in general, engage in evaluating one's understanding of the content provided by instructors, and assess one's level of knowledge. The development of a self-assessment literacy regarding academic performance thus becomes a fundamental part of the broader learning process (Galliani, 2015; Serbati, Grion & Fanti, 2019).

3. This study

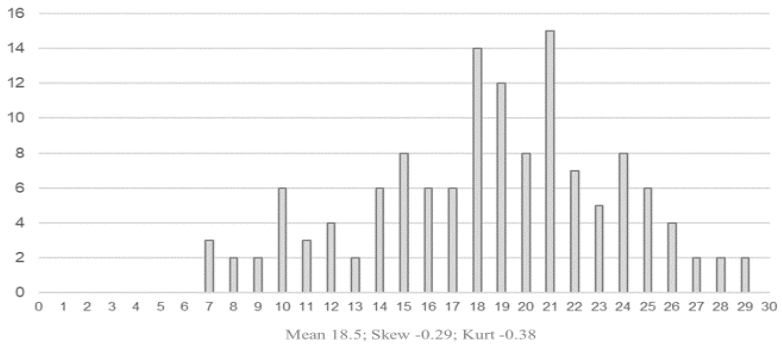
In order to better understand the perception that students have of their level of preparation and, consequently, their expectations regarding the grades they will achieve in the exams, the present study involved 134 students (with a similar gender composition). The participants were freshmen enrolled in the first year of a bachelor's degree program, attending the "General Sociology" course.

Before the start of the exam, which took place in December 2024, students present in the classroom were asked to answer the question, "What grade do you think you will get on this exam?" in order to compare this self-assessment with the grade they ultimately achieved. This simple question was accompanied by a recommendation to answer only after careful and honest consideration of several aspects that characterized their preparation for the exam, which could contribute to making the self-assessment valid. These aspects included: attention during lectures, effort put into studying and its organization, feedback received from the instructor during exercises, and so on.

The exam consisted of a written test with 30 multiple-choice questions. The grading criteria for the exam involved awarding one point for each correct answer and penalizing half a point for each incorrect answer. A perfect score of 30/30 could be achieved by answering all the questions correctly. The Italian grading system has specific features that significantly differ from those in many English-speaking countries. It uses a numerical scale up to 30, with 30 representing excellent performance (with the possibility of adding "lode" for exceptional performances), and 18 being the minimum passing grade. Unlike many systems where grades are determined cumulatively through courses, quizzes, and tests throughout the semester, the Italian university grading system often relies on a single final exam, either oral or written. This exam usually covers all the material taught during the course, making exam preparation crucial for success.

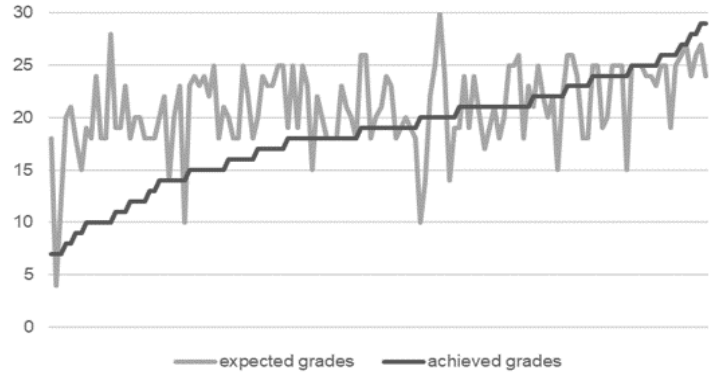
The result of the exam on which this study is based was generally unsatisfactory, with a significant portion of students (about 35%) failing to reach the minimum passing grade of 18, and no student achieving the highest score. The following figure (Figure 1) shows the distribution of scores. The lowest score was 7, awarded to 3 students, while the highest score was 29, awarded to 2 students.

Figure 1. Achieved grades, scores from 0 to 30 (N 134).



The following figure compares each student's predicted grade with the grade they actually achieved (Figure 2).

Figure 2. Expected grades vs. achieved grades, scores from 0 to 30 (N 134).



As can be seen, there are very few cases of perfect alignment between the predicted grade and the grade actually achieved (specifically, 7 cases). However, many students predict a grade that is close to the actual result, with a discrepancy of only a few points. Nonetheless, a significant number of students seem to lack awareness of their performance in terms of university grading. In particular, there is a noticeable tendency for students with unsatisfactory results—and thus inadequate preparation—to overestimate their performance. On the other hand, students with the best results appear to have underestimated their preparation predicting outcomes lower than those they ultimately achieved.

Let's now examine the relationship between grade expectations and some characteristics of the students' previous educational background that we consider relevant. Specifically, we focus on the type of secondary school attended (which has been categorized into two tracks for simplicity: lyceum and technical-vocational school) and the final high school grade obtained (Table 1). High expectations are those expressed by students who predict a grade higher than the one they ultimately achieved, while low expectations are those expressed by students who predict a grade lower than the one they actually obtained. The few cases of exact predictions were not considered.

Table 1. Expectations based on the type of secondary school attended and the diploma grade.

		Diploma grade	
Type of secondary school		Medium-low	High
Lyceum	High expectations	56%	76.9%
	Low expectations	44%	23.1%
	Total	100%	100%
Technical-vocationalschool	High expectations	70.6%	58.8%
	Low expectations	29.4%	41.2%
	Total	100%	100%

The observation of the data shows that the type of secondary school attended appears to be significant in shaping students' expectations and, by extension, their self-assessment abilities. Specifically, students with a lyceum diploma tend to have a lower tendency to overestimate their abilities, especially when they completed their secondary education with a medium-low grade, compared to students from a technical-vocational school. On the other hand, students from a technical-vocational school, when they completed their secondary education with a high grade, seem to be insecure about their preparation and display lower expectations compared to students with a high diploma grade from a lyceum track.

This distribution suggests that freshmen from technical and vocational tracks, which have lower social prestige and where teachers have lower expectations compared to those teaching in lyceums, may be less equipped in terms of self-assessment skills. It is worth noting, however, that regardless of the track attended, freshmen generally have relatively high final grades on their high school diploma exams, with only 16% having obtained a sufficient or slightly higher diploma grade. Nearly 30% of students achieved the highest possible score. This could be attributed to a structural characteristic of the Italian educational system, namely the tendency to assign high grades. This aspect is of interest because it may contribute to a socialization into a self-assessment culture that is somewhat unrealistic.

Therefore, it is already in high school that students acquire, alongside knowledge, the necessary skills to manage the transition to the next level of education, to self-assess adequately, and to approach university exam preparation with confidence.

4. Limitations of this study and future research

This study has several limitations: a small sample size, lack of representativeness, and self-selection of participants, as it was up to the individuals whether to respond. It is, in fact, an exploratory study aimed at better understanding the expectations of freshmen regarding their success in a university exam.

These limitations are expected to be addressed through a deepening and expansion of the study, to be conducted in the next academic year 2025-2026, with the following objectives: increasing the sample size, adding questions on study motivation, differentiating between degree programs and disciplines (with a distinction between Humanities and STEM programs), and involving other Italian universities with their respective degree programs and courses.

The expansion of the study in terms of sample size and the variety of information collected is hoped to allow for a broader understanding of students' expectations through the use of more sophisticated statistical analyses and the consideration of other influencing factors.

5. Discussion and conclusions

The results of this study highlight the presence of a relationship between previous schooling experiences and the self-assessment of one's performance during the first university exams. The explanations considered in this study pertain to individual factors, but we do not exclude the influence of organizational or institutional reasons.

Among the individual reasons, it can be noted that the students involved in the study are freshmen, and therefore still not very familiar with university evaluation methods. Additionally, they are socialized into evaluation criteria that are not particularly strict in high school, at least for students in technical and vocational tracks. To explain the misperception, the so-called "Dunning-Kruger effect" is also considered, as identified by David Dunning and Justin Kruger (1999). They highlighted how less competent individuals tend to overestimate their abilities, often due to a lack of awareness of their own limitations, while more competent individuals tend to underestimate their abilities due to excessive self-criticism.

Among the institutional/organizational reasons, we can point to the possibility offered to the students at the University of Turin involved in this study to "attempt" the exam in numerous sessions (up to eight per academic year) without any limits on the number of retakes. This large number of attempts might not encourage students to develop and strengthen self-assessment skills which are necessary to decide whether or not to take an exam when the opportunities are more limited.

This study leads to recommendations aimed at strengthening the existing support and orientation actions for freshmen at the University of Turin, such as tutoring for completing formal procedures, initiatives like "A Day as a Freshman" and "Welcome Freshmen". It is hoped that these will be complemented by increasingly individualized support actions for each freshman, as well as real opportunities for bridging the gap between high school and university to facilitate the transition.

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STUDENT COMPETITIONS: OPPORTUNITIES TO PRACTICE INTERDISCIPLINARY KNOWLEDGE IN PRACTICAL PROBLEM SOLVING

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Abstract

Various recommendations and actions have been taken regarding Estonian educational strategies that emphasise the value of science education. One example is STEAM (Science, Technology, Engineering, Arts and Mathematics). This approach makes scientific content understandable and science-related professions attractive to students. STEAM as an educational approach connects various disciplines. Home economics, as a subject area, can complement a STEAM education with practical activities. It helps to set gained knowledge into a real-life context and strongly supports fostering students' 21st-century skills. The recently developed Science Kitchen learning environment at Tallinn University provides opportunities to connect theoretical understanding and practical activities in a way that supports the transfer of knowledge and skills into learners' everyday lives. Moreover, the student competition Kringel demonstrates the connections between home economics and a STEAM education by focusing on food-related processes grounded in scientific principles. To deepen the Kringel competition's concept and learn from good practices, an online literature search was performed studying scientific peer-reviewed articles from the last decade (2014–2024). We targeted articles on academic competitions for students. This systematic analysis enabled us to provide an overview of the aims, content and organisational issues as well as the possible impact of such events from the students' perspective. A contemporary subject competition has a multi-stage structure, containing theoretical and practical tasks that engage students or student teams in providing solutions to real-life problems. Besides strengthening students' subject-related knowledge, these strongly support the development of 21st-century skills. The findings are used to determine the developmental implications of the Kringel competition.

Keywords: *Students' competitions, home economics, STEAM.*

1. Introduction

Estonian educational strategies (e.g., Haridus- ja Teadusministeerium, 2021) emphasise the importance of science education at all academic levels. Recommendations and actions are taken to make scientific content understandable every day and to make science-related professions attractive to students. STEM is a well-known educational approach that connects various disciplines – science, technology, engineering and mathematics – whereas STEAM merges the arts with STEM subjects (Perignat & Katz-Buonincontro, 2019). The latter is the fundamental approach used in this study. Home economics as a subject area can complement a STEAM education with practical, real-life activities (Paas et al., 2025). Notably, students are more motivated and involved in lessons when they can connect the learning content to their real-world experiences (Christensen, 2019). The field of home economics is, therefore, beneficial because it helps set the knowledge learned from school subjects into real-life contexts and strongly helps foster students' 21st-century skills, namely the 4Cs: collaboration, cooperation, critical thinking and creativity (Taar & Palojoki, 2022). These valuable cross-curricular skills are essential for the future, in further studies, in future professions and generally in everyday life.

Unfortunately, schools often lack the needed equipment and have face-time limitations for teaching the analytical and problem-solving skills that accompany STEM (Morgan, 2015). Therefore, a variety of alternative extracurricular activities and informal learning environments have received attention in educational settings to develop science literacy and promote students' learning (Sahin, 2013; Robelen, 2011). The recently developed Science Kitchen, a learning environment at Tallinn University, provides opportunities to connect theoretical understandings and practical activities in a way that supports the transformation of knowledge and skills into learners' everyday actions. It unites a multifunctional classroom, study kitchen and lab. To support and strengthen the Science Kitchen concept, funding was received from the EU's Horizon Europe Widening Participation and Spreading Excellence Programme for

the project SHAREE, i.e., STE(A)M for Home Economics and Research Exchange (Tallinn University, n.d.).

Several activities have been developed for the SHAREE project to bridge home economics topics with STEAM pedagogy. One activity is the extracurricular national competition Kringel (i.e., the pretzel-shaped striezel, a typical pastry in Estonia), targeting talented science-motivated Estonian high school students aged 16 to 19. Estonia has other STE(A)M-related competitions (e.g., the Estonian Science Olympiad) that combine science subjects and engineering, although the connection with arts or real-life content is not always thoroughly established.

Kringel offers students an interactive way of solving real-life problems rather than working on formal textbook tasks, which might be the case in competitions (Morgan, 2015). Karpov (2003) pointed out that pure scientific knowledge and pure procedural knowledge might remain meaningless for students and non-transferable beyond the classroom. Home economics tasks allow the implementation of knowledge acquired at school into practical knowledge applied at home or to other school subjects, as noted by Taar and Palojoki (2022). Furthermore, combining STEAM and home economics allows students to engage in practical activities that integrate STEAM concepts into concrete situations (Paas et al., 2025).

In addition, extracurricular competitions with hands-on experiences motivate future scientists and help students develop skills relevant to STEM careers (Stringer, Mace, Clark & Donahue, 2020; Miller, Sonnert & Sadler, 2018). Furthermore, competitions and other STEM-related extracurricular activities are gateways to STEM-related higher education and careers for many students (Morgan, 2015).

2. Methods

This paper shares the results of a decade-long review (2014–2024) of scientific peer-reviewed articles, including research and review articles, to deepen the Kringel concept. We performed an online literature search using EBSCOhost e-databases available to registered library users at Tallinn University. The search terms were ‘national competition for students’, ‘school contests’, ‘STEM competition AND education’, ‘STEM contest AND education’ and ‘STEM Olympiad AND education’. Articles concentrating only on theoretical competitions, music or sports competitions, the winners’ profile or coaches’ role were excluded from the analysis. Additionally, the chosen articles were limited to secondary and higher education levels.

Overall, 398 topical scientific articles were available with full access to the database, while 15 relevant papers remained eligible for inclusion after careful reading. The thematic analysis (Ezzy, 2002) was used to pinpoint the four key themes in the articles, namely content, competition aims, organisational issues and the possible impact of such events from the students’ perspective. Two researchers read the texts several times, coded and recoded the topical extracts (n = 106) and systemized the codes into categories.

3. Results

The findings of the analysis are presented, relying on the four key themes. The chosen sample represented competitions with both national and international influence. Most international competitions act as a final level at which students compete, meaning that if students win at the local and national stages, they are expected to represent the country internationally. International competitions are organised for students from the upper grades, mostly at the high school level.

The first theme to discuss is competitions’ content, which strongly relates to the science aspect of STEM (Table 1). Nevertheless, the content did not integrate all the subject fields into the same competition. Rather, specific subject areas, such as physics or robotics, are represented, opening up the subject content in more detail. None of the STEAM competitions was represented in the sample. Since scientific articles aim to address a broader aspect of competition (e.g. gender equality or motivational aspects), several articles fell short in thoroughly describing the content or nature of the competition.

The second theme, the aim of the competition, was described in more detail in the analysed articles. Three categories summarise the aims of the sample, namely subject-specific content (n = 19), 21st-century skills (collaboration, cooperation, critical thinking and creativity; n = 8) and performance aspects (n = 4). The most common aim of the competitions relates to subject-specific content.

Competitions are organised to enhance participants’ knowledge and skills (n = 13) or, more broadly, to strengthen their interest or motivation in the subject area (n = 4). Interest and motivation are perceived as crucial factors in students’ future career choices, which was mentioned as a long-term aim concerning the two analysed competitions.

Table 1. The content overview of the analysed data.

	Title of the competition	Influence area	Subject area	Target group
A1	World Robot Olympiad	International	Robotics	Aged 10-16
A2	World Robot Olympiad	Asia	Robotics	Primary, secondary school
A3	InfoSukces Contest	Poland	Informatics	Aged 14-18
A4	Cryptography Competition	Bulgaria	Cryptography	Grades 5-7
A5	Ireland's Future is MINE	Iceland	Minecraft	Grades 3-6
A6	National Technology Competition	Taiwan	Technology	Middle school
A7	1st European Physics Olympiad	International	Physics	High school
A8	XXII Ibero-American Physics Olympiad	International	Physics	High school
A9	German Physics Olympiad	Germany	Physics	Secondary school
A10	SciChallenge	International	Science	Aged 10-20
A11	International Sustainable World Energy, Engineering, and Environment Olympiad	International	Science	High school
A12	Sleek Geeks Science Eureka Prize	Australia	Science	Primary, secondary school
A13	National Chemistry Competition	Macedonia	Chemistry	Grade 8
A14	Plant Science competition	Australia	Plant science	Up to year 12
A15	10th International Earth Science Olympiad	International	Earth science	High school

The development of students' 21st-century skills is also considered important because all 4Cs are represented in the aims of the competitions. For example, the German physics competition mainly concentrates on the development of such skills, listing collaboration, creativity and critical thinking among the aims of that competition. There was little emphasis on the competitive aspect of the event, for example, evaluating one's performing or identifying the most talented students.

The third theme is impact. Compared with the aims, the organisers have set more demanding expectations for the impact (n = 83) of students' competitions. Again, codes were grouped into three categories – subject-specific impact (n = 33), impact on 21st-century skills (n = 26) and impact on students' personal strengths (n = 24). When studying subject-specific expectations, it becomes evident that competitions should provide content knowledge and deepen students' understanding (n = 12) of given topics. Moreover, the competition's content could attract students and enhance their interest (n = 11) in specific subject fields. As stated earlier, the results also demonstrate strong hope that competitions will strengthen students' choices of STEM careers.

Developing students' communication skills (n = 10) is in the lead in terms of 21st-century skills, predominantly in competitions where students work in groups. In addition, competitions offer opportunities to become familiar with subject enthusiasts globally. Teamwork is also considered to strengthen collaboration skills (n = 6). Critical thinking (n = 5) through analytical ability, logical capability or just broad thinking skills, as well as creative problem solving (n = 6) are perceived as an added value of competitions.

Moreover, expectations of students' personal strengths become visible through various aspects pointed out in the articles. For example, the articles note aspects of competing (n = 6) and expressions such as 'learning to challenge themselves'(A2), 'to cope with pressure'(A2) or 'nurture students' individual potential and interests regardless of success'(A9). New experiences (n = 3) can present both 'stressful situations' and the possibilities of taking part 'in the fun activities' as part of extra-competition activities. Students, organisers and coaches observe the benefit of competitions in students' confidence (n = 4), discipline-specific development (n = 3) and in their life attitudes (4). In addition, students gain new learning tools and practice time management.

The fourth theme, organisational aspects, reflects practical examples of how the studied competitions are structured and held. Two categories emerged from the data: practicalities (n = 88) and engagement (n = 14). The practicalities first include the method of participation. Not all articles mentioned such details; therefore, the overall tendency is impossible to say. However, based on the available information, there are equally many competitions in which students participate individually or in teams. In some competitions, it is even possible to choose how to participate. Descriptions reflect that students prefer working with peers and having the opportunity to discuss possible solutions.

One of the criteria in the article search was practical tasks; therefore, all the represented competitions contained some kind of practical activity in which students had to use their knowledge in

real-life situations. Some competitions (n = 7) also included theoretical tests. In four competitions, the content was only practical, and in four competitions, we did not obtain sufficient information on the given aspect. Based on the available information, at least 10 competitions were organised in different stages. Usually, there is a local-level preliminary stage for engaging more students to participate. Larger competitions are held in various age groups in parallel. The practicalities also include providing supportive materials for coaches. Information sheets, training materials or lists of additional materials provide teachers with basic information about a particular topic or the societal challenges of a given issue. Award-related information was again unequally mentioned by the articles. However, winners are always awarded, in some cases with medals or even with an impressive monetary prize.

The category 'engagement' includes various examples of including stakeholders in the competition's organisation. In the pre-competitions phase, collaborative partners are sought to support the event in both content and funding, for example supporting students with scholarships to participate in international events. During the event, scientists might engage in networking to enable students to make contacts and have discussions with experts. Quite ordinary in these international competitions is offering extra-competition activities, such as 'a rich programme of talks, exercises and excursions that allows exchange among the students'(A9). Gifted students enjoy meeting new friends with similar interests. The public should be invited to follow the event at the venue or through social media. In any case, engagement attracts participants by adding value to their work in the competition and achieving a greater impact for the event.

4. Discussion

Similar to Christensen (2019), we have observed that subject competitions encompass a range of educational themes and pedagogical approaches. Nevertheless, the competitions are designed to engage students in real-world problem-solving tasks, enhance their interest in specific subject areas and foster their awareness of potential career paths. Because our findings have predominantly developmental implications, we hereby describe the details of the Kringel competition by considering the results gained through the analysis.

We define the Kringel competition as an annual event in which Estonian high schoolers have the interactive opportunity to challenge themselves and compete against peers in integrated STEAM and home economics content. As per the findings, it is difficult to unite all STEAM disciplines into one competition, whereas the scientific aspect of the acronym is mostly presented. Cristensen (2019) noticed a similar phenomenon. We thereby centred the sciences and arts at the contest.

Kringel complements curricular content, highlighting food-related processes often based on scientific principles for which students must integrate knowledge of various disciplines to understand and make sense of given problem-solving tasks. Thereby, Kringel focuses on transferring knowledge by combining the two sides stated by Taar and Palojoki (2022): theoretical knowledge and practical skills.

Kringel aims to support students' subject-specific interests and knowledge and to support all 4Cs. The tasks are planned to support students' critical thinking and creativity, while teamwork expects collaboration and communication skills. Students participate in the competition as a three-student team from one school. Participating in teams has several advantages. Working in teams allows the complementing of each other's knowledge and experiences to bridge the gaps one might face alone. The findings illustrate that students enjoy engaging in competition with peers. In addition, Stinger et al. (2020) indicate that peer influence correlates with interest in future STEM careers.

As reflected in the competitions, we hope that Kringel's content will attract students and enhance their interest in home economics and STEAM areas. The desired impact could be students' ability to notice science in their daily lives. We are not aiming for the level of international competitions; rather, we hope that Kringel demonstrates that science-based subjects can be comprehensible and engaging to all students. Therefore, for wider engagement, the competition has been divided into two stages so teachers can implement the competition into their learning.

In the first stage, students solve tasks in an online form. Several food-related questions and tasks guide students in combining their theoretical knowledge with practical experiences to work out solutions. As a practical outcome, the teams assemble a one-minute video explaining one food-related scientific process or reaction. In a well-made video, scientific terms are used to explain the processes, and calculations or formulas are included. An important aspect of the video is creativity. The 12 best teams are invited to the second stage, where students compete in the Tallinn University Science Kitchen and Physics Lab.

In the second stage, students have both theoretical and practical tasks that involve a knowledge of home economics, chemistry, physics and geography. The practical tasks expect students to use 21st-century skills when solving experimental problems in teams. As is typical of home economics education, the results are evaluated not only for correct subject knowledge but also for their aesthetic appeal.

5. Conclusion

Although subject-specific competitions evolve, they remain relevant to educational contexts. These competitions not only adapt to changing trends and educational priorities but also serve as a platform to engage and challenge students with a special interest in the subject areas, including STEAM education. For students, it is a valuable opportunity to meet like-minded peers and challenge themselves with tasks, expecting more effort to perform than in school tasks. To remain effective, student competitions should keep pace with changing times and educational expectations, support student development and provide both engagement and sufficient challenges for young learners with a special interest in particular fields. Therefore, aspects such as students' performance and experiences in the competition require further research to better prepare the tasks for the competitions.

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POSTERS

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TRANSITIONING PROFESSIONAL CURRICULA TO WORKFORCE DEVELOPMENT TRAINING: BRIDGING EDUCATION AND EMPLOYMENT

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Abstract

The field of community recreation and youth development often attracts individuals with degrees in related fields (e.g., kinesiology, child development, education) or those with no post-secondary education but substantial experience. While qualified for entry-level positions, these individuals require additional training to develop the competencies needed for career advancement. Adapting a professional recreation education curriculum into a workforce development training series is key to aligning educational offerings with industry needs. This shift transforms traditional academic programs into flexible, skills-based training that caters to a diverse, non-traditional workforce. The transition involves several key steps: focusing on applied skills, incorporating industry-specific tools, and aligning outcomes with professional certifications and job opportunities. The training must also be modular, allowing for different learning styles and experience levels, and fostering greater inclusivity. Instructional methods emphasize hands-on learning, problem-solving, and situational applications, using both in-person and online formats to maximize reach. Ongoing evaluation is vital to the success of the transition. Feedback from employers, trainees, and instructors helps refine and improve the training program. Success is measured not only by completion rates but also by post-training employment outcomes, retention, and career advancement. Ultimately, this transition bridges the gap between education and employment, equipping individuals with the practical skills necessary for success in the modern workforce. By focusing on tangible skills, certifications, and career pathways, this workforce development training offers a responsive, scalable solution to workforce needs, promoting economic mobility and professional growth.

Keywords: *Workforce development, professional curriculum, skills-based training.*

1. Introduction

The field of community recreation and youth development is integral to fostering healthy and engaged communities. A community recreation department, operated by a public entity such as a city or county government, provides sports, arts, culture, and other recreational activities designed to enrich the lives of its residents. Full-time employees in these programs commonly fall into two categories, the first is those with college degrees in recreation or a related degree. Related degrees include areas like education, child development, and kinesiology. The second category is those with little or no formal post-secondary education. These individuals begin in part-time positions, and over time their experience creates opportunities for full-time employment. While either path is adequate for entry-level positions, individuals without a degree in recreation may face challenges in advancing their careers due to gaps in specialized training and competencies. The need for additional development becomes especially pronounced as the demand for skilled professionals grows in this field. Thus, transforming traditional academic programs into workforce development training series offers a practical solution for aligning educational offerings with industry needs.

The conversation concerning the need for workforce development in community recreation is taking place across the United States. Recognizing the critical contributions workforce development programs make to the future success of the field, the National Recreation and Park Association conducted a survey to better understand the current state of workforce development programs (NRPA, 2020). Results indicate one in three respondents have an existing workforce development program and one in five are working to establish a program. Agencies in urban areas were more likely to have a program currently in place but interest in developing programs was consistent across urban, suburban, and rural agencies. Several program structures exist but the most common workforce development programs are:

- In-house staff training (84 percent)
- Leadership development (71 percent)

- Transitional employment opportunities, such as entry-level jobs and internships (68 percent)
- Summer youth development programs (58 percent)
- Specialized skill-based training programs, such as first aid, public safety, horticulture and green infrastructure (53 percent)

2. Design

Fresno California is located in the middle of the state of California with a population of 545,716 (US Census Bureau, n.d.). Fresno's recreation services are provided by the Parks, After School, Recreation and Community Services (PARCS) Department. The main function of PARCS is to offer the public access to green space to enjoy leisure and recreation. PARCS (2025) maintains the City's 1,500 acres of open space and the team is devoted to providing organized recreation programs and activities for the community.

In 2024, the PARCS Department began a conversation with the Department of Recreation Administration at Fresno State to determine a structure to develop and implement a workforce development program for its employees. Partnerships are a common element of workforce development (NRPA, 2020); however, it is not common to see a partnership with a local university. Literature on workforce development, however, supports the idea that a critical component of workforce development is the transformation of traditional academic programs into flexible, skills-based training (Chau, Bana, Bouvier, & Frank, 2023). Academic curricula tend to focus on theoretical knowledge, which is important, however, it can lack the practical skills required for success in the workforce. This transition involves rethinking the educational approach to emphasize applied skills, situational problem-solving, and the use of industry-specific tools.

A shift from theoretical-based programs to practical, job-focused training can better prepare individuals for the rapidly evolving demands of the recreation and youth development sectors. For instance, training programs that incorporate hands-on learning experiences, such as workshops and real-world scenarios, equip trainees with the tools necessary to succeed in their day-to-day roles. This shift should focus on enhancing specific competencies, including leadership, communication, and programming skills. Furthermore, aligning educational outcomes with professional certifications is critical, as these credentials can open doors for greater job opportunities and career advancement.

In the initial conversations between the PARCS Department and the University, the PARCS department identified several priorities, including 1) Current full-time employees, 12-month intermediate-level training; 2) Current part-time employees, 12-month beginning level training; and 3) Summer youth employment, 3-month intensive beginning-level training. Understanding that the training should be specific to needs and abilities, and based on current needs, the initial focus was on a year-long training for current full-time employees. With the intention of developing training for the other groups over time, the partnership recognized that by offering a variety of training options, they can cater to different learning styles and experience levels, ensuring that the program is inclusive and accessible to a broader range of individuals.

Agency structure dictated a 12-month format so the training schedule was developed to fit into this structure. Content, instructional methods, and delivery formats were key considerations. Four broad categories of competencies were identified for this group (See Table 1). The categories were then operationalized by identifying courses where those competencies were addressed and identifying key learning outcomes in each area. Faculty with expertise in each subject area were recruited to create and deliver interactive, skills-based training.

Conforming to agency practices, the training was designed to occur in person once a month for four hours. In-person learning provides the benefit of direct interaction and hands-on practice. These immersive experiences help trainees gain confidence and proficiency in handling real-world situations. Additional materials are provided online through a learning management system and can be completed asynchronously by the trainees. This allows flexibility, allowing trainees to progress at their own pace, and proves the opportunity for trainees to meaningfully engage in the content. This blended learning approach, having both in-person and online learning, helps to address a diversity of learning styles and provides the opportunity for trainees to revisit materials as needed.

3. Evaluation

The success of workforce development programs depends on their ability to evolve and adapt in response to the needs of both the participants and the employers. As such, ongoing evaluation is essential to ensure that the training remains relevant and effective. Feedback from employers, trainees, and instructors can provide invaluable insights into areas where the program may be lacking or where improvements can be made. Due to administrative delays, this program has not yet gotten underway,

however, a key element in its planning has been a determination of how the training is to be evaluated. PARCS and the trainees themselves will provide feedback on the alignment of skills needed in the workplace with the competencies taught. Instructors will identify challenges in format and structure and will be able to suggest ways to enhance the training experience. Collectively, this feedback creates a cycle of continuous improvement, ensuring that the program remains up-to-date with industry trends and workforce demands.

Perhaps key to the determination of success is the tracking of post-training employment outcomes, such as job placement rates, job retention, and career progression, to determine whether the program is leading to tangible improvements in participants' professional lives. By monitoring these indicators, trainers can refine their curricula and instructional approaches to better serve the workforce and adapt to changes in the field.

4. Conclusion

Workforce development in recreation is essential for addressing the evolving needs of the industry and ensuring that individuals are equipped with the practical skills and competencies necessary for career advancement. This is especially important in a field that is increasingly becoming professionalized, as employers seek employees possessing both the technical skills and the interpersonal competencies needed to excel in their roles. By adapting traditional educational models into flexible, skills-based training programs, this shift fosters a more inclusive, responsive, and accessible workforce. Through hands-on learning, modular training, and ongoing evaluation, workforce development programs can help bridge the gap between education and employment, promoting career growth, economic mobility, and professional success in the community recreation and youth development sectors. As such, these programs represent a crucial step toward building a more capable, skilled, and sustainable workforce for the future.

Table 1. Themes and Workshop Topics Workforce Development Training.

Professional Development Theme	Month	Workshop Topics
Fundamentals	January	Foundations and Careers in Recreation
	February	Diversity and Inclusive Practices
	March	Municipal Government
Programs & Operations	April	Recreation and Parks Facilities
	May	Programming in Recreation
	June	Special Event Planning
Comm Relations & Special Demographics	July	Community and Non-Profit Recreation Ser
	August	Recreation and Older Adults:
	September	Programming for Youth At-Risk -
Leadership & Professionalism	October	Leadership
	November	Research and Evaluation

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HIGHER EDUCATION FOR SOCIAL EDUCATORS IN ITALY: THE IMPACT OF THE INITIAL TRAINING EXPERIENCE ON COMPETENCIES DEVELOPMENT

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Abstract

The world of educational professions is re-reading and reforming skills effectively and functionally to solve increasingly complex educational and training problems and respond to targeted quality interventions. Today, education has a fundamental and powerful meaning since it directly responds to resolving social issues through educational action. In the European community scenario, education professionals are necessary to promote individuals' well-being and harmonious development. In Italy, with L. 205/2017 and L. 55/2024 recognizing the profession and establishing a professional order, it shed light on training professionals to deal with educational practice. The reflection on the design of training provision to develop the competencies of professional educators within initial training paths is a crucial topic that requires careful discussion. What is the real impact of university training experience for professional educators serving in the national territory? This question is the base for the project which plans to investigate how much initial training courses contribute to forming competent and effective professional social educators. The final research object is to explore mixed survey processes that provide for administering a questionnaire to professional social educators serving in the national territory. The contribution aims to provide an overview of the results obtained from the survey conducted and to bring out the opinions and perspectives of educators.

Keywords: *Educational needs, social educators, training paths, professional competencies.*

1. Introduction

The modernity of our time is marked by numerous changes that bring with them a series of complex and varied socio-educational problems and emergencies (ONU, 2015). Consequently, the field of educational professions is re-examining and reformulating competencies effectively and functionally to address educational and training issues (Gaspari, 2018), responding with targeted and increasingly high-quality interventions (WHO, 2016). Today, education holds a fundamental and powerful meaning as it represents a direct response to resolving social issues through educational action, even within the European community where education professionals play a necessary role in promoting the well-being and harmonious development of individuals (Euridyce, 2023; 2019). Therefore, professional educators are key players in implementing educational practices that address the complexity and challenges of the system (Gaspari, 2018). With Law 205 of 2017 and Law 55/2024, the professional educator obtains normative recognition regarding the profession and qualification, shedding light on the issue of training professionals capable of addressing educational practice (Gaspari, 2018). The definition and development of solid professionalism, functional to applying knowledge and competencies, are achieved through targeted and planned initial training pathways to ensure high standards of practical and quality training (Rossini, 2020). Universities have the full responsibility to train education professionals, adapting training pathways to the needs of real contexts (European Commission, 2020), allowing future professionals to develop skills and knowledge suitable for addressing the wide range of evolving and growing educational and training needs (Sposetti et al., 2022; Boffo, 2021; Biasin et al., 2020;). Reflection on the design of educational offerings to develop the skills of professional educators within initial training pathways is a crucial topic that requires careful discussion. But what is the real impact of the university training experience for professional educators in service throughout the national territory? It is from this question that the project takes shape, aiming to investigate how initial training pathways contribute to the formation of competent and effective professional educators.

2. Design, methods and objectives of research

The reflection on how to build the professional competencies of educators within initial training pathways is a central theme in the academic debate (Sposetti et al., 2022; Fioretti, 2022; Boffo, 2021). However, it is increasingly urgent to strengthen the connection between academic training and the real contexts of educational work in order to design coherent and meaningful learning experiences (European Commission, 2016; 2020). In this framework, the research project is guided by key questions: What competencies are essential for professional practice in education today? How do these competencies develop through work experience? The main objective is to investigate how in-service educators develop their professional identity, which competencies they use and consider essential, and how their training and professional practice have contributed to shaping their expertise (Rionero et al., 2024). The exploratory study follows a mixed-methods approach and is organized into five phases. The first phase involves the construction of a questionnaire divided into four sections. The tool includes both closed and open-ended questions and aims to collect descriptive data on competencies considered essential for practice, the level and type of initial and ongoing training received, and to promote self-assessment of technical, organizational, relational, and reflective competencies acquired and consolidated through professional experience. The second phase consists of submitting the research protocol to the CERT ethics committee of Sapienza, University of Rome for approval. Before full deployment, the questionnaire will undergo a try-out phase to assess the effectiveness of the items. In the third phase, the questionnaire will be distributed online via Google Forms to a national sample of in-service educators, selected using snowball sampling. Finally, the fourth phase focuses on data analysis using mixed methods: descriptive statistics for the closed questions and qualitative analysis for open-ended responses. The latter will follow a bottom-up, evidence-based coding approach (Braun & Clarke, 2006; Gale et al., 2013), aimed at identifying recurring patterns and shared meanings supported by statistical analysis software.

3. Results

The questionnaire was administered to a random sample using the snowball method and reached 324 socio-pedagogical professional educators operating nationwide, all of whom have been working in the field for over five years. The sample consists predominantly of female professionals (91.7%) with an average age of 38 years. The three most represented regions are Lombardy (22%), Lazio (13.3%), and Sardinia (12%). The socio-pedagogical educators who responded to the questionnaire are primarily employed in private services (70.7%), such as nursery schools (28.7%), educational support in schools (16%), day centers for individuals with psycho-physical disabilities (9.1%), 0–6 educational services (6.8%), or other types of services (39.4%). Of the total (324 persons), 35.5% hold a degree in Education Sciences (L-19), qualifying them as socio-psycho-pedagogical educators, while 17.6% have obtained a Master's degree in Pedagogical Sciences (LM-85). Among the 324 respondents, 173 professionals continued to complete the section of the questionnaire dedicated to pre-service university training. Of these, 40.5% reported that the knowledge and skills acquired during academic training were "fairly useful," identifying the internship experience as the most formative activity (79.2%) due to its experiential nature and the opportunity for reflective practice on theoretical content. Regarding in-service training, 34.6% of the total sample reported not being involved in any continuing education or professional development programs. Nonetheless, 87% of respondents expressed a need to acquire further tools and knowledge to enhance their educational practice. Frequently mentioned topics include psychological aspects related to the functional psycho-physical development of children and parental support, emotional regulation, and educational planning in complex contexts.

4. Discussion and conclusion

The analysis of the quantitative data, briefly presented here, together with the ongoing qualitative investigation, clearly highlights a strong and shared demand from socio-pedagogical educators to revise university degree programs in order to foster a more effective connection with the concrete realities of educational work. Alongside this need is a growing awareness of the importance of in-service training, recognized as a key resource for updating and improving educational practices, although it remains insufficiently widespread across educational services. It is within this context that the proposed research project is situated, aiming to support the development of both initial and in-service training programs that are more closely aligned with real-world educational practice.

The perceived gap between academic training and the complexity of professional contexts calls for a deep rethinking of how training pathways are designed. While the transmission of pedagogical knowledge and approaches during university education is undoubtedly essential, it is not sufficient: it is the

concrete experience in educational settings, with their daily challenges, that gives meaning and substance to this knowledge, transforming it into live, actionable competence (Perillo, 2023; Sposetti et al., 2022). In this light, listening to the experiences of in-service educators becomes a privileged channel for building a meaningful bridge between theoretical and practical knowledge (Rionero et al., 2024).

Universities and the field of educational work are therefore called upon to engage in a shared effort to prepare professionals capable of navigating complex situations and promoting the well-being of the individuals they work with (Boffo, 2021; Rossini, 2020). Designing training paths that are coherent with the actual needs of educational services has become an urgent priority (Perillo, 2023). From this perspective, situated practices and reflective experience play a central role in the development of innovative teaching methodologies that can support the continuous and dynamic growth of professional competence.

Rethinking both initial and continuing education in light of real practices and professional experiences means not only responding to a call for coherence and quality but also actively contributing to the construction of a shared and recognized professional identity over time.

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COMMUNICATION AND SELF-CARE TRAINING FOR NON-TEACHING UNIVERSITY EMPLOYEES

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Abstract

The work duties of non-teaching first contact employees (employees of study departments, libraries, student houses, canteens and others) at the Pavol Jozef Šafárik University in Košice are focused on providing assistance to students and guiding them through the various challenges of university life. In the current situation of increased levels of inclusion and diversity at universities, the demands and pressure on first contact employees are also increasing, with regard to managing various crisis situations or working with specific types of students. The main aim of this study is to a) introduce training program for non-teaching first contact employees; b) explore the perceived effectiveness of this training through the degree of perceived usefulness by employees. The training program, conducted in February 2025, focused on enhancing communication skills, conflict resolution, and self-care practices. The training employed activating teaching methods to ensure participant engagement and practical skill acquisition. Specialized lecturers delivered parts of the training, including a session on supporting students with special needs and a mindfulness workshop aimed at stress management. A total of 36 employees (mean age = 42.5; SD = 3.45) participated in the program. To assess the perceived usefulness of the training, a custom-designed questionnaire was developed, comprising three subscales: Communication, Managing Stress, and Managing Conflict, each consisting of six items. The questionnaire was administrated 2 days after the training. The internal consistency of the questionnaire was high, with Cronbach's alpha exceeding 0.85 for all subscales. Additionally, a modified version of the Session Rating Scale (SRS) with four items was administered to gather immediate feedback on the training experience. Results indicated no statistically significant differences in perceived usefulness between employees with more than ten years of experience and those with less than ten years, nor between student office employees and other staff categories (e.g., library staff, dormitory staff, international office employees). Overall, the training was evaluated as highly effective, with mean scores across all subscales exceeding 4.0, indicating a positive reception and perceived utility among participants. The findings suggest that targeted training programs employing interactive methods and addressing specific workplace challenges can effectively enhance first-contact employees' preparedness to support a diverse student body while promoting personal well-being.

Keywords: *Non-teaching staff, communication, conflicts, stress, training.*

1. Introduction

Frontline non-academic staff (such as employees of study departments, libraries and student dormitories among others) play a key role in providing information, support, and administrative assistance to students. This represents a specific type of interaction in which frontline staff are placed in a position where concrete advice or intervention is expected from them. Interpersonal and communication skills are critical for both the effectiveness of their work and their overall job satisfaction (Menke et al., 2020). Elevated stress levels among frontline non-academic staff are linked to various internal and external factors specific to each university (Mensah et al., 2017; Verma & Kumar, 2014). A significant and often stressful part of their responsibilities involves communication with students who may be angry, frustrated, or distressed. Survey findings have shown that nearly 40% of university students reported experiencing overwhelming anger during the course of two semesters (Preece et al., 2017). Some students express their frustration passively, while others may do so in ways that staff could perceive as threatening. A specific category includes students with special needs, whose numbers are steadily increasing year by year. Data from the Annual Report of the University Counseling Center at Pavol Jozef Šafárik University in Košice over the past three years indicate a significant rise in students with special needs (2020/2021 = 42 students; 2022/2023 = 61 students; 2023/2024 = 96 students). In order for frontline non-academic staff to effectively support students, help de-escalate emotional situations, or respond appropriately to their needs and feelings,

they must themselves feel safe and confident. Research highlights that one of the factors influencing job satisfaction among both academic and non-academic staff is the degree to which the organization provides care and support—such as access to supervision and training programs for professional development (Fabian & Reyes, 2024; Nacor, 2013).

2. Design and objectives

A cross-sectional design was used. The main aim of this paper is to a) introduce training program for non-teaching first contact employees; b) explore the perceived effectiveness of this training through the degree of perceived usefulness by employees.

3. Methods

3.1. Sample and procedure

A total of 36 employees (mean age = 42.5; SD = 3.45) participated in the training. The training program was focused on two key areas: a) development of communication skills (including the advantages and disadvantages of various communication forms, effective communication, introduction to helping conversations, crisis intervention, conflict management, and working with specific types of students), and b) self-care (covering stress and relaxation techniques). To assess the perceived usefulness of the training, a custom-designed questionnaire was administered two days after the training. Given the length, content, and format of the intervention, we chose to evaluate the effectiveness of the program by examining the extent to which it met participants' needs, their satisfaction levels, and the perceived usefulness of the training.

3.2. Measures

- Session Rating Scale (SRS) (Johnson, 1995) is four-item scale designed to assess the quality of the therapeutic alliance. In this study it was adapted to evaluate the training alliance. The scale uses 4-point Likert-type responses (1 = not true at all, 5 = very much true) across the following subscales: Relationship, Goals and Topics, Approach or Method, and Overall. Cronbach alfa was 0.72.
- Communication scale is customed-design scale created for the purpose of this research. It consistent from 6 items focused on: clarity and comprehensibility of communication, self-confidence in communication, knowledge of specific communication techniques, ability to adapt communication style to challenging situations, and perceived adequacy of the training content. Responses were recorded on a 5-point Likert scale (1= strongly disagree, 5 = strongly agree). Cronbach alfa was 0.92.
- Managing Stress Scale is custom-designed 6-item scale measuring the ability to identify sources of stress in both personal and professional contexts, self-confidence in managing stressful situations, knowledge of specific relaxation strategies, and perceived ability to cope with or prevent stress. Responses were recorded on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) Cronbach alfa was 0.89.
- Managing Conflict scale is a custom-designed 6-item scale focused on self-assessment of participants' abilities to identify the causes of conflict, respond effectively to conflict situations, and prevent their escalation. Items included references to interactions with both students and colleagues, self-confidence in conflict resolution, knowledge of specific intervention techniques, and overall perception of the training's usefulness. Responses were recorded on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Cronbach alfa was 0.93.

3.3. Results

3.3.1. Introduction of training program. The training was delivered in the form of an intensive two-day in-person workshop, with 36 participants per session. The sessions run from 8:30 AM to 4:00 PM each day and combine theoretical input with practical exercises, group activities, and experiential learning.

- Day 1 focuses on: Effective communication with students in psychologically sensitive situations; Managing conflict in academic settings; Self-care and stress management strategies for educators
- Day 2 builds on this foundation with sessions on: Relaxation techniques and grounding methods; Basic crisis intervention and referral strategies; Conflict resolution in the workplace; Program reflection and evaluation.

Participants are encouraged to bring comfortable clothing and yoga mats, as the program includes practical components such as guided relaxation and movement. All training materials, writing supplies, and catering were provided.

3.3.2. Effectiveness of the training program. The data were analysed by IBM SPSS Statistics, version 21 for Windows. The results have shown no statistically significant differences in perceived usefulness between employees with more than ten years of experience and those with less than ten years, nor between student office employees and other staff categories (e.g., library staff, dormitory staff, international office employees). Overall, the training was evaluated as highly effective, with mean scores across all subscales exceeding 4.0, indicating positive feedback among participants.

Figure 1. Descriptive statistics of research variables.

	N	Min-Max	Mean	St. deviation
SRS	36	1-5	4.77	0.32
Communication scale	36	1-5	4.03	0.72
Managing stress scale	36	1-5	4.01	0.77
Managing conflict scale	36	1-5	4.08	0.76

4. Discussion and conclusion

The training program was developed in response to a critical and often overlooked need within university support systems: the psychosocial preparedness of non-teaching first-contact staff who are neither clinically trained nor institutionally supported to manage encounters. Presented training program directly addresses this gap offering a structured, evidence-informed program focused not only on skill-building in communication and conflict management, but also on cultivating a sense of self-efficacy and psychological safety among participants themselves. Supporting both the student and the staff members is essential in a time when student populations are becoming more diverse, more vulnerable, and more likely to seek help. By embedding practices such as guided reflection, grounding techniques, and relational micro-skills into an intensive yet accessible format, training offers containment, collegiality, and competence. The overwhelmingly positive reception from participants across departments and seniority levels suggests that this is not a peripheral benefit, but a core need. As universities seek to strengthen their support ecosystems, initiatives like our program should not be optional add-ons, but integral components of staff development policy.

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INTEGRATION IN WORKFORCE OF QUÉBEC ADULTS LIVING WITH AUTISM SPECTRUM DISORDER OR ASPERGER SYNDROME

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Abstract

This communication presents an exploratory study which evaluates the impact of the program *Le Pacte pour l'emploi: Le Québec de toutes ses forces (2008)*. This program aims at the professional integration of adults with autistic disorder (ASD) or Asperger syndrome (AS). This program is implemented in different regions of Quebec. The evaluation takes into consideration the conditions of employment, professional integration procedures and the receptivity of potential employers. The results show that the employment conditions of these people are quite similar. However, the type and number of services offered as well as the training of information agents vary from one employment center to another.

Keywords: *Autism, disorder, integration, adults, Asperger syndrome.*

1. Objective

Current employment conditions for people with Autistic Spectrum Disorder (ASD) are similar in all regions of Quebec. The majority of employment agents maintain that, without specialized training, these workers secure wages that correspond to the skill levels, often limited to the minimum-wage positions. Those organizations that employ trained educators to support new employees, to provide on-the-job follow-up, to make adaptations to the environment, and raise and to raise awareness in the community, would like to have more than one in their team. Such a specialized educator provides a framework for the worker and the workplace, which potentially contributes to success. There is a consensus that employment subsidy programs have adequate funding and financial resources, which often meet demands for successful workforce integration (Martin, 2018).

2. Methods

This exploratory research aimed to document services provided in employment centers for people with ASD or Asperger syndrome (AS), and to assess the impact of the implementation of the Quebec program. An important theme that emerged from the interviews highlights the transition from school to the job market as a turning point in these people's lives. Counselors at centers that have developed services in this area, realize the importance of investing in this transition process. In the case of centers that offer no transition services at all, it's unrealistic to think that a person with ASD or AS will be able to maintain a job position, if they have not had the opportunity to develop professional, communicative and social skills (Gouvernement du Québec, 2024).

Overall, the findings of this exploratory study indicate that professional integration for adults with ASD or AS follows a similar pattern across the six regions of Quebec. Based on questionnaire results, this study allows us to identify the different nuances of this problem, which, to our best knowledge, is unprecedented in our literature review on the subject. This analysis shows how far we have come and, above all, the challenges that still need to be addressed for a successful professional integration of adults with ASD or AS (Howling, 2000).

Considering the study findings, it is evident that some people enter the workforce long before obtaining a school-leaving certificate. Therefore, the following questions remain unanswered. What happens after school? Are we offering these students all the tools they need to achieve full citizenship? Should funding for the professional integration of adults with disabilities be used exclusively to add work contracts, internships and work contracts, internships and jobs with adapted companies? Are we providing the right tools and sufficient training for employment centers? Clearly, much remains to be done to improve support services for the professional integration and job of adults with ASD or AS.

3. Discussion

It is surprising and even concerning that only four out of ten agents report having required understanding of ASD and AS. Identifying the specific needs, strengths, and limitations of adults with these limitations requires knowledge. Why don't employment center managers and university programs offer courses and training on the different training on the different clienteles of employment centers? Why not structure the network into specialized vocational integration service points specialized according to the agent's expertise? This is so because we can't expect our agents to know all the particularities of each of limitations, nor can they be expected to know how to deal with all clients that they serve (Spectre emploi, 2024).

The introduction of the Quebec program is regarded as a commendable government initiative to address the issue of labor shortage. However, agents still question how the funds will be used: hiring specialized educators, awareness-raising employers in their region, setting up internships and exploratory workshops, etc.

In fact, this study emphases the professional integration of adults with ASD or AS extends far beyond searing employment and earning a salary. Various factors such as the employer's open-mindedness, training, employability, subsidies, etc., often add complexity to the job-hunting process. For example, employment centers do not necessarily have the same resources nor do they offer the same services pertaining to school-to-work transition, exploratory internships, training courses, specialized educators, adapted workshops, etc.

Moreover, most agents do not have the training required to sufficiently serve specific clienteles they work with on a daily basis. Undoubtedly, they do the best they can to help with what they know. Those who have employers who are more supportive of professional development are likely more at ease in their work, more realistic in their expectations and assessment of the candidate, better able to find the right environment and, thereby successfully integrating their clientele.

This research also highlights several weaknesses in the professional integration process of the adults concerned. Would it be more appropriate to fund the various services that play a decisive role in the success of professional integration? In any case, we can draw up a list of such services that deserve to be developed and financed: the school-to-work transition, on-the-job instructors - mentors in the workplace, an increase in the number of vocational integration agents in employment centers, internships, semi-specialized training, awareness-raising services for employers and co-workers, training for training for employment center agents in psycho-social matters and the development of subcontracting agreements. These are components likely to reinforce the various success parameters- the process of integrating adults with autism or ASD into the workforce (Nesbitt, 2000).

4. Conclusion

Finally, like most exploratory research, this one has its limitations. Here are at least three of them. Firstly, even though we had access to six regions of Quebec, it was impossible to obtain the participation of employment center agents in the Montreal area. From this first limitation stems a second: the limited nature of the sample. Thirdly, we regret that the Centres de readaptation en déficience intellectuelle-troubles envahissants du développement (CRDITED) did not participate in this study on the grounds that their current priority is early childhood. Their views would obviously have provided a broader perspective on this research. This absence is all more regrettable in that CRDITED are as important players as the employment centers we contacted.

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ASSESSING STUDENT PERFORMANCE AND DEVELOPMENT FOR SUSTAINABLE HIGHER EDUCATION

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Abstract

This research looks at the diverse topic of assessment and evaluation in higher education, focusing on students' viewpoints and experiences. Considering the different aspects impacting learning and skill development, including the changing dynamics of professionalization within the educational system, the study seeks to understand the complex link between assessment techniques and student performance. Data were obtained from undergraduate students enrolled in two Romanian institutions, covering a wide range of academic levels and study subjects. A survey was used to collect demographic information and responses to Likert-scale questions about students' satisfaction with academic achievement, preferences for assessment techniques, self-perceptions, study habits, and stress associated with evaluation procedures. Students were also questioned about their performance objectives, assessment preferences, and recommendations for improving academic support services. A descriptive analysis was undertaken to investigate university students' perceptions of the survey items. Because they promote meaningful learning experiences, lessen academic stress, and promote ongoing self-improvement, assessment tools are essential to this process. The results indicate that supportive academic settings and well-crafted assessment techniques can raise student engagement and motivation, which will ultimately help create a higher education system that is more future-focused and sustainable.

Keywords: *Higher education, evaluation choices, academic accomplishment, skill development*.

1. Introduction

Sustainable higher education is an educational system that promotes long-term academic, social, and economic progress while maintaining inclusion, equity, and adaptation to future problems. It combines sustainability ideas into academic institutions by encouraging lifelong learning, ethical responsibility, and environmental and social consciousness. A sustainable higher education system stresses student well-being, competency growth, and employability in a continually changing labor market (Klußmann et al., 2019). This approach stresses creative teaching and assessment approaches that improve critical thinking, creativity, and problem-solving abilities, preparing students for both professional and societal contributions (Kim, 2022). In addition, sustainable higher education prioritizes assessment and evaluation methods that go beyond traditional grading systems to encourage deeper learning, self-reflection, and skill acquisition (French et al., 2024; Marsh & Hagan, 2024). Digital innovations, formative assessments, and competency-based evaluations help create a student-centered learning environment, reducing stress and promoting engagement (Rayens & Ellis, 2018). Institutional policies also play a crucial role in sustainability by integrating flexible learning pathways, interdisciplinary collaboration, and environmentally conscious practices (Martin & Godonoga, 2020). By embedding sustainability principles into curriculum design, teaching methods, and institutional governance, universities can create an education system that remains resilient, equitable, and impactful (Chankseliani et al., 2021), ultimately shaping individuals who can address global challenges and drive sustainable development forward.

2. The importance of competency-based assessment for lifelong learning

In a continuously changing world, education must do more than just impart knowledge; it must also provide students with the skills they need to adapt, grow, and prosper throughout their lives. Competency-based assessment (CBA) is particularly important in this context (Ponomariovienė et al., 2025). Unlike traditional assessments that emphasize memory and standardized testing, CBA focuses on

what matters most: the capacity to apply knowledge, solve problems, and demonstrate mastery in real-world circumstances (UNICEF, 2019).

Consider a student learning not only to pass an exam, but also to understand complicated subjects, collaborate with others, and think critically in unexpected scenarios. Students are encouraged to take responsibility of their learning by using competency-based assessment, which allows them to go at their own speed and improve their abilities through continual feedback. This strategy not only encourages self-directed learning, but it also develops transferable skills such as communication, problem-solving, and adaptability, which are useful even beyond graduation (UNICEF, 2019).

3. Assessment methods for sustainable learning: Balancing tradition with innovation

Innovative assessment methods, such as project-based learning, digital simulations, and collaborative evaluations, promote a more inclusive and dynamic learning environment (Kapsalis et al., 2019). They go beyond the strict limitations of traditional testing, allowing students to demonstrate proficiency in a variety of ways. E-portfolios offer a comprehensive snapshot of a student's abilities, whereas AI-powered assessments adjust in real time to customize learning. Integrating these approaches transforms education toward sustainable learning, where assessments are about building curiosity, resilience, and a lifetime learning mentality rather than just grades. The future of education lies in integrating tradition and innovation, with evaluations serving as stepping stones to deeper engagement, meaningful learning, and long-term success.

4. Goals of present study

The major purpose of this study was to investigate students' attitudes about assessment, evaluation, and academic participation in higher education. The purpose of this study was to discover significant elements impacting student achievement and well-being by examining students' academic satisfaction, assessment choices, self-awareness, confidence, and stress.

5. Methods

5.1. Participants and data collection

This study employed a survey-based quantitative research design to examine students' perceptions of assessment, evaluation, and academic engagement in higher education. Data were collected using a structured questionnaire comprising 27 items, categorized into six subscales: (1) academic satisfaction and development, (2) preferred evaluation methods, (3) self-awareness and accountability, (4) belief in personal competencies, (5) assessment-related stress, and (6) learning strategies and preparation. The survey primarily included close-ended Likert-scale questions, as well as demographic items capturing participants' age, gender, program enrollment, and level of study. A Cronbach's alpha coefficient of 0.992 confirmed the high reliability of the survey instrument. The questionnaire was distributed via Google Forms, and responses were collected over a three-month period from March to June 2024. Participants provided informed consent before completing the survey, and all responses were anonymized to ensure confidentiality. The study sample comprised 273 undergraduate students enrolled at two universities in Romania. The gender distribution of participants was 77.7% female (n = 212) and 22.3% male (n = 61), reflecting the broader demographic trend of female overrepresentation in higher education in Romania. The age distribution of participants was as follows: 18–24 years: 215 students, 25–34 years: 43 students, 35–44 years: 8 students, 45–55 years: 7 students

Regarding the level of study, 89% (n = 243) were enrolled in bachelor's programs, while 11% (n = 30) were in master's programs. In terms of program enrollment, 58.6% (n = 160) were in vocational higher education courses, while 41.4% (n = 113) were in Bachelor/Master of Science programs.

5.2. Research questions

1. What are students' overall perceptions of academic satisfaction and development?
2. What are students' preferences regarding evaluation methods in higher education?
3. How do students perceive their self-awareness and accountability in academic settings?
4. What is the level of belief in personal competencies among students?
5. How prevalent is assessment-related stress among students?
6. How do students evaluate their learning strategies and preparation?

6. Results

A descriptive analysis was conducted to explore students' perceptions across the six subscales. The results indicate that students generally expressed positive academic experiences, with **Academic Satisfaction and Development** having the highest median score (Mdn = 4.000, SD = 0.757), suggesting that most students feel satisfied with their academic progress. **Preferred Evaluation Methods** scored a median of 3.600 (SD = 0.712), indicating that students had mixed preferences regarding assessment types. **Self-Awareness and Accountability** had a median of 3.800 (SD = 0.754), demonstrating that students recognize their role and responsibility in their learning process. In terms of confidence, **Belief in Personal Competencies** scored a median of 3.750 (SD = 0.744), showing that students generally feel capable in their academic abilities. However, **Assessment-Related Stress** had a median of 3.500 (SD = 1.061), revealing that a considerable number of students experience anxiety related to assessments. Lastly, **Learning Strategies and Preparation** received the lowest median score (Mdn = 3.400, SD = 0.805), suggesting that students may require additional support in developing effective study habits and preparation techniques.

7. Conclusions

The study offers useful information about students' perspectives of academic satisfaction, assessment preferences, self-awareness, confidence, and stress in higher education. The findings imply that most students have favourable academic experiences, although there are significant disparities in assessment preferences and stress levels. Students reported higher levels of worry over assessments, emphasizing the importance of supporting interventions to alleviate stress and boost confidence. The findings underline the need of using a variety of evaluation techniques to meet different student preferences and lessen anxiety. To foster a more inclusive and supportive learning environment, educators may consider using a variety of evaluation methods, such as practical assessments and group-based assessments. In addition, institutions might introduce tailored academic support programs to assist students in developing appropriate study techniques and resilience in dealing with assessment-related stress.

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APPLICATION OF PROJECT-BASED LEARNING DIDACTICS FOR A FIRST-YEAR COURSE OF ELECTRONIC ENGINEERING

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Abstract

Project-Based Learning is a powerful teaching method that transforms traditional education into an engaging, student-centered experience. The National Kaohsiung University of Science and Technology in Taiwan encourages the departments to offer the first-year students with a course of professional field exploration enabling them to gain insight into the future development of the people majoring in one's department. This paper presents the experiences of applying project-based learning didactics on the course of professional field development exploration for the first-year electronic engineering students. In the course planning, by some homework assignments, the teacher lets the students experience self-directed learning. So, students can take the initiative in planning and managing their learning. The course arrangement reveals successful result according to the questionnaire result of pre-test and post-test and final reports of many students' thoughts.

Keywords: *Professional field development exploration, project-based learning, course planning, self-directed learning.*

1. Introduction

In Taiwan, many students often rely on memorization-based learning to quickly grasp course material to perform well in entrance examinations. When choosing a major, they do not have much idea to their own interest. According to our conversation with many new students who majoring in electronic engineering, it reveals that many students opt for electronic engineering due to its perceived advantages in future employment prospects. For having an insight into the future development of the students majoring in one's department, the National Kaohsiung University of Science and Technology (NKUST) in Taiwan encourages the departments to offer the first-year students with a course of professional field exploration (楊 & 柯, 2023).

To help first-year students majoring in electronic gaining a deeper understanding of university-level learning and future career paths after graduation, we have arranged a course titled "Professional Field Development Exploration". In this course, some example course pathways and future professional career development are introduced. It's well known that Project-Based Learning (PBL) offers several key advantages for fostering better learning attitudes among students. It has been applied to this course to make good use of PBL. In this course, the teacher requires students taking the course to submit their assignments. According to the questionnaire result of pre-test (at the beginning of the course) and post-test (at the end of the course) and the final post-course reflection reports of many students, they reveal positive message about success in such a course arrangement.

2. Method

For the one-semester course of "Professional Field Development Exploration" in the electronic department, the students taking this course have been grouped into teams of three. Then the teacher announced some assignments in the beginning. Namely, students are required to submit five assignments: (1) an exploration of job requirements for a desired career, (2) a student course progression plan for professional competency development, (3) an insight report from the expert seminar, (4) post-course

reflection report, and (5) a self-directed learning report on a topic of their choice within the field of information and electronics by one group.

There are four main research directions in the Electronic Department of NKUST. These four areas are respectively: Electronic Circuits and Devices, AI technology and Communication Systems, Information and Digital IC Design, and Biomedical Electronics. As part of the 'Professional Field Development Exploration' course, we have invited professionals from the electrical and information engineering field to present their technical expertise and share their educational journeys, allowing students to develop a clearer insight into the industry.

The objective of the above first assignment is to guide students in their initial exploration of careers and the essential expertise required for targeted job positions. With this initial exploration, the students are asked for course progression plan for professional competency development during undergraduate studies by referring to the course offerings on the department's website. So, each student can have an initial deep thought about one's undergraduate learning. This is the goal of the second assignment. Since some speeches have been given by scholars and industry experts in electrical and information engineering field, students are required to choose any three lecture speeches and submit the written insight report based on the speech contents. In addition, another assignment is a self-directed learning report on a topic of information and electronics by each student group. The exact project topic is decided by the group members.

Project-Based Learning (PBL) is widely recognized as a student-centered pedagogical approach that emphasizes learning through the active exploration of real-world challenges. Thomas (2000) describes PBL as a dynamic process through which students gain deeper knowledge by engaging in meaningful projects. Rooted in Dewey's (1938) theory of experiential learning, PBL encourages students to "learn by doing," fostering not only content mastery but also the ability to apply knowledge in practical contexts. PBL supports interdisciplinary learning, allowing students to draw on diverse fields of knowledge to solve complex problems over an extended time frame (Blumenfeld et al., 1991). This approach aligns closely with the development of 21st-century skills such as critical thinking, communication, collaboration, and creativity.

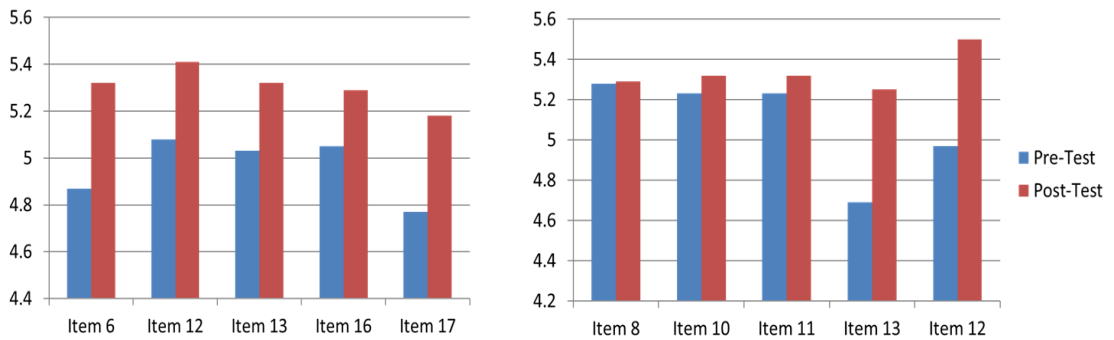
In the Electronic Department of NKUST, PBL didactics has been applied to some courses, such as Electronics and Analog Integrated Circuit Design. To help students begin to understand and engage with PBL, some core characteristics of PBL are integrated into the assignmant 5. They are: (1) the topic has real-world relevance, (2) Students have the opportunity to make decisions about the project's direction, process, or outcome, (3) learning is driven by inquiry and research, and (4) students work in teams, learning to communicate, and share responsibility. Besides, the instructor demonstrates the usage of internet resources, such as ChatGpt, Youtube course, and OpenCourseWare.

Finally, the last assignment is the post-course reflection report. It helps the instructor to collect student's feedback on the course experience.

3. Result

To know the effect of course arrangement, the questionnaire analysis of pre-test and post-test of this course was carried out. The questionnaire was designed to include both a learning effectiveness scale and a learning motivation scale, as shown in Table 1. Figs. 1 and 2 show the selected improvement in learning effectiveness and motivation, respectively. From the result of questionnaire analysis, it reveals two messages: first, this course successfully met its goal of increasing students' understanding of academic and career connections, planning abilities, and confidence in future learning; second, students reported greater curiosity, engagement, and emotional connection to the course after participation. In addition, from the post-course reflection reports of students, many students express that the course arrangement and assignments help them to find their own interest and plan their future professional development.

Figure 1. Selected Improvements in Learning Effectiveness. Figure 2. Selected Improvements in Learning Motivation.



4. Conclusion

In this article, the arrangement of a one-semester course of electronic engineering for professional field development exploration of first-year students of undergraduates is presented. By virtue of the course assignments, the core characteristics of PBL is introduced. From the investigation of questionnaire result of pre-test and post-test and post-course reflection reports of students, it reveals that the curriculum scheme has accomplished the desired effect.

Table 1. Questionnaire with both a learning effectiveness scale and a learning motivation.

#	Learning Effectiveness Scale Question	Learning Motivation Scale Question
1	I understand the purpose of attending university.	I find the course novel.
2	I understand the developmental directions of my department.	I find the content of the course attractive.
3	I understand the compatibility between my interests and department.	I am very interested in the course.
4	I understand the future course content I need to take in my department.	The course stimulated my curiosity.
5	I understand how to plan my future courses.	The course helped me understand professional knowledge and skills.
6	I understand the connection between the department's curriculum map and future career development.	The course connected to my life experience.
7	I understand the potential conflict between department choice and future career.	The course helped me plan my learning path.
8	I clearly understand the relationship between my field of study and future development.	The course is helpful for my career development.
9	I know how to manage my learning methods.	I feel proud completing course assignments
10	I understand the industrial development in my department's field.	I am happy that I chose this course.
11	I understand the qualifications required for professional jobs in my field.	I feel that the effort I put into this course is worthwhile.
12	I understand the talent demand in the professional field I am studying.	Time passed quickly during this course.
13	I understand the core professional competencies related to my field.	After this course, I feel confident in understanding other courses
14	I understand information about further studies.	After this course, I feel confident in learning new subjects I haven't studied.
15	I have the ability to work in a team.	After this course, I feel capable of planning my future studies.
16	I have experience and ability in problem solving.	After this course, I feel I can overcome setbacks during my academic journey.
17	I have communication and expression skills.	

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CP AND TEACHER EDUCATION: THE CASE OF A POSTGRADUATE PROGRAM (P.S.P.) AT THE UNIVERSITY OF CRETE, GREECE

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Abstract

The Postgraduate Studies Program (P.S.P.) *Educational Sciences, Critical Pedagogy and Teacher Education* was established in 2017–18 in the Department of Primary Education of University of Crete. It is affiliated with the Centre for the Study and Research of the History of Education and the Teaching Profession (C.S.R.H.E.T.P.) and remains active to this day (*contact: kemeiede@edc.uoc.gr*). No comparable postgraduate program currently exists in Greece that addresses the same subject matter – critical pedagogy, activism, open-minded educators within the field of Educational Sciences.

Keywords: *CP, teacher education, Crete.*

1. Subject of the P.S.P.

The focus of the P.S.P. is the production and dissemination of scholarly knowledge in the fields of Educational Sciences, CP (CP) and Teacher Education (TE). Through a combination of academic knowledge, hands-on experience, and practical expertise, the program prepares postgraduate students with both theoretical foundations and metacognitive skills. It serves as both a conceptual framework and a practical tool for contemporary education, addressing the pressing need to redefine educational goals in response to the socio-political, economic, demographic, and cultural challenges of the 21st century.

The program demonstrates its impact on both formal and non-formal education through lectures, workshops, seminars, and field visits. Grounded in the theories of Paulo Freire, Henry Giroux, Michael Apple, Antonia Darder, and other scholars, CP fosters a more humane and just society. It emphasizes educational and social inequalities, supports marginalized groups, and links theory with praxis, especially in the context of teacher education.

Key themes include innovation, empathy, democracy, social justice, inclusivity, the pedagogy of love, deliberation, gender issues, human-technology interaction, and the "missing voices" of contemporary societies. These elements highlight the essential role of teacher education and their transformative role of educators in our digital era, as critical thinkers. Activists, and open-minded human educators.

1.1. Objectives of the P.S.P.

- To equip students with the necessary knowledge, experience, and skills in Educational Sciences, CP, and Teacher Education to enable them to pursue professional careers in both formal and non-formal education grounded in CP principles.
- To enable students to critically connect theory, research, and practice within educational and social contexts in pursuit of professional and/or academic excellence.
- To promote international collaboration, the exchange of best practices, critical thinking, and the cultivation of humanistic values through a broad-based curriculum.

1.2. The philosophy of the P.S.P.

The philosophy, objectives and intended learning outcomes of the curriculum – as well as the teaching methods, assessment strategies, and course content – are designed to support student-centered learning. The program adheres to the principles of critical lifelong learning and open/distance education.

1.3. Educational methods, techniques and tools

The P.S.P. employs a variety of educational methods, including experiential and critical-practical workshops, Art-Based Educational Research (ABER), fieldwork, and educational visits to institutions engaged with cutting-edge technologies and to sites serving vulnerable populations (e.g., prisons, Roma camps, and refugee centres). Workshops are conducted both on-site and remotely.

1.4. Learning outcomes

- Familiarity with contemporary challenges in schooling and teacher education within the framework of CP.
- Development of critical psycho-pedagogical, research, and instructional competencies aligned with transformative educational paradigms.
- Capacity to analyse and interpret current ideological, political, demographic, social, cultural, economic, and educational issues in global contexts.

1.5. Program structure

The curriculum is structured into three semesters (two semesters of coursework and one for thesis writing). Classes are held on Saturdays and include seminars, workshops, and lectures. The third semester is dedicated to the completion of a compulsory thesis. Instruction is supported by a blended learning approach. To graduate, students must earn 90 ECTS credits.

1.6. Examinations

Students may choose among the following assessment options for each course: a) written examination, b) oral examination, or) optional assignment.

1.7. Thesis

The thesis must align with the goals of the program, focusing on Educational Sciences and CP in relation to Teacher Education. Interdisciplinary research methodologies grounded in critical and postmodern epistemologies are used, including ABER.

2. Academic year 2024-2025

- Winter semester

Teacher Education in Historical, Philosophical, and Metacognitive Pedagogical Contexts
Learning Theories, Adult Education, and Social Intervention
The Teaching Profession and CP: Gendered Achievement and Postmodern Trends

- Spring semester

Principles of Psycho-pedagogical Research and Didactic Communication in the 21st Century, Exercise I
Professional Development of Teachers through Creative and Humanistic Pedagogy
Non-Formal and Informal Educational Structures and Lifelong Learning
Art, Teacher Education, and the De-Schooling of Knowledge

2.1. Employment opportunities

Graduates of the P.S.P. are often experienced professionals in public education but may also pursue careers in private education (e.g., Second Chance Schools, Vocational Training Institutes), adult education, training programs, or curriculum development. They may work in museums, NGOs, public and private sector organizations, or civil society bodies involved in education.

2.2. Teaching staff

Courses are delivered by professors, researchers, external collaborators, and Ph.D. holders. Internationally recognized scholars are frequently invited as guest lecturers. Courses are conducted in Greek, except for guest lectures by international scholars (e.g., Michael Apple from the USA, Antonia Darder from the USA, Tien Hui Chiang from Taiwan, Hermendidle Rwantabagu from Burundi, Wang Disngua from China).

3. Conclusion

According to the internal evaluation conducted by the University of Crete's Quality Assurance Unit (MODIP), the P.S.P. emphasizes:

- Student-centered, interactive, and critical-practical education

- Knowledge co-construction through experiential learning
- Diverse educational environments and field-based learning (e.g., Museums, Schools, Prisons, Refugee Centers, Roma Camps, University Labs, and Public Spaces)
- Multidisciplinary teaching approaches—each course is co-taught by multiple instructors
- Flexible assessment methods, with students selecting their preferred form of evaluation
- Artistic and educational projects with impact on the academic and broader community
- International dimension through guest lectures and events
- Global academic engagement through symposia, workshops, and reflective online forums
- Development of alternative teaching materials and audiovisual content promoting CP
- Integration with current research methodologies including ABER and other innovative approaches

The program recently evaluated by an external international review board as “fully compliant”.

In conclusion, our experience with this P.S.P. in CP and Teacher Education demonstrates its potential to contribute meaningfully to innovation, transformation, and critical learning methodologies in both education and society in the 21st century and promote the role of teachers as critical pedagogues, activists and open-minded educators. This ongoing work on creating an environment that embodies the theoretical, ethical, political, and educational commitments of critically democratic practices provides a model of what needs to be done now and in the future. It does indeed give us "hope."

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THE 2024 TOTAL SOLAR ECLIPSE AS A DRIVER FOR ENGAGEMENT AND RESEARCH COLLABORATION BETWEEN HIGH SCHOOL AND COLLEGE STUDENTS

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Abstract

The total solar eclipse of 8 April 2024 tracked across the central and eastern United States, creating an opportunity for millions of people to see this remarkable phenomenon. It also provided a shared experiential learning opportunity for students of all ages. This poster reports on a collaborative effort between undergraduate students at Bucknell University and high school students at The Greenhill School. Both groups of students worked together to design and execute an "astronomy fair" on the day of the eclipse for the Greenhill community. This fair comprised hands-on stations and in-person presentations describing the scale and geometry of the Earth, Moon, and Sun, and the precise alignment required for a total eclipse. Both groups also worked together to design and enable research experiments involving observations of the Sun's inner corona (which can only be done during an eclipse). The educational and scientific components of the program were quite successful, based on the feedback of the ~1500 K-12 participants and the scientific data acquired. Perhaps even more importantly, the student organizers (both high school and undergraduate) deeply valued the opportunity to develop and lead the program collaboratively. As a result of this experience, several indicated interest in pursuing physical science or science education as careers.

Keywords: *Science and technology education, secondary education, higher education.*

1. Introduction

Total solar eclipses leave an indelible mark on those fortunate enough to see one. These people can vividly recall many details of the event many years, and even decades, after it occurred (Sang, 1999). For a few brief moments when the moon blocks the bright central region of the Sun (the photosphere), the sky darkens markedly and reveals the Sun's looping filamentary outer veil called the corona. Invisible under normal circumstances, the corona is visible during eclipse extends across the sky in a display that is many times the size of the eclipsed Sun. Solar eclipses are relatively common, occurring on average every year or so. However, the total eclipse phase can only be viewed from a narrow strip of the Earth's surface -- the "Path of Totality" -- which is typically only a few tens of km wide. Moreover, at any point within this path, totality occurs for at most a few minutes, and can be observed only if weather conditions permit. Thus, only a small fraction of the world's population has direct experience with this phenomenon.

Two recent eclipses have garnered substantial attention because their paths of totality stretched across highly populated regions of North America. The path of the 2017 eclipse passed from the U.S. state of Oregon across the United States to South Carolina, and the 2024 total solar eclipse path stretched from Mexico thorough the central United States and into Canada. Because of mostly cooperative weather several tens of millions of people observed totality during each of these events. These events provided opportunities for people to see this phenomenon; however, it is not clear that these observers fully understood the circumstances and geometry required for this view. In research published before these eclipses, Kanli (2015) found that many high school and undergraduate students, as well as their teachers, could not reliably describe the geometry necessary for a total solar eclipse. Thus it was clear that these two eclipses provided opportunities to help address broadly-held misconceptions regarding the geometry of the local astronomical environment.

2. The eclipse research and education project

A group of students and faculty from Bucknell University in Lewisburg, Pennsylvania constructed a plan to observe the 8 April 2024 total solar eclipse, with the twin goals of astronomical research and

public science education. The research component would involve detailed observations of the Sun's chromosphere and inner corona, regions of the solar atmosphere that can be most easily observed during totality. Plans were made to construct a research field station comprising several portable telescopes and cameras for data acquisition. An outreach component was envisaged to include presentations and hands-on demonstrations available to the public just prior to totality, so as to provide context for the phenomenon they were about to observe. However, since the Lewisburg campus of Bucknell University was not in the path of totality, a better-positioned site was required for this project.

A site within the path of totality was found via a collaboration with the Greenhill School in Addison, Texas. The K-12 private school agreed to provide a site for the field research station, as well as power and support facilities. While the collaboration originally revolved around logistical issues, it evolved into collaborative efforts in programming and outreach. Interested high school students were paired with Bucknell undergraduates, and together these teams worked on both the research and educational projects. Teams met via Zoom in the months before the eclipse, and then worked together on the ground in the critical few days prior to eclipse day.

3. Eclipse day events

Education and outreach activities on eclipse day were organized into an "Astronomy Fair" for the student population of the Greenhill School in grades 5-12. Approximately 1000 students moved among nine stations throughout the time before totality. At each station, students engaged with concepts related to the eclipse. Station activities included observing the partially-eclipsed Sun with a projection telescope, a craft showing the relative motions of the Sun, Moon, and Earth, and the construction of a planet walk illustrating the relative distances between the solar system's planets. Students carried with them a passport, and for each completed activity, they received a passport sticker.

Figure 1. Students compare the size of the Sun with the size of planets and the Moon.

Figure 2. A student shows off her Eclipse Day passport with stickers that show she has completed four stations.

Students were also able to interact with Bucknell students taking data at the field research station. Observations focused on measurements of the spatial structure of the inner corona, and the time-variability of coronal emissions, two types of measurements that are difficult to conduct except during totality. This station was set up centrally on the Greenhill School campus, so that Greenhill students could interact with

the students conducting the science research. Before and after totality, Bucknell students were able to answer questions and describe their research projects to interested students.

Figure 3. Students at the on-campus field research station conducted experiments to measure the structure and time variability of the Sun's corona. Note that many parts of the equipment have labels describing their function.

4. Reflections on the eclipse education experience

Many days after the eclipse, Bucknell students reflected on their experience as participants and curators of the eclipse experience. Students commented on the sense of awe they felt during the brief moments of totality, and they also took great value from their roles as science educators. Three students captured the importance of their combined roles in the following excepts:

- *"Seeing the reactions of those around me made me realize that providing the students with some educational background about the event makes it even more awe-inspiring. Understanding how exactly the geometries of the sun and moon interact to create a thin path of totality along the Earth, coupled with the knowledge of the vast scales at play, creates a profound appreciation for the event, something that is lost on those ignorant to the background of the topic."*
- *"one can study a phenomenon their whole life and understand it in every minute detail, but if one has never observed the phenomenon can they really say they 'know' it? For younger students, such as the Greenhill students, this kind of experience can be incredibly inspirational and help them find a passion that they might want to pursue."*
- *"In retrospect, it wasn't just the celestial spectacle of totality that made our trip unforgettable; it was the collective anticipation, the shared moments of discovery, and the lasting impact on those around us that truly made it special."*

Acknowledgments

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BRIDGING THE GAP: TEACHERS' PERSPECTIVES ON THE TRANSITION FROM PRESCHOOL TO PRIMARY SCHOOL

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Abstract

The transition from preschool to primary school represents a critical event shaped by several interconnected factors. Previous research highlights the importance of teachers in this process, but also emphasizes the lack of comparative studies on the practices and collaboration between them. Our study aims to explore the perspectives of preschool and primary school teachers, focusing on their representations, emotions, concerns and practices about the preschool-to-primary school transition. A group of 284 teachers participated (130 KT, preschool teachers, and 154 PT, primary school teachers), with a mean age of 45 years, including three males. Participants responded to a questionnaire constructed ad hoc, based on previous research. The analysis revealed that *curiosity* characterizes the emotional experience for both KT and PT, but the emotion of *nostalgia* [$F_{(1,277)}$=61,21; p.<.001] and *sadness* [$F_{(1,277)}$=25,19; p.<.001] more strongly connotes the experience of KT, while *anxiety* characterizes more that of PT [$F_{(1,277)}$=28,33; p.<.001]. Main concerns involve *teaching style* and *parental disengagement*; specifically, primary school teachers worry most about parental disengagement [$F_{(1,273)}$=92,3; p.<.001], while preschool teachers focus on teaching style [$F_{(1,273)}$=7,50; p.<.007]. Most teachers reported beginning to introduce transition support activities in the second half of the final year of preschool, and multivariate analyses show that anxiety [$F_{(1,262)}$=3,157; p.<.044] is significantly lower in educational settings where transition practices start earlier. These results suggest coordinated interventions to support smoother transitions. Findings emphasize the need for tools and strategies to enhance the transition experience, benefiting both children and teachers by fostering an adaptive, high-quality educational environment.

Keywords: *Teacher practices, preschool, primary school, transition to first grade, teacher perspectives.*

1. Introduction

The transition from preschool to primary school represents a critical event in children's growth, shaped by several interconnected factors (Margetts & Phatudi, 2013; Nicholson, 2019). Research highlights that the success of this transition depends not only on children's individual skills but also on their interaction with external factors, including the preparation and support provided by preschool and primary school teachers (Dockett & Perry, 2013; Margetts & Phatudi, 2013). The educational environment provides children with valuable time and opportunities to express and explore their potential (Loizou, 2011). In this context, preschool and primary school teachers play a key role in shaping children's well-being and their ability to adapt to the school environment. Teachers' actions can have a significant impact both on short- and long-term outcomes (Aksoy, 2021; Lazzari et al., 2020). Moreover, the differences between the two school levels can be perceived by children as a discontinuity, making it essential to prepare them for primary school during their preschool years (Wilders & Wood, 2023), and to organize activities that support their adaptation during the first grade (Sylaj & Ramabaja, 2022).

Positive relationships between children and teachers, marked by closeness, support, and respect, enhance engagement, behavior, and academic performance (Pianta & Stuhlman, 2004). These relationships promote school adjustment, social skills, and academic resilience, fostering a supportive learning environment (Rimm-Kaufman, 2015). Despite the importance of this topic, studies emphasize the lack of comparative research on educational practices and systematic collaboration between teachers from the two school levels (Dockett & Perry, 2004; Peters, 2010).

2. Objectives and methods

This study aims to explore the perspective of preschool and primary school teachers.

Specifically, it aims to investigate teachers' perceptions, emotional experiences, and concerns related to this transition, as well as explore the educational practices they propose to prepare children for it. To explore the teachers' perspectives on the preschool-to-primary school transition, two tailored questionnaires were developed for each participant group, based on the existing literature on the research topic. Both questionnaires include 10 questions, of which 3 are open-ended questions aimed at investigating the teachers' representations about the transition, and 7 closed-ended questions that explore teachers' emotions, concerns, and educational practices.

A total of 284 teachers participated in completing the questionnaires (130 preschool teachers, KT, and 154 primary school teachers, PT), with a mean age of 45 years, including three males. Subsequently, the collected data were analyzed using the SPSS statistical software, with variance analysis and multivariate analysis performed.

3. Results

3.1. Teachers' representations

The five most recurring words that emerge when KT think about the transition of children to primary school are: *Growth* (mean = 0.33; SD = 0.576), *Skills and knowledge* (mean = 0.32; SD = 0.557), *Continuity* (mean = 0.28; SD = 0.502), *Collaboration* (mean = 0.26; SD = 0.536), and *Learning prerequisites* (mean = 0.24; SD = 0.702). Meanwhile, among PT, the five most frequent words are: *Welcoming* (mean = 0.36; SD = 0.483), *Collaboration* (mean = 0.26; SD = 0.645), *Growth* (mean = 0.21; SD = 0.442), *Novelty* (mean = 0.20; SD = 0.529), and *Socialization* (mean = 0.20; SD = 0.418). Futhermore, the results indicate that both KT (mean = 0.43; SD = 0.497) and PT (mean = 0.27; SD = 0.447), represent the transition as a *process that respects the individual developmental trajectories of children*. Moreover, results highlight areas of deficiency in the organization and management of the transition process. The most significant shortcoming, for both KT and PT, concerns the *collaboration between preschool and primary school* (mean KT = 0.28; SD = 0.453; mean PT = 0.15; SD = 0.358).

3.2. Transition activities

Among the transition activities proposed to children, *peer collaboration* is the most frequently suggested activity by KT (mean = 3.40; SD = 0.694), while for PT, it is the *promotion of children's processing of their experiences regarding the change* (mean = 4.40; SD = 0.732).

The results highlight that *meetings between preschool and primary school teachers* are among the most common practices for both groups, aimed at organizing transition activities (KT: mean = 3.07; SD = 0.949; PT: mean = 3.09; SD = 1.519).

Moreover, for a smooth transition, KT believe that *welcoming children* is the most important action carried out by PT (mean = 3.72; SD = 0.467), while PT identify *encouraging children to participate actively* as the most important action that KT can perform (mean = 3.71; SD = 0.496).

3.3. Emotional experiences

Results underline that *curiosity* is the predominant emotional experience among both KT (mean = 2.96; SD = 0.820) and PT (mean = 3.37; SD = 0.704). On the other hand, *anxiety* is the least frequent emotion among KT (mean = 1.37; SD = 1.482), while *sadness* is the least frequent emotion among PT (mean = 1.34; SD = 0.607).

Multivariate analyses highlight that *anxiety* [$F(1,262) = 3.157$; $p < .044$] is more pronounced when transition activities start in the second half of the last year of preschool, with a further increase in the first half of the first year of primary school.

3.4. Concerns

The results show that KT are more concerned about *teaching style* and the *relationship with children* (mean = 2.59; SD = 0.655). On the other hand, PT express greater concern about *parents' lack of interest* in the children's school life (mean = 2.84; SD = 0.892).

Multivariate analyses show that a delay in the start of transition activities is associated with an increase in concerns related to children's [$F(1,262) = 3.033$; $p < .050$] and parents' [$F(1,262) = 3.525$; $p < .031$] lack of interest.

4. Discussion

The data emerging from the research highlight the importance of a gradual approach, starting from the very first moments of transition-supporting activities. A process that takes this aspect into

account could prove to be of fundamental value, both for teachers and for children, contributing to a more harmonious and conscious transition (Cronin et al., 2022).

In particular, the results could have a significant impact on teacher training, making their representations of the transition process more informed. By comparing the experiences of teachers from different schools, it will be possible to highlight similarities and differences in the processes implemented, allowing for a deeper reflection on the methods and strategies used (Marcineková et al., 2020). In this context, the research opens the possibility of designing effective teaching strategies and tools to facilitate an adaptive transition, capable of improving not only the quality of education but also the overall well-being of both children and teachers.

Finally, the data collected suggest the possibility of initiating coordinated interventions among all stakeholders, in order to make the transition process more gradual and structured, with tangible benefits for all parties involved.

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PHARMPATH: VIRTUAL IMMERSIVE SIMULATIONS AND IN-PERSON EXPERIENTIAL OPPORTUNITY IN PHARMACY EDUCATION FOR SECONDARY AND POST-SECONDARY STUDENTS FROM UNDERREPRESENTED COMMUNITIES

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Abstract

Pharmacy professionals have a critical role in health promotion and acute/chronic disease prevention and management. There is a need for greater diversity among pharmacists and pharmacy technicians as Black and Indigenous communities continue to be underrepresented in these professions. To foster a more diverse field of pharmacy professionals and to provide equitable and culturally competent care to the communities they serve, Equity, Diversity, and Inclusion (EDI) initiatives must be incorporated in the pharmacy education recruitment process. The PharmPath project prioritized underrepresented communities in all stages of development and delivery of the on-site experiential day for aspiring students who identify with these groups. This poster illustrates findings after deployment of 3 new simulation videos and the second, expanded PharmPath experiential day for underrepresented students.

Keywords: *Pharmacy, inclusion, experiential, underrepresented, health sciences.*

1. Introduction

Pharmacy professionals have a critical role in health promotion and acute/chronic disease prevention and management. In Canada, pharmacists' scopes of practice have expanded allowing them to prescribe treatment for several minor ailments (Government of Ontario, 2024). Pharmacists are sometimes the only accessible health care provider patients have access to (University of Waterloo, 202) so ensuring high quality care is important. One driver of quality care is the diversity of the healthcare team (Gomez & Bernet, 2019; Jackson & Gracia, 2014). In Canada, for example, Black and Indigenous communities continue to be underrepresented in Canadian PharmD graduating classes (Association of Faculties of Pharmacy of Canada, 2023). There is a need for greater diversity among pharmacists and pharmacy technicians and this project aimed at increasing interest in the professions among typically underrepresented students.

2. Project design

To foster a more diverse field of pharmacy professionals and to provide equitable and culturally competent care to the communities they serve, Equity, Diversity, and Inclusion (EDI) initiatives must be incorporated in the pharmacy education recruitment process. The PharmPath project was created to inspire interest in pharmacy and pharmacy technician programs among historically underrepresented students. The project uses a three-pronged approach: 1) video testimonials from pharmacy professionals and pharmacy students, from diverse backgrounds, sharing their pathways to the career; 2) six pharmacy virtual simulations showcasing the work of diverse patients, pharmacists, and pharmacy technicians; and 3) an in-person experiential day at the University of Toronto's Leslie Dan Faculty of Pharmacy (LDFP). All aspects of the PharmPath program are free of charge and the project team provides transit passes to/from the university for those indicating need for financial support to travel.

The virtual simulations were collaborative effort between colleagues from the University of Toronto Leslie Dan Faculty of Pharmacy, the University of Waterloo School of Pharmacy, and Centennial College's Pharmacy Technician program. Cases for the simulations were designed by pharmacy professionals and the team further collaborated with students from Seneca College's course called Design

for Social Change who were responsible for a number of creative elements. The completed virtual simulations have been made available to anyone wishing to use them. Further, all associated media assets have been uploaded to a repository to allow broad access. Intructors are also welcomed to modify the simulations to suit their needs and the code to do so has been made available on GitHub.

The virtual simulations touch on entry-to-practice competencies for pharmacists and pharmacy technicians such as collaboration and decision making which illustrates to potential students some aspects of the work one might expect as a pharmacy professional. The simulations were also created with diversity in mind showing both pharmacy professionals and patients from a broad range of backgrounds.

The virtual simulations acted as an introduction to pharmacy, and students who completed the virtual scenarios (n=130) were then invited to the experiential day at LDFP in March, 2024. Throughout the experiential day, students (n=39) heard from a keynote speaker, participated in hands-on pharmacy lab activities, and had tours of LDFP and the University of Toronto led by PharmD students from the Black Pharmacy Students Association.

3. Methods

To understand the influence the virtual simulations and the experiential day on participants' understanding of pharmacy professions, we conducted both a post-event survey and invited students to participate in focus groups. Of the 39 experiential day participants, 13 completed the survey and 15 chose to participate in a focus group. Four focus groups were created from the 15 participants and semi-structured interview-style questions were asked (e.g., How did the experiential learning day affect your knowledge about pharmacy professions?; How did the experiential learning day affect your perceptions, attitudes, and interest in pursuing a pharmacy career?; What factors or influences play a role in shaping your decision to pursue a career in pharmacy?).

Findings from the survey participants (n=13) indicated that 92% of respondents strongly agreed they were more familiar with the roles and responsibilities of pharmacists after the experiential day. Eighty-five percent of respondents agreed or strongly agreed they learned a lot from the experiential day and 77% indicated they agreed or strongly agreed that they knew more about PharmD admission requirements because of the experiential day.

Two members of the research team conducted thematic analysis on the focus group transcripts (n=15) using NVivo14 and consensus on the findings was reached in conversation with the research team.

4. Findings

Four main themes emerged from the focus groups: Engagement, changed perspectives, financial considerations, and the need for more experiential opportunities. In terms of engagement, students enjoyed the experiential day and liked the smaller group setting and supportive environment which made the learning activities effective. They found engaging with the activities, volunteers, PharmD students, and faculty to be both fun and educational. Students' perspectives about pharmacy changed and they indicated that pharmacists and pharmacy technicians do much more than dispense medications. They found pharmacy to be impactful, collaborative, and more attainable as a career than previously thought. Financial barriers to pharmacy were raised as an issue during focus groups. Students suggested additional financial support in the form of both scholarships and paid practical experience placements could help mitigate financial issues somewhat. Finally, students suggested more experiential opportunities would be helpful in terms of preparing them for a future in pharmacy.

5. Discussion & conclusion

Based on the success of PharmPath Experiential Day 2024, a second annual event has been planned for March 2025 following a similar path to entry (e.g., virtual simulations, registration for the event, financial support through transit passes). Further, the virtual simulations proved important not only to PharmPath but they were also used in LDFP's Medication Therapy Management 2 course and by the Ontario College of Pharmacists in an online learning module. As such, three additional simulations have been created and deployed for this year. At the time of writing (February, 2025), 35 students are registered for the 2025 Experiential Day and we will cap the event at 60 participants to ensure students are in small enough groups to engage fully in the lab and other activities. We will refine the survey and focus group questions this year to understand more about students' motivations for participating and their thoughts about pursuing careers in health sciences broadly, and within pharmacy specifically. Like many teams, we are challenged to continue providing relevant virtual scenarios and hosting the Experiential Day given the dual constraints of time and finances. Fortunately, the virtual scenarios are an asset that can be used in perpetuity and are available to other educators wishing to use or adapt them.

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OPTIMIZING COMPETENCY-BASED LEARNING IN ENGINEERING: A STUDY ON THE BEST-FIT METHODOLOGIES FOR TRANSVERSAL SKILLS

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Abstract

In modern education, addressing students' lack of motivation, attention deficits, and difficulties in connecting theoretical content with real-world applications is a growing challenge. Traditional lecture-based methodologies often result in passive learning, limiting opportunities for interaction and practical application. At the same time, the continuous exposure to digital technologies has affected students' ability to maintain focus in educational settings. This study proposes an integrated methodological approach combining active learning strategies, teamwork methodologies, and Information and Communication Technologies (ICTs) to develop both specific and transversal competencies in Engineering courses. The methodologies implemented include Problem-Based Learning (PBL), cooperative learning, flipped classroom, gamification, and escape rooms, among others, while the ICT tools used encompass clickers, augmented and virtual reality, digital portfolios, and webquests. Additionally, Artificial Intelligence (AI) has been incorporated to personalize learning experiences and optimize assessment processes. A structured implementation plan was designed across multiple undergraduate and master's degree courses, targeting competencies such as critical thinking, problem-solving, teamwork, autonomous learning, adaptability, sustainability, and digital skills. The evaluation combined quantitative (SEEQ) and qualitative methods (focus groups, student reflections) to assess students' perceptions, learning outcomes, and competency development. The results indicate that integrating active learning methodologies with ICT and AI significantly enhances student engagement and long-term knowledge retention. Based on the findings, the most suitable methodologies and ICT tools are proposed to effectively implement a broad range of transversal skills in the classroom, providing a holistic educational experience aligned with current academic and professional demands.

Keywords: *Active learning, artificial intelligence, engineering education, competency-based learning.*

1. Introduction

Competency-based learning in engineering education requires students to develop transversal skills such as collaboration, critical thinking, communication, and digital skills. In modern education, growing concern about low student motivation, limited attention, and difficulty connecting theory to practice has highlighted the limitations of traditional lecture-based approaches (Freeman et al., 2014). To address these challenges, active learning methodologies, competency-based teaching, and alternative assessment strategies are being adopted to promote student engagement and the development of transversal skills through meaningful learning experiences. This study explores how active methodologies combined with digital tools and generative artificial intelligence can support the acquisition of these competences providing a more meaningful and lasting learning experience.

2. Design and methods

The general objective is to integrate various active methodologies and digital tools in a way that enables students to learn by doing, while developing essential competencies for both their personal and professional lives. To achieve this, it is crucial to engage students in their own learning process and to foster active and attentive participation in the classroom. The specific objectives include implementing these methodologies and assessing their impact on the development of subject-specific competencies, as well as

transversal competencies promoted by the university. The aim is to analyze the effectiveness of these methodologies from a holistic perspective, recognizing their complementarity and their contribution to enhancing motivation, attention, and collaborative learning.

The methodology followed to carry out this study is outlined below: (1) Identify the specific and transversal competencies to be developed in each course. (2) Select the active learning methodologies and digital tools that best align with the identified competencies. (3) Design and implement learning activities based on the selected methodologies, objectives, and competencies of each course. (4) Assess student progress and collect feedback from instructors.

3. Discussion and results

This study was carried out by monitoring three undergraduate and master's degree courses in Agricultural Engineering, Industrial Engineering, and Computer Engineering at the University of Almería. Each course selected several transversal competencies from the general framework defined by the university for its academic programs, in addition to the specific competencies relevant to each course. The selected transversal competencies included teamwork, critical thinking, problem-solving, autonomous learning and time management, effective communication, adaptability, digital skills, and sustainability.

Given the engineering context, it is important to highlight that teamwork is a critical competency in most professional environments. Active learning methodologies, such as cooperative learning and problem- or project-based learning, have proven particularly effective in fostering key interpersonal skills, including collaboration, communication, leadership, and conflict resolution. Consequently, teamwork and digital competence—integrated through the use of a group digital portfolio—were established as core transversal competencies across all three courses analyzed.

In the master's degree course in Computer Engineering, the implemented methodologies included both formal and informal cooperative learning, service-learning, flipped classroom, and gamification (Gil et al., 2011). These approaches aimed to develop transversal competencies such as teamwork, critical thinking, and sustainability, particularly through the service-learning component. The methodologies were integrated with various digital tools, including audience response systems (clickers) using Wooclap (Gil et al., 2018), WebQuests created with Google Sites (Shaukenova, 2015), a collaborative digital group portfolio (also hosted on Google Sites), and generative artificial intelligence. Table 1 presents an activity entitled "Green ICT Challenge: Reducing Our Digital Footprint," proposed in the Computer Engineering course, designed to foster transversal competencies through the selected active methodologies and digital tools.

Table 1. Summary of the "Green ICT challenge: reducing our digital footprint" activity.

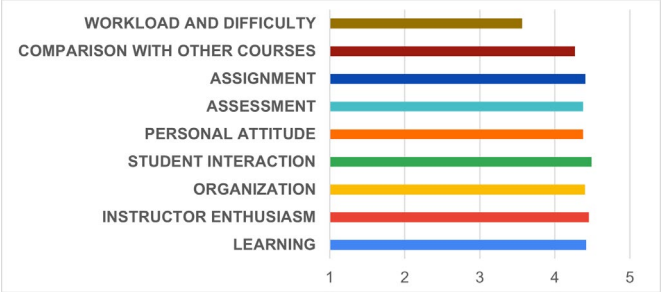
Objectives	To develop transversal competencies such as teamwork, critical thinking, digital competence, and sustainability by analyzing the energy impact of ICT use in the university environment and proposing innovative solutions.			
Methodologies	**Cooperative learning**	**Flipped Classroom**	**Service-Learning**	**Gamification**
	Teams of 3–4 students with defined roles (research, data analysis, communication, and source verification)	Students watch videos and complete readings before class on topics related to the energy impact of device usage, cloud storage, generative AI, etc.	The final proposal must be applicable within their faculty or to students' daily digital habits, ensuring real-world impact.	Weekly missions and challenges are introduced, such as conducting an energy audit of students' digital habits.
Digital tools	**Wooclap (Clickers)**	**WebQuest**	**Digital Group Portfolio**	**Generative AI tools**
	Initial survey on digital habits ("How many hours of streaming do you do per week?") Quick quizzes following flipped-classroom videos	Guides the research and reflection process. Example tasks include: Investigating how much CO_2 a one-hour video call generates.	Each group documents their proposals for reducing energy consumption, critical reflections, and evidence of the use of reliable sources.	Use counterfactual scenarios with prompt such as: *"What would happen if all students reduced their screen time by one hour per day?"*
Assessment	Rubric-based evaluation of transversal competencies	Participation in Wooclap activities and reflections in the digital portfolio.	Submission of a viable, data-driven intervention	Group self-and peer- assessment using rubrics

In the Industrial Engineering course, the methodologies applied included cooperative learning, problem-based learning, and flipped classroom strategies, all aimed at fostering teamwork, problem-solving, autonomous learning, and time management. These were supported by digital tools such as clickers, digital group portfolios, and subject-specific simulators. In the Agricultural Engineering course,

project-based learning (PBL), gamification, and flipped classroom approaches were employed to strengthen teamwork, effective communication, and adaptability. These were likewise supported by clickers, digital group portfolios, and generative artificial intelligence tools.

Student progress was evaluated using the Student Evaluation of Educational Quality (SEEQ) questionnaire (Marsh, 1982), an instrument designed to assess teaching effectiveness across ten dimensions. Each dimension consists of several items rated on a five-point Likert scale. A total of ninety students across the three courses completed the questionnaires. Figure 1 displays the average scores for each dimension in the SEEQ questionnaire. All categories achieved scores above 4—except for workload and difficulty—which, given the scale midpoint of 3, indicates a highly satisfactory evaluation of the learning experience.

Figure 1. Average score for each dimension of the SEEQ questionnaire.



In addition to the quantitative evaluation, students were asked to reflect on how they had improved in each competency throughout the course, supporting their reflections with examples of work included in their digital portfolios. Participating faculty members were also invited to share the most positive aspects of the experience, as well as the main challenges encountered during the implementation of the methodologies. All participating faculty members rated the experience very positively in all aspects, although one of the main difficulties they highlighted was the increased workload required to assess the wide range of proposed activities. Their insights will be valuable for refining and improving future implementations.

4. Conclusions

The integration of active learning methodologies, digital tools, and artificial intelligence in engineering education has proven effective in fostering transversal competencies and enhancing student engagement. The results underscore the value of combining cooperative strategies with emerging technologies to improve learning outcomes. This approach supports meaningful, competency-based learning that is closely aligned with real-world professional demands. Student feedback, gathered through the SEEQ questionnaire, indicated high levels of satisfaction across all evaluated dimensions—particularly in learning, enthusiasm, and organization—reinforcing the positive impact of the implemented strategies.

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THE CONNECTION BETWEEN GUT-BRAIN AXIS, ANXIETY AND LEARNING: A MICRO-SCENARIO FOR HIGH SCHOOL STUDENTS

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Abstract

The gut-brain axis is a term used to describe the reciprocal connection between the central and the gastro-intestinal nervous system. It plays a crucial role in linking the emotional and cognitive brain functions with the peripheral intestinal ones. Degradation of this communication can lead to anxiety, mood disorders and impaired learning ability. By acknowledging the increased anxiety levels and learning difficulties of students in secondary education, this lesson plan aims to educate them on the importance of the gut microbiome in emotional and intellectual processes, while informing on ways to protect and restore it. In the context of a biology course, students will navigate through an online learning environment that provides insight into the human microbiome. After being inspired by an art exhibition and a related poem, students will create an artistic representation of the gut-brain axis. Moreover, a brainstorming session will tap on the factors that affect the gut microbiome, such as breastfeeding, nutrition, exercise, sleep and smoking/vaping. The impact of excessive antibiotic use on the balance of the intestinal microbiota will be showcased through an online game. In addition, the role of the gut-brain axis in maintaining a healthy brain will be emphasized through a theatrical improvisation activity that incorporates healthy eating habits, a short exercise routine and a set of relaxation techniques. Finally, students will be introduced through a Jigsaw activity to the cutting-edge biotechnological approach of fecal transplants for restoring gut microbiota. The current teaching intervention will be assessed through self-reflection, open discussion and online reports.

Keywords: *Gut-brain axis, gut microbiome, active learning, STEAM education, secondary education.*

1. Introduction

Recently, there has been an increasing interest of the scientific community on the bi-directional communication between the gut and the brain that is referred to as the gut-brain axis (Carabotti, Scirocco, Maselli, & Severi, 2015). The medical community has acknowledged the significant implications of gut-brain axis on mental health (Skonieczna-Żydecka, Marlicz, Misera, Koulaouzidis, & Łoniewski, 2018). Moreover, multiple studies suggest a strong correlation between gut-brain interactions and academic performance (Chakrabarti et al., 2022). However, to the best of our knowledge this is a topic that has been heavily overlooked, even within the medical education context (Simons et al., 2022). To address this educational disparity, this lesson plan incorporates STEAM (Science, Technology, Engineering, Art, Math) and active learning approaches that raise awareness, while boosting research thinking and science communication skills.

2. Methodology

Subject: Biology – Topic: The interplay of gut-brain axis, anxiety and learning – Age Group: Teenagers – Time: 90 minutes.

2.1. Educational goals

This lesson aims to: 1) Boost science and technology literacy skills of secondary education students. 2) Promote active learning, research thinking, and collaboration. 3) Develop science communication skills. 4) Educate on the gut-brain axis and its interconnectedness to learning, education, emotion, stress and anxiety. 5) Inform on the factors that influence the gut-brain connection. 6) Raise

awareness on misuse of antibiotics and antimicrobial resistance. 7) Introduce microbiome restoration and relevant applications. 8) Raise awareness on habits and behaviors that protect gut and brain function.

2.2. Materials

Video projector, IT (Information Technology) classroom with Internet connection, containers with labels, a zip-lock bag, shower gel, pom-poms, spaghetti, beans, chickpeas, craft eyes, craft sticks, a box, and three ribbons.

2.3. Procedure

This lesson plan spans two teaching hours. During the first hour, the gut flora and the gut-brain axis are introduced to students. In the second hour, students explore the interplay between gut-brain axis, anxiety and learning, and the factors that influence this axis. Finally, assessment of the teaching intervention occurs, by means of self-reflection, a plenary discussion and student experience evaluation.

2.3.1. 1st Phase: (time: 45 min). 1st micro-activity (time: 20 min). Virtual representation of microbe and microbial community behavior via an online simulator.

1. Students are directed to an online microbiome simulator by Learn.Genetics, a genetic science learning center (https://learn.genetics.utah.edu/content/microbiome/simulator/).
2. We ask students to observe the virtual microbes and to describe over spreadsheets how the virtual microbial community behaves.
3. Students are requested to report on how virtual microbes respond to changes in their environment that cause a temporary or permanent effect.

2nd micro-activity (time: 25 min). Introduction to the gut-brain axis.

1. First, students are requested to explore an online exhibition, namely the *Mind the Gut* by the University of Copenhagen (https://www.museion.ku.dk/en/mind-the-gut_/). In more detail, students navigate posters, videos, artwork and narratives so to appreciate the complex connection between mind and gut via the threefold of science, art and history.
2. Second, students watch a video by the Bohorquez Laboratory, Duke University (https://youtu.be/oym87kVhqm4?feature=shared). We then ask them to describe on their spreadsheets: (i) the recently discovered pathway that bridges the gut with the brain, (ii) how this can become a target by pathogens and (iii) how this information may be employed to develop therapies.
3. Next, students engage in the active reading of a poem (https://drive.google.com/drive/folders/1NhaQmFcb6wjG3E5XB3l0ELiCwdyW6oda) inspired by microbial role and function in the human body and how the latter is affected by lifestyle choices. We ask students to attempt rewriting parts of it, so to communicate more effectively the science involved, and to brainstorm on provisional titles of the reworked poems.
4. Subsequently, we provide students with labeled containers that correspond to elements of the gut-brain axis and ask them to produce an artistic representation of this axis. The provided materials are as follows; the zip-lock bag represents the intestine, the shower gel the stomach fluid, the pom-poms the bacterium *Bacteroides fragilis*, the spaghetti the bacterium *Bifidobacterium animalis*, the beans the bacterium *Enterococcus faecalis*, the chickpeas the bacterium *Escherichia coli*, the craft eyes the probiotic *Lactobacillus*, the craft sticks the probiotic *Bifidobacterium*, the box represents the brain and the ribbons the three pathways connecting the gut with the brain.
5. Finally, students present their artwork in the classroom.

2.3.2. 2nd Phase: (time: 45 min). 3rd micro-activity (time: 10min). Link of gut health to cognition, mood and memory.

1. Students watch a BrainFacts.org video on the connection between the gut microbiome and the brain (https://youtu.be/5S-eOHfbwa8?feature=shared).
2. Subsequently, they describe on their spreadsheets the relationship between gut, serotonin, stress response and memory.
3. Students offer their thoughts on the influence of gut microbiome on mental health and cognition.

4th micro-activity (time: 30min). Nutrition and other factors influencing the gut-brain axis; antibiotics, antimicrobial resistance and effective treatments.

1. Students brainstorm on the factors that influence gut microbiome (such as diet, exercise, sleep, smoking/vaping and breastfeeding), using concept mapping as a teaching method.

2. Students watch a Ted-Ed video (https://youtu.be/1sISguPDlhY?feature=shared) and make notes of the foods that promote a healthy gut; bacterial diversity, balance, growth, as well as prevalence of probiotic bacteria. They also note the influence that lifestyle has on gut microbiome and how this supports body functions.
3. In an improvisation activity, students act out lifestyle habits that support healthy gut function, i.e., wholesome nutrition, physical activity, stress management, good quality of sleep, relaxation techniques.
4. Students are directed to *Agent Antibiotic,* an online game by *Learn. Genetics* site (https://learn.genetics.utah.edu/content/microbiome/agentantibiotic/). They note down on their spreadsheets observations on bacterial infections, the impact of antibiotics treatments on intestines, side-effects of treatments, the role of probiotics, new effective treatments and, importantly, antimicrobial resistance, its implications on health and effective strategies to avoid it.
5. Finally, in a jigsaw activity (Chopra et al., 2023), the fecal transplants treatment is addressed. Students work in mock- expert groups, each responsible for a key issue on this topic, such as mechanisms, applications, challenges, etc. Then, each team engages in teaching, thus promoting peer instruction.

2.3.3. Evaluation (time: 5 min). Assessment of student understanding and experience.

1. Students engage in self-reflection, which they note on their spreadsheets. This is based on the following prompts: “Today I learned”, “Today I felt”, “Today I experienced”.
2. A plenary discussion is held on the content of the lesson, the activities employed and whether learning objectives were accomplished.
3. Students participate in a Mentimeter poll (https://www.mentimeter.com/) to offer their insight into student experience, e.g. “How did you enjoy the lesson?”, “Did you like the material?”, etc.

3. Conclusions

Data collection on learning outcomes and student experience by means of student feedback will help shed light on the effectiveness of the described lesson plan (Carless & Boud, 2018).

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ANALYSIS FOR CHARACTERISTICS OF LOW-ACHIEVERS AND CONSTRUCTION OF A CLASSIFICATION MODEL USING PROGRAMMING DATA

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Abstract

Since 2018, programming has become a compulsory component of information education in Japanese senior high schools. Programming proficiency should be increased by improving instruction for difficult to understand content. This study aims to construct a model to classify students into subgroups at risk of low proficiency using machine learning, focusing on the types and number of token occurrences in student-created programs. Students created programs using a newly developed web-based coding system. When an operational event such as character input or execution occurs, the type of event, time, and current program are sequentially recorded as programming data. The student-created programs were divided into tokens and the occurrences of these tokens was analyzed. A classification model was constructed using machine learning to detect subgroups based on the number of occurrences of each token. It was found that low achievers could be classified with an accuracy of approximately 70% using this model. This has important implications for providing focused instruction for weaker students.

Keywords: *Programming, machine learning, classification model, low-achiever, token.*

1. Introduction

Educational activities in Japanese senior high schools are conducted according to nationally standardized curriculum guidelines. The current curriculum guidelines were announced in 2018, when the subject area of informatics was revised, and a new subject “Informatics I” was established and made compulsory. This subject includes programming, requiring the development of skills related to the ability to select and correctly express an algorithm, consider the efficiency of an algorithm, create a program, check the operation of the created program, and, correct defects (MEXT, 2018).

These skills require extensive instruction, particularly for students weak in programming. Our previous research indicates that the degree of similarity between student-created and exemplar programs is related to proficiency level (Hasegawa 2024a). The purpose of this study is to construct a model for detecting low achievers through machine learning, using the number of occurrences of each token in the student-created programs.

2. Teaching practice

In 2024, three lessons with a binary search program as a teaching unit were taught to 135 second-grade students in four classes at a private senior high school in Kyoto, Japan. Prior to this teaching practice, the students had learned fundamental programming skills such as branching, iteration, and arrays. They had also taken a class on creating a linear search program. JavaScript was used as the programming language. In the first lesson, the teacher explained the binary search algorithm. In the second lesson, an exemplary program was presented with an explanation by the teacher, after which each student attempted to create a binary search program independently. The third lesson reviewed key points to reinforce each student’s understanding of binary search programs.

A written examination was conducted to assess student proficiency after the last lesson. Of the six total questions, one was on understanding the algorithm, four on completing the program, and one on improving the program. Each question was allotted one point. The mean score was 3.6±1.6 (n=132). Given the importance of identifying weaker students and provide them with early assistance, we classified the students into top, middle, and lower groups according to their scores on the written examination. The actual

classification results showed that students with a score of three were classified into the middle and lower groups. All students with a score of 3 were classified in the middle group, because more students were classified in the middle group than in the lower group. Finally, 35 students were classified as low achievers. 97 students were classified into the non-lower group, which was the sum of the middle and upper groups.

3. Programming data

The students used a web-based coding record system newly developed by Hasegawa (Hasegawa 2024b) for their study. A block diagram of the system is shown in Figure 1. Students can create programs in JavaScript and execute them by accessing the system through a web browser. The system detects operational events when a student enters characters to create or execute a program. Immediately after the detection, the type of operation event, the current timestamp, and the entire program being created are sequentially recorded as "programming data" into the system's database. A total of 58,817 records were obtained from 126 students for 20 minutes of creating programs in this teaching practice.

The time-series mean changes in the cumulative event count and number of characters in the program obtained as programming data for the lower and non-lower groups are shown in Figures 2(a) and (b), respectively.

Figure 1. Block diagram of a web-based coding record system.

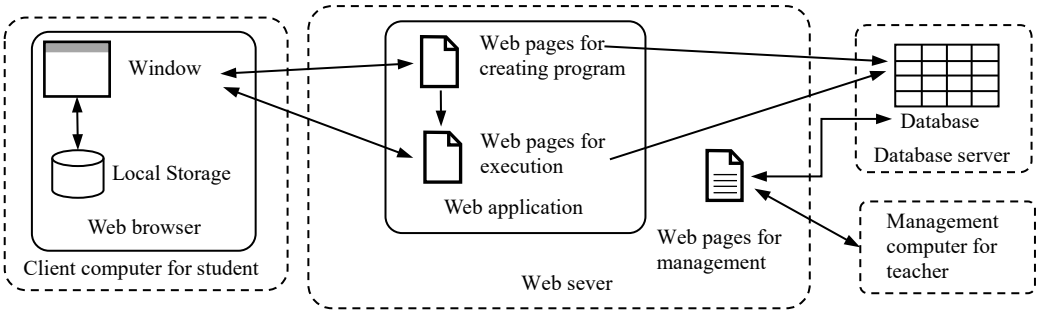
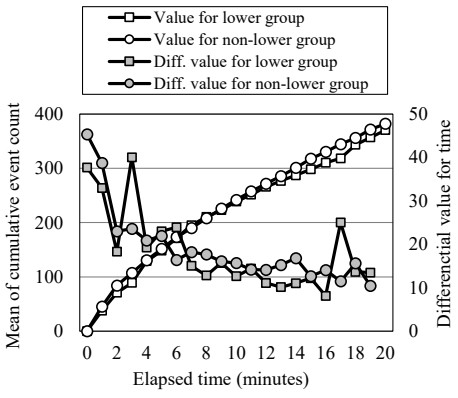
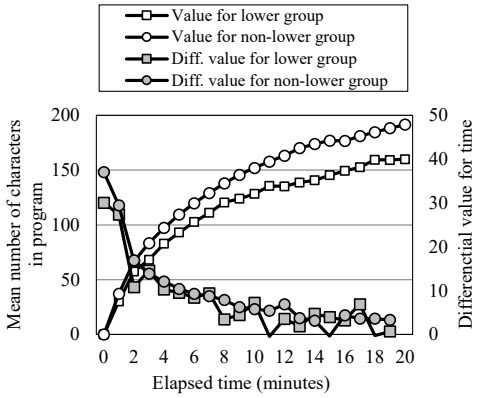


Figure 2. Time-series mean changes in programming data for the lower and non-lower groups.



(a) Cumulative event count



(b) Number of characters in program

As shown by the difference values, the cumulative number of events for both groups increased with time. However, the increase in the mean number of characters in the programs for both groups was suppressed after approximately 2 minutes. One possible reason for the time-series changes shown in Figure 2(b) is that the characters were deleted to modify the program. The mean number of characters in the programs at 20 minutes was 160.0 for the lower group and 191.6 for the non-lower group. The difference between the two means was significant at the 0.05 level of significance. The mean number of program execution events was 2.0 for the lower group and 2.2 for the non-lower group. Only three students in the non-lower group completed the program.

4. Classification model

We propose a model that classifies students into lower or non-lower groups by employing the programming data. First, we extracted the programs created by 126 students at 20 minutes. These programs are divided into tokens. Subsequently, space, string and numeric literal tokens, and tokens that did not appear in the answer program were removed. The number of occurrences of each token is then determined. We obtained the mean number of occurrences of each token in the programs for the lower and non-lower groups, and applied a t-test to verify whether these means differed significantly. There were significant differences in the tokens such as '/', '<=', 'Math', 'floor', 'while' and others. The results suggest that it may be possible to classify students into the lower group based on the number of occurrences of tokens.

A classification model was constructed by applying machine learning, where the explanatory variable was the number of occurrences of each token, and the objective variable was the lower and non-lower groups. Five algorithms were selected to investigate the suitability of machine learning for this classification: (M1) logistic regression, (M2) decision tree, (M3) support vector machine, (M4) random forest, and (M5) gradient boosting (Géron, 2019). Hyperparameters were adjusted in the machine learning model to optimize recall, which is an indicator of the proportion of models correctly predicted as positive among actual positive instances. A high recall value indicates that the model successfully detected most of the lower-group data without omission.

A five-fold cross-validation was performed to evaluate the generalization performance for 126 records. The recall of the models ranged from 0.74 to 0.77, while the precision fell within the range of 0.70 to 0.78. Here, precision indicates the proportion that actually belong to the positive class among the instances that the model predicts to be positive. M1 achieved the highest recall and precision among all the models. Although it is generally difficult to correctly classify the minority lower group using statistical models, the low achievers belonging to the lower group could be classified with approximately 70% accuracy using the machine learning model.

5. Conclusion

In this study, we proposed using the number of token occurrences in student-created programs to detect low achievers in programming education in senior high schools. A machine-learning model was constructed to classify students into lower and non-lower groups using the programming data. The findings suggest that it is largely possible to identify students with lower proficiency using this method. Consequently, teaching staff can provide individualized instruction for such students.

For future research, we plan to analyze the temporal variation of the tokens in the program students are creating, to detect those likely to have weak programming-related mastery.

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UNPACKING THE NEEDS AND CHALLENGES OF EMBEDDING SOFT SKILLS IN STEM CURRICULA IN EU HEIs

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Abstract

The climate crisis and green transition are reshaping the way STEM young graduates respond to challenges in a rapidly changing workplace. Several studies highlight the emerging role of soft skills, as part of the development of new competences for green jobs. For soft skills to be adopted in green industries, synergies between Higher Education Institutions (HEIs) and companies are needed. The Erasmus+ SOFTEN project promotes the integration of 'green soft skills' into STEM schools across four HEIs in the EU by training educators and equipping STEM graduates with capabilities needed. As part of the research phase, the project designed a framework about the current needs and challenges of soft skills integration in green STEM curricula in Europe, through mixed-method research. The project's team performed desk research about initiatives in HEIs on soft skills integration in STEM courses, followed by semi-structured interviews with STEM educators and green industry representatives in Greece, Lithuania, Italy, Poland, Portugal and Finland. An online survey was distributed to STEM students in these countries to triangulate results about needs and gaps. The findings were validated through online focus groups. The paper presents the qualitative component of the research, in particular the results of the semi-structure interviews with STEM educators and green economy stakeholders. As such, it contributes to the growing body of literature about mismatches between green soft skills supply side (by HEIs) and demand side (by green industry) across different academic and industry settings in the EU.

Keywords: *Green transition, soft skills, green soft skills, STEM, higher education, research.*

1. Introduction: The rising importance of green soft skills in HEIs

Green soft skills represent a specialised subset of soft skills that focus on fostering environmentally sustainable practices within various sectors. They span from effective communication about sustainability issues to adaptability to new environmental technologies. They are increasingly recognised as essential for individuals in both leadership and operational roles across industries.

Incorporating green soft skills into STEM curricula involves a multifaceted approach. Their development necessitates implementing teaching strategies that encourage critical thinking and communication, which are essential for collaborative problem-solving in sustainability-related projects. HEIs that emphasize soft skills alongside technical competencies significantly enhance the employability of graduates, as employers place equal importance on both types of skills (Messaoudi, 2021; Rodríguez et al., 2021). However, educators and business leaders face barriers in the implementation of green soft skills in STEM curricula in HEIs. One challenge is the traditional focus on hard skills and technical knowledge in these fields, often at the expense of soft skills (Mwita et al., 2023). This focus can result in a skills gap wherein graduates lack the necessary interpersonal skills to navigate the complexities of modern workplaces (Messaoudi, 2021). Additionally, institutional policy plays a crucial role in shaping the curriculum. Some HEIs lack the necessary infrastructure and commitment to embed soft skills into their programmes. It can also be difficult for educators, who may not have been trained to teach soft skills, to effectively introduce these concepts into existing curricula (Ernawati & Bratajaya, 2021; Amantay

& Ermakov, 2021). Another barrier is the ingrained perception within HEIs that hard skills are of primary importance, often at the expense of soft skills (Hwang, 2022).

To counteract such trends, approaches like project-based learning can help illustrate the real-world relevance of soft skills while maintaining a strong focus on technical knowledge (Joseph & Uzondu, 2024). Professional development programmes on methods for integrating soft skills can empower faculty members (Joseph & Uzondu, 2024). Collaborative efforts among disciplines and the establishment of a shared vision for curricular integration can facilitate a more coherent approach to teaching green soft skills within STEM programmes (Tan et al., 2019). As sustainability-related challenges in fostering soft skills development in green STEM curricula are context-dependent, the SOFTEN project performed research to unpack specific barriers and repercussions in six EU countries, thus informing the associated educational solutions.

2. Research design & methodology

The research phase was framed as stakeholder-informed research that combines qualitative depth with wider quantitative information. The qualitative arm comprised semi-structured interviews involving two principal sets of participants: (i) STEM academic staff and (ii) members of the green sector, conducted across Greece, Lithuania, Italy, Poland, Portugal, and Finland. Interviews probed how soft skills are now perceived, ordered, and (under)developed in educational and working life, guided by an interview protocol that allowed contextual consistency but national variation. Participants were invited through purposive and snowball sampling to offer variety in expertise, institutional role, and disciplinary background. The interviews yielded rich context-specific insights into facilitators and barriers to the development of STEM soft skills, and the data was analysed thematically to produce concrete results.

The research approach combined depth and scope through 57 semi-structured interviews with STEM educators and green industry representatives in six European countries. A shared thematic guide ensured consistency across interviews while allowing local relevance. Participants were sampled from a variety of STEM fields and green sectors, including circular economy, energy, and sustainable technologies. Interview answers addressed green soft skills awareness, opinions regarding their perceived utility to future graduates, operational barriers to their implementation, and existing activities to incorporate them into education or into in-work training. The interviews were thematically coded to look for recurring patterns and national differences. The findings were triangulated with quantitative survey outcomes and refined through discussion in focus groups.

3. Objectives

The qualitative research pursued three general objectives. Firstly, it sought to understand how green industry professionals and STEM educators perceive the role and importance of green soft skills in sustainability careers. Secondly, it sought to identify specific gaps in current STEM curricula in terms of incorporating soft skills, particularly emphasising structural, cultural, and institutional barriers. Third, the research aimed to reveal examples of good (best) practice and stakeholder-driven recommendations to inform curriculum innovation. The achievement of the objectives ensured that the research provided an evidence-informed foundation for the SOFTEN framework and the subsequent results, such as a Massive Open Online Course (MOOC) and an online platform to support STEM educator capacity-building.

4. Findings: deficiencies in the skills supply and repercussions to the skills demand side

The findings reveal a set of barriers to the integration of soft skills in green STEM curricula (for STEM educators) and how these barriers translate into challenges in green industry workplaces during the education-to-workplace transition of STEM students. Therefore, the findings offer a comprehensive overview of academic gaps (skills supply side) and associated problems in the green occupational sector (skills demand side) of the academic-employment trajectories of STEM students.

The cross-country analysis of data generated a cluster of commonly perceived barriers and needs across all examined academic settings. The recurrence of these barriers in academic contexts which differ culturally and institutionally illustrates their significance and informs EU-wide policy actions.

At the institutional level (macro- and meso-level), STEM educators stressed the absence of clear state-level or university-driven strategies that are necessary to support more inclusively green skills with the integration of soft skills. This is naturally linked to limited or absent dedicated time regarding introducing and teaching soft skills in the syllabus of STEM courses. In addition, lack of resources and poor cooperation with the private sector and non-academic stakeholders have been cited by interviewees.

At the individual level (micro-level), STEM educators across all countries self-reported the lack of proper training of teachers on soft skills. From a behavioural angle, reluctance from educators in

changing teaching methods and embracing interdisciplinarity through innovative learning units is a theme that has been observed in all countries.

The interviewed stakeholders from the green sectors outlined a series of current gaps that are exhibited by employees in the workplaces and are associated with the deficiencies in the supply side of the skills equation. The sectors that were covered in the research indicatively include circular economy, green energy, waste management, refining industry, green infrastructure, water treatment, and green architecture; thus, capturing a plethora of green occupations.

A major problem that was discussed concerns the difficulty from the side of young STEM graduates and young employees to adjust their technical knowledge and skills into real-world needs. This points out a mismatch between technical knowhow and contemporary green challenges that require an interdisciplinary mindset to be addressed. Additional gaps relate to the lack of taking risks, limited creativity and poor communication skills that young employees display in their work tasks.

The second strand of challenges that was discussed with industry stakeholders regarded obstacles to workplace initiatives that can compensate for the skills gaps of employees by providing training in soft skills. Interviewees highlighted the lack of organised and top-to-bottom efforts to develop soft skills due to immature organisational culture in the local green industries. Limited budget in organising capacity building training is another organisational barrier that keeps green soft competences underdeveloped.

5. Conclusions

Green soft skills are increasingly recognised as essential for leadership and operational roles across sectors. Despite their importance, gaps persist in how these skills are integrated in HEIs.

Research across six European countries revealed that HEIs often lack clear strategies and dedicated time for embedding soft skills into STEM curricula. Educators report insufficient training and show reluctance to adopt interdisciplinary and innovative teaching methods. Limited resources and weak cooperation with industry further hinder progress. On the industry side, young STEM graduates frequently struggle to apply their technical expertise to real-world green challenges, lacking creativity, risk-taking, and communication skills. Organisational barriers, such as immature cultures and limited budgets for green soft skills training, keep these competencies underdeveloped in the workplace. Addressing these gaps requires multi-actor collaboration to foster holistic skill development.

The SOFTEN project responds to these challenges by developing a framework for green soft skills integration and creating resources to support STEM educators' capacity building. These initiatives aim to better equip graduates for the demands of a sustainable, rapidly evolving labor market.

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SOCIO-PEDAGOGICAL EDUCATORS AND TEACHERS IN ECEC SERVICES: WHAT IS THE INITIAL AND IN SERVICE TRAINING FOR PROFESSIONAL COMPETENCIES

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Abstract

In response to the scenario of national and European political and pedagogical debate, with the introduction and progressive system setting of D.Lgs. n.65 of 2017 born in Italy the integrated system of education and education services 0-6 which is a crucial moment for the education sector of first and second childhood. The quality of services is closely linked to the professionalism of SP (Socio-Pedagogical) educators and teachers, who must have solid pedagogical and methodological preparation to respond to children's needs and development rhythms. Specific and coherent initial training coupled with continuing training processes enables professionals to competently address educational challenges and adapt to educational policies and changes in family needs. What are the professional skills essential for educational practice for socio-pedagogical educators and teachers in ECEC (Early Childhood Education and Care) services 0-6? And how did they build and consolidate their competencies? The proposed exploratory survey addresses SP educators and teachers in service on the national territory to investigate the issue of the construction of professional profiles in real contexts through the administration of a questionnaire to educational professionals in ECEC services. The study is formulated according to mixed survey processes and aims to initiate a reflection on training experiences that contribute to the development of professionalism. This contribution aims to present the research design and preliminary results of questionnaire administration.

Keywords: *Socio-pedagogical educators, teachers, ECEC services, initial training, professional competencies.*

1. Introduction

While reflecting on the quality of educational offerings is essential, it is not sufficient. It is equally necessary to establish a continuous and direct dialogue with the real contexts of educational work in order to ensure coherence between training pathways and professional practice (European Commission, 2016; 2020). This becomes particularly urgent in light of today's socio-cultural landscape, marked by the growing complexity of educational needs, especially those related to special educational needs. In response, there is a pressing need to promote a unified pedagogical approach within early childhood education and care (ECEC) services for children aged 0–6. At the European level, ECEC is considered a priority area to ensure equitable and universal access to high-quality education from the earliest stages of life. The integrated model, which combines early childhood services (0–3 years) with preschool education (3–6 years), aims to support children's cognitive, emotional, and social development while promoting values such as equity, inclusion, and well-being (Vandenbroeck et al., 2013; Heckman, 2011). The quality of these services depends largely on the initial and continuous training of educators and teachers (European Commission, 2014; CoRe, 2011), making it crucial to rethink professional preparation. Nevertheless, as highlighted by the Eurydice reports (2019; 2023), training systems remain fragmented across Europe. In Italy, for instance, there are still two separate qualification pathways: the L-19 degree for educators and the LM-85 bis master's degree for preschool teachers. Despite Legislative Decree 65/2017, which formally established the integrated 0–6 system, significant challenges persist in aligning training and fostering collaboration between the two professional groups (Sposetti et al., 2024). Educational work itself, however, represents a powerful formative experience, continuously shaping all participants in the pedagogical relationship (Fadda, 2016). Educators and teachers develop their competencies through an increasingly complex process, integrating academic knowledge with strategies refined through practice (Sposetti et al., 2024; Sposetti et al., 2022). Universities, therefore, hold a crucial responsibility in designing training programs that both guarantee educational quality and respond to the evolving needs of professionals operating in diverse and dynamic settings (Rossini, 2020; Fioretti, 2022; Boffo, 2021; Biasin et al., 2020).

2. Design, methods and objectives of research

The research project revolves around two key questions: What competencies do educators and teachers consider essential for their professional practice? And how are these competencies developed and strengthened in the workplace? The aim is to gather the perceptions and experiences of those who co-design educational services for children aged 0–6. By analyzing their reflections on both training and daily professional practice, the project seeks to identify how educational professionalism is developed and to understand which competencies are central to effectively addressing emerging educational and developmental needs. Areas of investigation include the development of professionalism in universities and in service, the competencies they consider necessary to address educational practice, their perception of the level of skills they have developed through training and experience, and levels of self-efficacy in addressing educational work. The research has exploratory purposes and is formulated according to mixed inquiry processes, which initially involve administering a questionnaire to professional educators in service throughout the national territory. The questionnaire, consisting of five sections, aims to explore and collect descriptive statistics—through both closed- and open-ended questions—on the competencies considered essential in educational practice, as well as on the level and type of initial and continuing training. Additionally, it invites respondents to reflect on the collaborative relationship between the two professional groups within the zero-to-six system and to carry out a self-assessment of the competencies acquired. This contribution presents the results of an initial administration of the questionnaire to a small group of professionals in order to conduct a try-out phase and evaluate the effectiveness of the items.

3. Results

The questionnaire, administered using the snowball sampling method, was completed by 63 education professionals, predominantly female (96.8%). Currently, the majority of respondents work in the Lazio region (60%). The most represented professional role is that of educator, accounting for 57.2% of the sample, with an average of three years of service experience. More than half of the respondents believe they have a fair understanding of ECEC, despite 89% holding at least a degree in the educational or pedagogical field. This trend is also reflected in a more specific question regarding the competencies acquired during their studies and later developed through professional practice. Indeed, the professionals are fairly competent in designing interventions, organizing educational spaces, and identifying the educational needs of children in zero-to-six services. In-service training is considered crucial for strengthening professional competencies by 53% of the respondents.

4. Discussion and conclusion

The debate on the professional profiles of educators and teachers within initial training programs is currently a crucial issue for fostering effective collaboration in educational services. The diversity of training pathways calls for a rethinking of educational proposals, which should be grounded in the real-life practices of those already working in the field. It is essential to establish a structured dialogue between universities and the professional world in order to train practitioners who can effectively address real educational challenges (Boffo, 2021). Ensuring coherence between practical contexts and training proposals is key to building solid professional competencies (Perillo, 2023; Balduzzi, 2022; Sposetti et al., 2022). As confirmed by the data briefly presented, universities must incorporate more elements connecting academic learning with real-world educational contexts to enhance the competencies developed through initial training programs. At the same time, it is necessary to expand and ensure ongoing in-service training to foster the development of new skills in response to an increasingly complex educational landscape. Field experience plays a vital role in bridging theoretical knowledge and practical skills. Understanding how competencies develop within educational services allows for the design of more effective teaching strategies for professional development. The integrated training of educators and teachers is considered essential for the 0–6 education system (Lazzari, 2023). The proposed research project aims to contribute to developing both initial and continuing training paths, enhancing real-world experiences as a privileged channel connecting academic knowledge with professional practice (Perillo, 2023).

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THE NUTRITION NEXUS: EDUCATING ON THE SCIENCE, ETHICS AND HEALTH IMPACT OF FOOD CHOICES

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Abstract

"Let food be thy medicine and medicine be thy food", as stated by the father of modern medicine, Hippocrates. For centuries, people have experienced and questioned the impact of dietary choices on health. The present micro-scenario is designed to highlight the interconnected effects of eating habits, various cooking methods, and the role of genetically modified organisms (GMOs) on human well-being. This Biology lesson, intended for secondary and higher education, explores the biochemical transformations that food undergoes during cooking, comparing different techniques and examining their influence on nutrient preservation. Emphasis is placed on the importance of a balanced diet and the function of macro- and micronutrients in managing and preventing chronic conditions, such as diabetes and heart disease. Furthermore, students are instructed to delve into the controversial topic of GMOs, assessing potential advantages and drawbacks through the lenses of ethics, biosecurity and food safety. Through active learning and group projects, critical thinking and decision-making are promoted. Finally, students evaluate the educational experience and contribute their thoughts, in the form of a thesis on the question "Are we what we eat?", an inquiry initially posed by the French lawyer, politician and author, Anthelme Brillat-Savarin, that still troubles individuals to this day.

Keywords: *Biology, secondary education, higher education, food literacy, critical thinking.*

1. Introduction

It has been pointed out that food is a complex and multifaceted topic (Swan & Flowers, 2015) that encompasses science, technology, disease and society. Given its complexity, it is fundamental to foster critical and creative thinking in terms of food education (Silva, 2015). It has been indicated that food education should include practical skills (Sadegholvad, Yeatman, Parrish, & Worsley, 2017), that may empower students to make healthier food choices. Importantly, a clear connection must be established between nutrition and health, so to help prevent and manage related illnesses (Silva, Araújo, Lopes, & Ray, 2023). It is equally significant to nurture awareness on food ethics, which encourages sustainable and socially conscious decisions (Costa, 2017). Finally, biosecurity and food safety are vital issues that need to be addressed in the interest of public health and sustainability (Oswald Spring, 2011; Cole, Augustin, Robertson, & Manners, 2018). However multidisciplinary food literacy is (Vidgen, 2016), this is often overlooked in educational curricula, that fail to present it as a nexus. To address this gap, we have developed an integrated lesson plan that combines nutritional science, practical skills and ethical reasoning. This teaching intervention promotes critical thinking, student participation, and self-reflection, providing an active learning approach to food education.

2. Methodology

Subject: Biology and Food Literacy - Topic: Biochemistry, nutrition, public health, bioethics, biosecurity and food safety - Age Group: Teenagers and young adults - Time: 180 minutes.

2.1. Educational goals

Through this lesson plan we aim to promote: food literacy, science literacy, visual literacy, research skills, critical thinking, student participation, teamwork and collaboration skills, communication skills, practical skills in food education.

We also aim to inform on: the biochemical processes involved in cooking, nutritional value, the link between a balanced diet, health and disease prevention, food safety, bioethics and biosecurity, food sustainability.

2.2. Materials

(1) IT classroom, (2) Video projector, (3) Speakers, (4) Printer, (5) A4 paper sheets (6) Lesson plan resources (available online in the following Google Folder; https://drive.google.com/drive/folders/1rdeXLx9RxW2Dr-aY1BJ95xuCd3S3wbsJ).

2.3. Procedure

The lesson plan comprises three phases, lasting a total of three hours. In the first phase, students document biochemical changes that occur during cooking and examine how various culinary techniques impact nutritional content. In the second phase, they focus on analysing the role of health-related advertising claims in shaping consumer decisions, followed by a meal redesign aimed at enhancing nutritional value and minimizing the risk of chronic disease. Lastly, students engage in a debate evaluating benefits and risks of GMOs.

2.3.1. 1st Phase (duration: 60 min). 1st micro-activity (duration: 25 min). Recording biochemical changes occurring during cooking.

1. Students are requested to watch two educational videos. The science of denaturation is showcased (https://www.youtube.com/watch?v=CHMY4G9gTPA&list=LL&index=10) (0:00-0:57), as well as caramelization and the Maillard reaction (https://www.youtube.com/watch?app=desktop&v=oWCrmVMjeds) (duration: 7:32).
2. In parallel, students record on spreadsheets (see Google folder) visible changes, the biochemical transformations involved and subsequently provide additional examples of similar processes, e.g., emulsification, gelatinisation.

2.3.2. 1st Phase (duration: 60 min). 2nd micro-activity (duration: 35 min). Reporting on how different cooking techniques affect nutrient preservation.

1. Students write on the whiteboard their favorite dishes and the cooking methods used to produce those.
2. Next, students work in groups of 3-5 people, each group assigned with a cooking method.
3. Students report on spreadsheets (see Google folder) the effect of each method on food chemistry and its impact on nutritional value. For this, they may refer to the following source: https://chem.libretexts.org/Bookshelves/Biological_Chemistry/Chemistry_of_Cooking_(Rodriguez-Velazquez).
4. Outcomes are presented by means of a Canva infographic (https://www.canva.com/).

2.3.3. 2nd Phase (duration: 60 min). 3rd micro-activity (duration: 30 min). Reflecting on the impact of advertisement health claims on consumer choices (see more on https://food.ec.europa.eu/food-safety/labelling-and-nutrition/nutrition-and-health-claims_en).

1. Students are presented with a slideshow (see Google folder) featuring a selection of ads, product packaging and headlines that showcase health-related promotional claims.
2. Students are prompted to run fact-checking research (high school students are provided with curated literatures; see Google folder).
3. Students document findings and provide their thoughts (see Google folder) on the validity of the ad claims, as well as the possible impact on consumer behaviour.

2.3.4. 2nd Phase (duration: 60 min). 4th micro-activity (duration: 30 min). Redesigning meals to boost nutrition benefits and to reduce chronic illness risk (see also: https://www.brighamandwomens.org/patients-and-families/meals-and-nutrition/bwh-nutrition-and-wellness-hub/recipe-makeover-tips).

1. Students name junk food favorites.
2. Students are allotted unhealthy dishes and work in groups of 3-5 people on meal makeover assignments.
3. Assessment is based on whether criteria such as, improvement of nutritional value, compatibility to chronic illness diet and novelty, have been met (for rubric see Google folder).

2.3.5. 3rd Phase (duration: 60 min). 5th micro-activity (duration: 60 min). Debating GMOs.

1. A secret "for" and "against" student vote on GMOs takes place.
2. Then, students are presented with a case study, namely the "Hawaiian Rainbow Papaya" (https://www.youtube.com/watch?v=CX7AqBOJS84) (duration: 11:14).
3. They read literature (see Google folder) and watch audiovisual material (https://www.youtube.com/watch?v=7TmcXYp8xu4&t=28s) (duration: 9:02) on GMOs.
4. Next, they are randomly assigned (https://www.random.org/) to "for" and "against" teams.
5. Teams use 10 minutes to prepare arguments on the aspects of ethics, biosecurity and safety.
6. The debate (20 minutes) comprises of three rounds of arguments and counterarguments.
7. A fresh vote count takes place.
8. Students' complete reflection worksheets (see Google folder), pointing out possible shifts in their perspectives, as a result of this activity.

2.3.6. Evaluation. Self-reflecting and assessing student understanding and learning outcomes. Students are asked to produce a short paper, the question "Are we what we eat?" serving as a prompt. In their writing, they should incorporate insights from all teaching intervention phases; on food processing, nutrition, ethics and safety. Students are instructed to add the paper to their portfolio and submit it for assessment.

3. Discussion

The present study educates on food literacy within a science, ethics and health framework. To this end, engaging, hands-on activities are employed. Notably, critical thinking and reflection are promoted, so that students grasp the complex and interconnected aspects of nutrition. By means of a student portfolio assessment, the effectiveness of the teaching intervention may be evaluated.

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SPIRITUAL DEFICIENCY WITHIN HEALTH CARE EDUCATION

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Abstract

The purpose of this study was to investigate and challenge spiritual deficiency within health care educational leadership. The study included developing an understanding of the spiritual insights of ten Canadian educational leaders within health care. Muted discourses about spirituality, within educational leadership was one of the problems identified within the study The. The findings indicated that by more openly dialoguing about spirituality within health care education, leaders within the field can rediscover spirituality, associated with "heart wisdom," enabling them to view their roles through a fresh lens.

Keywords: *Spiritual, healthcare, heart, education, wisdom.*

1. Introduction

One of the gaps identified within health care educational leadership is that spirituality is absent in the Canadian competency framework (Sawa, 2014). Chuengsatiansup (2002) argues, "it seems that health professionals and policy makers not only have little understanding on spiritual life, but they are not familiar with the language of spirituality" (p. 4). Spiritual deficiency, related to muted discourses about spirituality, within Canadian Health Care Educational Leadership was one of the problems investigated within Doetzel's (2006) study. Muted discourses about spirituality, noted in the study, suggest that the term "spirituality" is not commonly referred to by educational leaders. These leaders may be concerned about being misunderstood by peers and students. However, as noted by Dossey (1993), "skirting the spiritual has had a shattering effect on every dimension of contemporary existence (p.10), including health care. A renaissance of interest in paths of the health care and spirituality exists, and this "resurgence of spiritual values crosses racial, political, cultural, and class lines" (Glazer, 1999, p. 3). Spirituality" could be viewed as an intercultural approach to education and health care (Vaill, 1998, p. 92).

Articulating and teaching aspects of spirituality within health care education introduces "secular sacred" discourses, thus a spiritual context applied does not endorse a particular religion, but could assist health care educators and students to monitor and adjust their thoughts. This thought adjustment could bring more hope about health situations while also assisting with cultural safety (Beck, 1986).

2. Objectives

Janis (2000) suggests Spiritual deficiency within health care education is "beyond mere outer appearances and the five senses and is an intuitive perception" (p. 10). Vaill (1998) further states that spirituality is "wholeheartedness and whole headedness." Janis (2000) and Vaill (1998) evidently acknowledge that nurturing one's spirituality challenges dualistic thinking and leads to a sense of wholeness, immanence and transcendence

Doetzel's (2006) study echoes some of Vaill's and Janis' findings. Within Doetzel's (2006) study, the operational definition of spirituality is outlined as "a latent inherent truth awakened by contemplation, rituals, peak life experiences and caring acts of kindness; when awakened, spirituality is a sensation of the sacred, a sentiment of hope, a feeling of enthusiasm and excitement, and a heart-felt sense of interconnection with others" (p. 17). Further, the term "heart" is outlined metaphorically in both analysis of literature and data base, as "a symbolism of the tacit and visceral nature of spirituality that makes it difficult to articulate in words or encompass in religious organizations" (p. 18).

3. Methods

As an approach to research that supports the working definition of spirituality, by awakening feelings of hope and excitement, Appreciative Inquiry, was applied to the research questions. Appreciative inquiry is a constructive approach to research that creates space for new voices and expands circles of dialogue to include discourses about spirituality. While sparking hope, this approach encourages leaders to establish systems that nurture educators and students within their classes (Doetzel, 2006). Ludema, Cooperrider and Barrett (2001) point out that organizations tend to move in whatever direction their research is focussed. "When groups study high human ideals and achievements, such as peak experiences ... these phenomena ... tend to flourish" (p. 192). Thus, they suggest asking participants positive questions to mobilize the inquiry into moments of enthusiasm. The positive core questions guiding this research about spirituality support an "Appreciative inquiry" approach to research. Appreciative inquiry focuses on asking positive questions to "ignite transformative dialogue and action within human systems" (p. 191) Data were analysed using a triangulated phenomenological, feminist and cooperative inquiry research design, (Doetzel, 2006). An application of a triangulated approach encourages the application of three different lenses when examining responses to a research question. Qualitative inquirers triangulate among different data sources to enhance the accuracy of a study. Applying "multiple lines of sight" (Berg, 2001, p. 4),

4. Discussion

Three participants indicated that signifying spirituality in healthcare meant acting morally and reflecting spirituality within their treatment of others. Habs insisted that he needed to be honest, open and sincere, to build trust in his students and peers; leadership is about helping others to reach for the stars. Similarly, Luv stated that demonstrating self-respect and respect for others with caring actions signifies spirituality in healthcare; and Newday argued that leaders must lead by example.

The findings support literature (e.g., L'Engle, 1997; Albright & Ashbrook, 2001) which suggest spirituality is signified more by actions than words. Palmer (1998) states that communicating spirituality is actively expressing kindness towards others, and Spink (1997) argues that expressing love with one's actions reflects spirituality in an ineffable way. As Vaill (1998) notes, non-verbal vocabularies are limitless sources of spiritual insight that can help cultivate spirituality within leadership practices.

5. Conclusion

Articulation of the findings could inspire educators to become more vocal about spirituality within health care. Additionally, by answering the research questions, study participants provided an original contribution to knowledge that encourages more open communication about the spiritual elements of leadership. This could be one more step towards assisting them to introduce discourses about spirituality into their leadership practices.

Study findings helped generate a better understanding of how spiritual deficiency in medical education can be further investigated and challenged. It demonstrated how elements of healthcare education is perceived by some educational leaders within the education related to health care systems and demonstrated ways educators can work towards being paradigm-shift pioneers within educational work by applying more heart-centred approaches to leadership and teaching practices within health care education (Doetzel, 2006). Outcomes of the research is an encouragement of more open dialogue about spirituality within educational systems and a contribution to the development of cultivation of spirituality within health care education models.

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USING MONTHLY WORKSHOPS TO DRIVE ENGAGEMENT AND REPEAT VISITS AT THE MCAULIFFE-SHEPARD DISCOVERY CENTER

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Abstract

The McAuliffe-Shepard Discovery Center (MSDC) in Concord, NH, USA has recently begun a program of monthly workshops organized around a program of astronomy and space science. The workshops are targeted at 9–14-year-old learners, and designed to provide a curated, hands-on educational experience. Examples of topics covered include the size and scale of our solar system, and how telescopes work. In addition to learning about the topic, participants also construct an artifact (in one case, a working telescope) to take home. In addition to the obvious educational mission, these workshops also serve to drive repeat visits to the MSDC, both from members and non-members of the organization. In this poster, we present examples of the workshop content, along with participant demographics and satisfaction gleaned from post-workshop surveys. We conclude that these workshops serve the mission of the MSDC by driving community engagement with astronomy and space science, through continuing patronage of the institution.

Keywords: *Science and technology education, educational projects, ubiquitous and lifelong learning.*

1. Introduction

Science literacy and an understanding of the scientific process are widely viewed as essential elements for participation in twenty-first century life. Though it is assumed that science education takes place largely in the structured school environment, a substantial amount of learning about science takes place in informal contexts, ranging from everyday experiences, to hobby activities, to engagement with science museums and science centers (Osborn & Dillon 2007). Informal science education can complement science learned in more formal environments, provide a platform for continued engagement in STEM topics, and can promote integrated learning across these fields (Anand & Dogan 2021).

Science museums play an integral role in the informal science learning ecosphere in that they provide a curated space for individual and group exploration, moderated and guided by science-literate professionals (Fenichel & Schweingruber 2010). The McAuliffe-Shepard Discovery Center is one such space in Concord, New Hampshire, USA. The Discovery Center's mission is "to inspire every generation to reach for the stars, through engaging, artful and entertaining activities that explore astronomy, aviation, earth and space science." In 2024 the Discovery Center served more than 30,000 visitors at its 20,000 square foot science and engineering facility and 100-seat digital planetarium. In addition, the Discovery Center provides outreach opportunities for schools and community organizations throughout northern New England (McAuliffe-Shepard Discovery Center, 2024).

Central to the Discovery Center's mission is a commitment to provide staff-led programming, particularly for school-aged populations. Off-site outreach programs reach young learners in school, libraries, and civic organizations with programming that includes a pop-up planetarium and educator-led activities such as comet-making and rocketry. Programs at the Discovery Center site include a bi-weekly structured curriculum for homeschooled students, and planetarium shows for visiting school groups.

2. "Universe Unplugged" workshops

Beginning in the fall of 2024, the Discovery Center added a new programming element – The Universe Unplugged --a monthly Saturday morning workshop for self-motivated young learners between the ages of 9 and 14. Each hour-long session focuses on a different astronomical topic as a standalone activity. While learners are encouraged to sign up for multiple sessions, there is no expectation that they will do so, and each session is pedagogically independent. The workshops are small (typically 12-15

people) and contain significant hands-on components, including kinesthetic learning activities and the construction of scientifically-accurate artifacts for participants to take home. The overall goal is to provide a positive learning experience for the participants, one that will motivate them to engage further in astronomy and space science subjects, both informally at the MSDC and other science-centered institutions, and formally through their continued education.

The table below shows several examples of the workshop activities, along with descriptions of the kinesthetic and hands-on components.

Table 1. Descriptions of Workshop Contents and Active Learning Components.

Description of Activity Content	**Kinesthetic Component**	**Hands-on Component (to take home)**
Exploration of the relative sizes of the Solar System's contents, and the distances between them	Participants created a "planet walk," a 100m scale model of the Solar System	Participants built a scaled "planet stack" of the inner planets, each represented by an appropriately sized Styrofoam sphere
Exploration of lenses and telescopes	Participants investigated the capabilities of a single convex lens, and made images using it	Participants built a two-lens telescope and practiced using it to view faraway objects
Exploration of light, colors, and spectra from glowing objects	Participants examined the spectra from everyday lights and laboratory sources using a diffraction grating	Participants built a spectrometer for further investigation at home
Exploration of the planet Jupiter, and its associated moons	Participants used a weather balloon and small spheres to construct a scale model of Jupiter and its largest moons	Participants constructed a Jupiter mobile with astronomical images of Jupiter and its four largest moons

Each workshop is designed for active participation, guided by an expert educator. The active learning components center on exploration of an astronomical object or instrument, with an emphasis on experiential learning. For example, participants construct and explore scale models of an astronomical geometries, or use simple instrumentation to view otherwise unobservable phenomena. The workshops culminate with the construction of an artifact that participants can use at home after the workshop. Participants leave with a working telescope, for example, or a craft that illuminates and extends the workshop content. We focus on these experiential, hands-on activities because they have been shown in other contexts to drive engagement with the science content and help participants to be more deeply invested in their own learning (Hussim et al. 2024).

Figure 1. Participants construct a "planet stack" depicting scale models of the Earth, Venus, Mars, and Mercury.

Participants must pay a nominal fee to attend, heavily discounted for McAuliffe-Shepard Discovery Center members. Part of the motivation for this program is a desire to provide members with more value for their memberships, and to drive repeat visits to the Discovery Center for our most loyal patrons. As the workshops program has only just recently been implemented, participant feedback is sparse. However, this feedback indicates anecdotally that participants are more likely to consider returning to the Discovery Center as a result of their workshop participation.

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COGNITIVE AND LINGUISTIC FACTORS PREDICTING DIFFERENT READING COMPREHENSION SKILLS IN THIRD AND FOURTH GRADE STUDENTS

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Abstract

The purpose of this study was to examine the extent to which linguistic skills- such as vocabulary and morphological awareness- and cognitive skills- such as planning and attention- predict performance in different reading comprehension tasks, after controlling for the effects of age and reading fluency. Eighty-four Grade 3 to 4 Greek speaking children were assessed on measures of receptive vocabulary, morphological awareness, planning, attention, word reading fluency, and reading comprehension. The results of multiple hierarchical regression analyses indicated that: (a) morphological awareness was the only factor that predicted performance in reading comprehension tasks requiring different levels of comprehension, after controlling for the effects of age, reading fluency, vocabulary and cognitive skills, and (b) vocabulary and attention significantly predicted performance exclusively in the reading comprehension task that required a relatively higher level of comprehension. Taken together, these findings suggest that the extent to which specific linguistic and cognitive factors predict performance in reading comprehension tasks may vary depending on the type of task.

Keywords: *Vocabulary, morphological awareness, planning, attention, reading comprehension.*

1. Introduction

Reading comprehension (RC) is a complex, multidimensional construct (see Kendeou, Papadopoulos, & Spanoudis, 2015). It has been established that linguistic skills, such as vocabulary and morphological awareness (MA), are significant predictors of RC (Cain & Oakhill, 2014; Liu, Groen, & Cain, 2024). On the other hand, successful RC seems to depend on cognitive skills, such as planning and attention (see Kendeou et al., 2015). Planning and attention play a crucial role in RC, as individuals must strategize their approach to a passage, continuously adjust their plan while reading, and filter out irrelevant information to construct a coherent understanding of the text (Dunn, Georgiou, & Das, 2014). Research has shown that planning skills have a unique contribution to RC in 9-to 15-year-olds (Sesma, Mahone, Levine, Eason, & Cutting, 2009). However, the role of attention in RC within the context of PASS theory has not been adequately studied (see Kendeou et al., 2015).

Nevertheless, the extent to which linguistic and cognitive skills predict RC performance may depend on the linguistic and cognitive demands of RC tests. Moreover, no research in Greek has examined the role of specific linguistic skills in RC in conjunction with planning and attention skills within the context of PASS theory. Given that MA plays an important role in RC in Greek, the purpose of the study was to examine the extent to which proximal skills- namely MA and vocabulary- and distal skills- such as planning and attention (PASS processes) -predict performance on different RC tests.

2. Method

2.1. Participants

Our sample consisted of 44 third graders (21 girls; Mage = 109.02 months, SD = 1.96) and 40 fourth graders (22 girls; Mage = 118.30 months, SD = 2.48), who were native speakers of Greek without any intellectual, or sensory problems.

2.2. Measures

RC was assessed by two standardized tests: the "Test for Detecting Reading Ability" (Tafa, 1995), (max=42), and the “Identification of Equivalent Semantically Sentences” subtest of Test-A (Padeliadu

& Antoniou, 2008), (max=4; converted into a percentage value). Word reading fluency was assessed by the measure of word reading efficiency (max=104), adapted in Greek from TOWRE (Georgiou, Papadopoulos, Fella, & Parrrila, 2012).

Receptive vocabulary was measured using the Greek standardization (max=173) of the Peabody Picture Vocabulary Test (PPVT; Simos, Sideridis, Protopapas, & Mouzaki, 2011), while morphological awareness was measured using the Word Analogy Task (Nunes, Aidinis, & Bryant, 2006), assessing children's awareness of inflectional and derivational morphology (max=16).

Planning and attention were assessed by Matching Numbers and Number Detection subtests respectively, from the Das-Naglieri Cognitive Assessment System (DN-CAS; Naglieri & Das, 1997). The participant's score in each subtest was derived based on the CAS instructions.

3. Results and discussion

Table 1 presents the descriptive statistics of our measures as well as the Pearson correlations between the measures. As expected, based on previous findings in Greek (e.g., Manolitsis, Grigorakis, & Georgiou), MA and vocabulary correlated strongly with RC (TDRA). In relation to cognitive skills, contrary to previous findings (see Kendeou et al., 2015), no correlation was found between planning and RC performance.

Table 1. Descriptive Statistics and Correlations between the Measures.

Variables	1.	2.	3.	4.	5.	6.	7.
1. WRF							
2. RV	.30**						
3. MA	.49**	.41**					
4. Planning	.25*	.15	.21				
5. Attention	.29**	.21	.41**	.32**			
6. RC (TDRA)	.58**	.62**	.62**	.21	.47**		
7. RC (IESS)	.32**	.28*	.41**	.01	.28*	.48**	-
Grade 3 (M/SD)	48.57/12.9	114.93/10.3	8.82/3.4	6.55/1.5	30.73/7.4	24.50/7.2	36.93/29.7
Grade 4 (M/SD)	51.60/13.9	122.93/15.5	10.70/4.0	7.75/2.1	36.08/10.4	28.57/9.4	45.62/32.9

Note. WRF: Word Reading Fluency; RV: Receptive Vocabulary ; MA: Morphological Awareness; RC (TDRA): Reading Comprehension (Test for Detecting Reading Ability); RC (IESS): Reading Comprehension (Identification of Equivalent Semantically Sentences); *$p < .05$; **$p < .01$.

Next, we performed hierarchical regression analyses to examine the extent to which the independent variables would predict RC, after controlling for age and word reading fluency (see Table 2). Planning did not predict performance in RC. When operation tasks are used (as in our D-N CAS subtest), planning exerts a limited role in RC (see Das & Georgiou, 2016). On the other hand, attention predicted performance only in the RC (TDRA) that required a relatively higher level of comprehension. It is possible that as the demands of the RC task increase, so does the relevance of attention (see Kendeou et al., 2015). In relation to linguistic skills, vocabulary and MA predicted performance in the RC (TDRA), in line with previous findings (e.g., Manolitsis et al., 2017). The TDRA test exerts processing demands on fluency and vocabulary skills, whereas the IESS subtest exerts processing demands on semantic and grammatical processes. Given that morphemes convey grammatical and semantic information (Manolitsis et al., 2017), it is not surprising that MA was the sole significant predictor of performance in both RC tests. Overall, despite certain limitations, our findings appear to suggest that the extent to which linguistic and cognitive skills affect performance in RC tasks may vary depending on the nature of the task.

Table 2. Results of Hierarchical Regression Analyses.

Measures	RC (TDRA)		RC (IESS)	
	β	ΔR^2	β	ΔR^2
Model 1				
(1) Control variables		.38***		.11**
Age	.19*		.10	
Word reading fluency	.57***		.31**	
(2) Cognitive skills		.07**		.05
Planning	.05		.05	
Attention	.30**		.21	

(3) Vocabulary	.46***	.17***	.18	.03
(4) Morphological awareness	.24**	.04**	.26*	.04*
Model 2				
(3) Morphological awareness	. 36***	.09***	.30*	.06*
(4) Vocabulary	.40***	.12***	.11	.01
Model 3				
(2) Linguistic skills		.25***		.09*
Vocabulary	.40***		.11	
Morphological awareness	.30**		.29*	
(3) Planning	.01	.00	.15	.02
(4) Attention	.22**	.03**	.13	.01

Note. RC (TDRA): Reading Comprehension (Test for Detecting Reading Ability); RC (IESS): Reading Comprehension (Identification of Equivalent Semantically Sentences) ; *p < .05; **p < .01; ***p < .001.

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SUSTAINABILITY IN STEM: TEACHING ENERGY AWARENESS IN ICT THROUGH INTERDISCIPLINARY APPROACHES

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Abstract

Sustainability and STEM (Science, Technology, Engineering, and Mathematics) education are deeply interconnected, as STEM disciplines play a crucial role in addressing environmental and societal challenges. As sustainability becomes an increasingly relevant global issue, STEM professionals must be equipped with the necessary competencies to actively contribute to sustainable development in their careers. This study explores the integration of sustainability in STEM education, emphasizing the need for interdisciplinary collaboration. It reviews various pedagogical strategies, including problem-based learning (PBL), service-learning, and experiential learning, to foster critical thinking and problem-solving skills. The study examines case studies from higher education institutions that have adopted sustainability-focused STEM programs and evaluates their impact on students' learning experiences. A case study on raising awareness of energy sustainability has been conducted with engineering students. This intervention aims to increase awareness and encourage engineering students to adopt responsible behaviours to reduce energy consumption associated with ICT usage. The findings indicate that by embedding sustainability education in STEM programs, universities can prepare students to become agents of change, equipped to develop innovative solutions for a more sustainable future.

Keywords: *STEM education, problem-based learning, interdisciplinary curriculum, energy sustainability in ICT.*

1. Introduction

STEM education, which integrates Science, Technology, Engineering, and Mathematics, promotes interdisciplinary learning aimed at fostering critical thinking and problem-solving skills. This educational approach equips students with essential 21st-century competencies, preparing them for a rapidly evolving global workforce. Additionally, it addresses contemporary societal challenges through active methodologies and the application of computational thinking.

In parallel, embedding sustainability into educational frameworks is vital to raising awareness and promoting responsible decision-making among future generations. Aligning educational practices with the Sustainable Development Goals (SDGs) (United Nations, 2015) empowers students to tackle global environmental and social challenges. This integration enriches STEM learning by connecting it to real-world problem-solving with long-term implications. The relationship between sustainability and STEM education is both significant and multidimensional, as STEM plays a key role in addressing complex global issues (Angelaki et al., 2024). Given the worldwide relevance of sustainability, STEM professionals must be equipped to respond to these challenges throughout their careers.

The aim of this study is to analyze how sustainability has been integrated into STEM curricula through interdisciplinary approaches in higher education. It begins by examining a series of case studies that illustrate the impact of sustainability-oriented programs on students' learning experiences. Particular attention is given to the challenges of designing STEM courses that effectively combine technical content with sustainability principles. Drawing on the insights gained from this analysis, an educational intervention was designed and implemented in several engineering courses at the University of Almería. The intervention comprised a series of activities aimed at increasing students' awareness of energy-saving practices related to the use of ICT (Information and Communication Technologies). These activities were structured using active learning methodologies, especially collaborative work and problem-based learning. Data collection focused on student perceptions and learning outcomes related to sustainability awareness.

2. Design and methods

In recent years, educational institutions have increasingly sought to incorporate sustainability into STEM curricula and assess its impact on student learning. However, implementing an interdisciplinary curriculum that integrates STEM and sustainability presents significant challenges. Craig et al. (2022) designed, implemented, and evaluated an interdisciplinary course combining STEM, sustainability, and management using the ADDIE instructional design model (Analyze, Design, Develop, Implement, Evaluate). Qualitative findings from student focus groups revealed that learners perceived the course content as highly relevant, both in terms of employability and its alignment with their academic programs.

Teaching sustainability in STEM subjects can be approached through various creative and integrated strategies. Problem-based learning encourages students to design projects that address real-world sustainability challenges using their STEM skills (Alkair et al., 2023). Service-learning offers opportunities to collaborate with local or community organizations on sustainability initiatives, allowing students to observe the real-world impact of their work. Martín-Sánchez et al. (2022) presented and evaluated a Service Learning (SL) methodology as an Education for Sustainable Development (ESD) strategy. Using a pre- and post-test design, the study revealed significant improvements in students' understanding of innovative teaching strategies and the SDGs. Participation in the SL project also increased awareness of community engagement and environmental responsibility. Similarly, Angelaki et al. (2023) found that a short-term intervention significantly enhanced ICT students' intention to engage in sustainability. Their findings highlight the importance of fostering critical, informed digital consumption and promoting literate citizenship to address collective behavioral challenges.

Our intervention aims to enhance awareness and sensitize prospective engineering students about the importance of adopting responsible behaviors to mitigate the energy consumption associated with ICT usage. Without portraying ICT in a negative light, the intervention also seeks to promote understanding of its potential to reduce environmental resource use and, consequently, global CO_2 emissions. Therefore, the focus is on raising awareness about ICT energy consumption at the user level. First, we analyze the most common habits among students and then develop activities to promote awareness and educate students on the responsible use of ICT and AI to reduce energy consumption. A mixed-methods approach (quantitative and qualitative) is employed to assess students' knowledge and awareness regarding ICT use. Initially, a pre-intervention questionnaire is used to identify students' digital habits (Gil, et al., 2024). Sample questions include: How often do you use electronic devices such as mobile phones, tablets, or computers in your daily life? How much time do you spend on social media each day? How often do you compress or reduce the size of PDF files and photos? How often do you avoid sending large email attachments and instead use web links? Have you ever considered how the intensive use of electronic devices may impact energy consumption and CO_2 emissions?

Subsequently, academic activities were implemented to raise awareness and educate students on the responsible use of ICT and AI. One such activity was titled "Simulation of a Digital Green Start-Up." A project-based learning methodology was employed, where each team was tasked with designing a technology start-up aimed at minimizing energy impact. The activity culminated in a presentation to potential investors, represented by the teaching staff. Finally, qualitative research was conducted through focus groups to evaluate the outcomes of the intervention and examine the importance of integrating sustainable practices in the use of ICT within STEM education.

3. Discussion and results

The questionnaires were completed by ninety-three students: fifty-seven women (61.3%), thirty-five men (37.6%), and one respondent identifying as another gender (1.1%). The participants were predominantly young adults aged between 21 and 27. Results from the pre-questionnaire revealed that around 98% of students spend a significant portion of their day using ICT devices and applications. Over 50% reported using social media for more than two hours daily. While approximately 83% were familiar with the concept of a carbon footprint and environmental sustainability, about 60% were unaware of the energy consumption and CO_2 emissions associated with ICT use. Notably, over 60% reported habits such as leaving electronic devices turned on and sending heavy attachments instead of links via email. Conversely, nearly 80% avoid printing on paper. Interestingly, over 90% were surprised to learn that sending stickers or GIFs in messaging apps can significantly contribute to energy consumption, given the scale of global messaging activity.

Post-questionnaire results highlight a strong need for further education on the environmental impact of digital behavior. Encouragingly, more than 89% of students expressed a willingness to reduce time spent on social media and the use of stickers and GIFs in messaging. Additionally, 95% reported an intention to manage their inboxes more responsibly by deleting unnecessary emails. When asked how they

would reduce their digital carbon footprint by half, responses included reducing GIF usage (22%), limiting non-essential video content consumption (33%), spending less time on social media (35%), and uploading fewer posts (8.6%).

Finally, a qualitative analysis was conducted at the end of the course using focus groups, where students addressed the question: *What role does sustainability education play in the context of information technologies and artificial intelligence?* The findings revealed strong student motivation to integrate sustainability and AI into their future professional practices. However, participants also noted a lack of training and critical awareness regarding the environmental impact of these technologies. Students identified several pedagogical opportunities to be explored within innovative teaching initiatives, particularly those involving active methodologies and challenge-based learning. The results highlight the need to design educational experiences that examine the energy consumption associated with ICT and AI, apply counterfactual reasoning to promote critical thinking about alternative scenarios, and foster sustainable digital skills and informed digital citizenship.

4. Conclusions

This study reviews various pedagogical strategies and case studies from higher education institutions that have implemented sustainability-focused STEM programs, evaluating their impact on students' learning experiences. It also presents an educational intervention aimed at raising awareness of energy sustainability, while introducing key concepts and practical digital tools. It is important to highlight that the intervention did not involve any changes to the official curriculum or course syllabi. The research employed a mixed-methods approach: a quantitative phase included a pre-intervention questionnaire to assess ICT usage habits, followed by a post-intervention survey to evaluate the effectiveness of sustainability awareness activities. Additionally, a qualitative analysis was conducted through focus groups to explore participants' perceptions regarding the importance of integrating energy consumption awareness related to ICT and AI into education. The findings indicate that even minimal interventions can significantly and positively influence students' intentions to engage in sustainability practices and incorporate them into their future professional endeavors.

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THE VIOLENCE CONDITION: AN ACTIVE LEARNING STREAM LESSON PLAN FOR HIGH SCHOOL STUDENTS AND UNDERGRADUATES

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Abstract

Violence, although upsetting, exists within and around us. It is innate, on a neurological and psychological level. On a societal level, it has often shaped entire civilizations through time. Recently, it has been pointed out that teenagers and young adults are alarmingly exposed to violent environments, both in real life situations and through the media. The aim of the present lesson plan is to educate on the causes and forms of violence and to encourage an informed outlook and action. Here, we propose a series of activities, appropriate to secondary and tertiary education: (1) Students are instructed to run literature searches on Scopus, Eric, and Google Scholar; to highlight the connection between violent media content and the increase of aggressive thoughts, emotions and behaviors in children and adolescents. Students then present their findings to the group. (2) Students explore material that demonstrates how young people are desensitized to violence due to their extensive exposure to it and employ roleplaying to promote empathy. (3) Students engage in group creative writing as a means to express frustration, fear and anxiety, and to connect with others. The teaching intervention is evaluated on the basis of self-reflection, plenary discussion and exit ticket reports.

Keywords: *Violence, active learning, secondary education, higher education, STREAM education.*

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1. Introduction

Violence is on the rise, also including violent content media exposure (Phillips, 2017). Research highlights that exposure to violence contributes to aggressive behavior and desensitization (American Psychological Association, 2013). This issue is particularly concerning young people, as violence influences not only their actions but also their thoughts and emotions (Benjelloun, 2020). Studies confirm that prolonged exposure to violence can lead to heightened anxiety and emotional distress, impacting social interactions and mental health (Drožđek, Rodenburg, & Moyene-Jansen, 2019). Despite its significant impact, there is a gap in educational literature on violence, in terms of dedicated curricula on its causes, effects, and implications (Hughes, 2019). To this end, in the current lesson plan, we draft a series of exercises to foster awareness and provide creative outlets. To achieve this, we use a framework of active learning techniques, such as role-playing, creative writing and storytelling, all the while boosting research thinking, science, technology and visual literacy.

2. Methodology

Subject: Violence, media and adolescents - Topic: Media influence on adolescent aggression, adolescents' desensitization to violence, creative outlet of frustration - Age Group: Teenagers and young adults – Duration: 180 minutes.

2.1. Educational goals

Through this lesson plan we aim to promote; research thinking, science and technology literacy, visual literacy, communication skills, writing skills, critical thinking, teamwork, creative expression, empathy, student participation.

We also aim to inform on; effects of exposure to violence, impact of media content, desensitization to violence, creative outlets of frustration, active learning techniques such as role-playing, storytelling and creative writing.

2.2. Materials

(1) IT classroom, (2) Video projector, (3) Speakers, (4) Printer, (5) A4 paper sheets, (6) Google Drive folder (https://drive.google.com/drive/folders/1vDuF1jdhGdu6hdBaPy-7y7T7d_OphQ1x?usp=sharing).

2.3. Procedure

The present lesson plan comprises three phases, plus evaluation. Activities are designed to span three hours. During the first phase, students investigate the connection between adolescent aggression and violent media content, by researching relevant scientific publications and sharing their findings with the group. During the second phase, they assess the effect of adolescents' exposure to violence on empathy and engage in role-playing. During the third phase, they use creative writing as a strategy, and by extension storytelling as a technique, to express themselves. Finally, the effectiveness of the lesson plan is assessed.

2.3.1. 1st Phase (duration: 60 min). 1st micro-activity (duration: 60 min). Investigating the connection between media and aggression.

1. Students are allocated to teams in a random fashion (e.g., via www.random.org).
2. Teams are instructed to conduct research into literature to identify academic studies linking violent media content to aggression amongst adolescents. Searches are conducted on the Scopus (https://www.scopus.com/), ERIC (https://eric.ed.gov/) and Google Scholar (https://scholar.google.com/) databases, for the 2020-2025 period. The following constructs are used; C1: "media AND violence AND youth", C2: "media AND violence AND adolescents" & C3: "media AND aggression AND adolescents", and searches are restricted to title only.
3. Students study the relevant literature and record their findings in research spreadsheets. Publication information is organized similarly to the study proposed by Gkouzioni, Kleidara, Shehu, Koulouri, and Andreou (2023), namely 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).
4. Then, teams collaborate to compare their findings and compile them into a single report, integrating results from all teams.
5. Teams take turns presenting findings, competing for the most comprehensive and engaging delivery.

Note to instructor: Results should be combined across databases and analyzed (see Gkouzioni *et al*., 2023) for the construct that yields the fewest search counts, for a more manageable -time and size wise- analysis.

2.3.2. 2nd Phase (duration: 60 min). 2nd micro-activity (duration: 20 min). Assessing the effect of exposure to violence on adolescent ability to demonstrate empathy.

1. Students are instructed to document in a spreadsheet, their thoughts on violence desensitization and the reasons behind it.
2. Promptly, the instructor projects excerpts of an informational video by University of Missouri, Department of Psychological Sciences (https://youtu.be/Ub-K4rt14Po?feature=shared), elaborating on how repeated exposure leads to desensitization towards violence.
3. Students reflect on their initial viewpoints and explain whether those have changed in their spreadsheets.
4. The instructor facilitates discussion, encouraging students to examine shifts in their perceptions before and after watching the short films, and to reflect on how media may shape emotional responses to real-life violence.

2.3.3. 2nd Phase (duration: 60 min). 3rd micro-activity (duration: 40 min). Promoting empathy through role-play.

1. The instructor informs the students that they will engage in a role-playing activity inspired by a science communication exercise, namely "The Rant" (Muldoon, 2022).
2. Students are divided into teams in a random fashion.
3. The students then form pairs in their respective groups. One person is the Ranter who receives a card with a prompt (see Google folder) describing an issue that they may present to the group as a topic that either upsets them or they are passionate about. The other person is the Reframer who may listen through the rant without interrupting and then highlight the positive attributes of the Ranter, as described on the card, and their core values being violated according to the scenario they have presented.

4. The Ranter of each team improvises a short (90 seconds) rant based on the prompt on their card. After they finish their rant, the Reframer provides their input, by acknowledging their stance and inviting reflection.
5. The students trade roles and pairs rotate so that everyone does the exercise.
6. The instructor facilitates discussion, highlighting the benefits of role-playing and the importance of communication and empathy.

2.3.4. 3rd Phase (duration: 40 min). 4th micro-activity (duration: 40 min). Employing creative writing to express frustration.

1. The instructor explains to the students that they will engage in a creative writing exercise (non-graded activity). Students may decide not to submit or submit their text anonymously. Also, if they like, they may request to receive feedback.
2. The instructor presents *Guernica*, a painting by Pablo Picasso, which depicts the horrors of war and violence on society (https://www.museoreinasofia.es/en/collection/artwork/guernica). Also, the painting by Edvard Munch, *The Scream*, is shown, demonstrating anxiety and existential dread (https://www.edvardmunch.org/the-scream.jsp).
3. The students are then asked to compose a short fictional story based on the following prompt: "Drawing from the emotions and themes presented in *Guernica* and *The Scream*, write a short story that explores the effects of fear, frustration and anxiety on the individuals or society at large.".
4. Lastly, the instructor facilitates a discussion on the benefits of storytelling as a creative outlet of anxiety, frustration and aggression.

2.3.5. Evaluation (duration: 20 min). Student spreadsheets are submitted for assessment. Furthermore, evaluation includes students engaging in a plenary discussion, where they reflect on the activities they participated in, as well as their perceptions before and after the lesson. They are also required to complete an exit ticket (see Google folder), through which they can provide anonymous feedback concerning their emotions, note key takeaways, comments and suggestions.

3. Discussion

While research has established the grave impact of violent media on behavior and desensitization, education has yet to fully address these concerns. Here, by means of active learning, we aim to boost student participation, raise awareness, educate on creative outlets of frustration, promote reflection and foster empathy.

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VIRTUAL PRESENTATIONS

Designed by Freepik

POSSIBILITIES OF USING AHARON APPELFELD´S PUBLICATION ADAM AND THOMAS IN TEACHING LITERARY EDUCATION

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Abstract

The main aim of the paper is to point out the possibilities of implementing Aharon Appelfeld´s book Adam and Thomas (2013) in the educational process with a focus on Literary Education. We believe that this narrative has the potential to arouse the interest of different groups of readers, from beginners to experienced ones. The compositional construction provides a considerable space of indeterminacy into which readers may (but need to) plant their ideas about themselves, society, or the world, guided by Appelfeld´s philosophical and transcendental ideas in relation to not only faith and God. On the other hand, the plot of this book may also be of interest to readers who are not looking for an interesting storyline and the portrayal of the fates of the main characters in liminal situations, in this case set against the backdrop of the events of World War II. This war conflict in this artistic narrative is merely a backdrop that causes Adam, Thomas and Mina to find themselves in a situation where they must rely on themselves, which they each do in slightly different ways. Based on the content narrative analysis, we point out different plot levels, themes and motives that we believe can be worked with in the teaching of Literary Education at different levels of education. Our aim is to present the ways of possible work with an identical passage from a text in relation to the age of the pupils (first grade of primary schools, lower-secondary schools and secondary schools).

Keywords: *Aharon Appelfeld, Adam and Thomas, literary education, research, implementation.*

"We will be able to talk about what we went through in the forest years later."
(Appelfeld, 2014, p. 108)

1. Introduction

The main aim of the paper is to point out the potential of Aharon Appelfeld´s publication *Adam and Thomas* (2013) in the context of its possible integration into teaching at different levels of education. We have chosen this book because we believe that it provides sufficient scope for its reception, among different age categories of readers. The youngest of them may be attracted by the story´s rather engaging but easily recognizable plot, while more experienced readers may reflect on various transcendental and other aspects of life and being while reading it.

Aharon Appelfeld, born in 1932 in what Ukraine is now, was a Holocaust survivor whose literary works often explore themes of trauma and loss, particularly focusing on the *impossible mourning* of his mother, who was murdered during the war. His novels delve into the psychological impacts of his traumatic experiences, using the image of the body to express the enduring pain and unresolved grief from his past (Bannasch, 2023; Xia, 2024). Coppel-Batsch (2005) adds that Appelfeld´s literature often reflects the tension between the Jewish diasporic past and the Zionist present, as he navigates themes of memory and identity through a unique narrative style that blends fiction with autobiographical elements. Langer (2023) states that his work is characterized by its exploration of the unsaid, where the avoidance of catastrophe and the silence surrounding it play a crucial role. This approach allows readers to engage with the underlying trauma and historical context through subtle hints and portents, rather than explicit depictions of horror. His narratives often focus on the internal struggles of characters who, like himself, are survivors trying to reconcile their past with their present, a theme that resonates with the experiences of other Holocaust survivors who were integrated into Israeli society (Shillony, 2014). Krausz (2011) concludes that through his evocative storytelling, Appelfeld preserves the cultural and historical episteme of Central European Jewry, offering a poignant reflection on the enduring impact of the Holocaust on individual and collective memory.

1.1. Shortly about Book Adam and Thomas

This book by Appelfeld is a kind of personal literary account of the author´s selected experiences during the events of World War II. Rather, it is an artistic elaboration of his feelings, thoughts and assumptions that arise from his memories of the Holocaust (Shoah). The events of the war appear in the book more as a kind of backdrop, as a space in which Appelfeld´s ideas are set, and which gives them a certain gravity and validates them in a certain way.

As we have already suggested, the primary storyline of this book is very simple: the mothers of the two boys, Adam and Thomas, take their Jewish sons into the forest with the hope of increasing their chances of survival. During their stay, they discover by chance that Mina, a girl they knew, has been hidden by a farmer whose farm is located near Adam and Thomas´ temporary home. The story ends happily: Adam and Thomas return to their mothers, and one of them adopts Mina, who lost all her relatives during the war.

As can be seen from the above, this storyline can be adequately understood and understood even by beginning readers who in most cases have not heard about the events of the Second World War. They will perceive the story as the adventures of children hidden in the woods. On this point, Lobel (1998) notes that stories constructed in this way can be comprehensible to beginners. This is aided by the way children´s literature often frames war through the lens of personal experiences and adventures, making complex historical events accessible to young readers.

1.1.1. Implementation of philosophical ideas. The above storyline is complemented by Appelfeld´s thoughts and opinions, in which faith and its (possible) conflict with pragmatic thinking are very often thematized. It is at this point that the simple adventure story transforms into a philosophical treatise on the meaning of life, the (non-)existence of God, the place and role of the human being in the earthly world, and so on. We are convinced that these narrative parts - irrelevant for an adequate reception of the storyline - guarantee that this book has the potential to appeal to teenage or adult readers who may ponder Appelfeld´s ideas, consider their premises and possible solutions, or relate them to their own lives.

As we have already indicated, this paper will point out the possibilities of implementing *Adam and Thomas* in teaching at different levels of education with a focus on the teaching of Literary Education. We believe that literary texts have considerable potential for introducing pupils and students to selected events of the Second World War.

2. Literary Education and presentation of the events of World War II

Literary Education holds significant potential for introducing pupils to the events of the Holocaust and the Second World War by fostering a nuanced understanding and critical engagement with historical narratives. Bélanger (2024) underlines the importance of using historical fiction to help young readers critically engage with literature, understand its revelations, and consider its omissions, thereby enhancing their comprehension of the Holocaust´s complexities. Literature serves as a powerful tool for humanizing the Holocaust, transforming personal accounts into cultural iconography that can convey the experiences of survivors and victims to new generations (Hertina, 2023).

The presentation of the Holocaust in Literary Education employs a variety of methods to engage students and foster a deeper understanding of this historical event. In a broader educational context, there is a growing recognition of the need to teach the Holocaust to raise awareness about the dangers of hatred and intolerance. This has led to the incorporation of new pedagogical approaches that aim for a comprehensive understanding of the Holocaust, adapting to cultural and political differences across countries (Schurster & Ramos, 2024). The use of memory and representation in curriculum theory highlights the ambivalence and complexity of understanding the Holocaust, suggesting that both historical texts and novels serve as forms of memory that educators must navigate carefully (Morris, 2001).

3. Research method

The analysis of *Adam and Thomas* was carried out through literary content analysis. This method is a multifaceted approach that has evolved to address the limitations of traditional methods of literary evaluation that often fail to capture the intrinsic value and thematic depth of literary works (Bingke et al., 2022). Thematic content analysis emphasizes the importance of identifying underlying themes and meanings in texts, which goes beyond mere word count and allows for a deeper understanding of literary works (J, 2020). Anagaw´s (2020) study of civic virtues and skills in literary texts highlights the application of content analysis in educational contexts and reveals inconsistencies in the inclusion of civic themes across different textbook editions, underscoring the potential of content analysis for assessing the educational value of literary texts. We believe that the chosen method is adequate to fulfill the aim of the paper, i.e., to highlight the possibilities of implementing *Adam and Thomas* in the teaching of Literary Education at different levels of education.

4. Results and discussion

In this section of the paper, we highlight the potential of implementing *Adam and Thomas* in teaching at different levels of education in the context of the above theoretical anchoring.

4.1. Reception of the primary storyline

In the beginning of the book, readers are introduced to Adam: “Adam is nine years old and about to finish fourth grade. He is not an outstanding student, but in the third quarter, three A´s stood out on his report card. This made his parents happy, and they bought me a new soccer ball” (Appelfeld, 2014, p. 8). We believe that the appropriate introduction of the readers into the plot, through a close introduction of one of the main characters, is adequate and quite sufficient given the reception of the primary storyline of the narrative. Thomas is characterized as follows: “Because of his conscientiousness and consistently excellent school results, Thomas was not popular with his classmates. He was humiliated, and he tried to defend himself with what he could: the numerous assignments he did, the essays he wrote, the books he read. But it was these efforts that compounded the hostility towards him. In vain did teachers try to defend him” (Appelfeld, 2014, p. 16).

As is evident from the characteristics of Adam and Thomas, they are opposites. This fact is explicated not only in their relationship in teaching, but also in their relationship to life, to God. We believe that the implementation of different characters can increase the motivation of readers, who will reciprocate the primary storyline, to read the story. This concept is supported by the notion that characters with distinct qualities and roles can enrich narratives, making them more engaging and relatable for readers (Alexandre, 2008). The portrayal of characters with varying relationships to life and God can introduce complex themes that resonate with readers on a personal level, as seen in religious character education, where diverse character traits are used to convey moral and spiritual lessons (Efendi et al., 2019).

Thomas is further characterized in relation to the family background from which he comes: “Thomas´ father, tall and short-sighted like Thomas, is a professor at the grammar school. His mother teaches in an elementary school. During the ghetto era, before he was taken to the labor camps, his father continued to home-school students who had been expelled from the gymnasium. ´Education protects us,´ he replied to all those who doubted his efforts. ´We have to take care of the soul, especially in our times,´ his father reiterated (Appelfeld, 2014, pp. 22-23) As can be seen from the above quotation, the inner characteristic of Thomas is further developed by the philosophically attuned thoughts uttered by his father. This is an example of a narrative that can be reciprocated in different ways by different readers. Readers with less reading and cognitive experience can relate to *only* the characterization of Thomas, while more mature readers can contemplate the sentences uttered by Thomas´s father. Importantly, even without reception of the relevant philosophically attuned passage, there is no lack of interpretation of the primary storyline, for the reception of which information about the family environment and its principles from which Thomas comes is central. A little further on, Adam and his background are specified: “Adam did not study during the ghetto, he helped his mother, who worked in a public kitchen. He scraped potatoes and beets, cut cabbage and washed pots. At noon there was a long queue in the kitchen and Adam helped ration the bread and soup” (Appelfeld, 2014, p. 23). The characteristics in correspondence with the lives of Adam and Thomas during the ghetto provide, especially for readers who can encompass the complete text (i.e., its full depth), a starting point for the subsequent mindset of the two boys in relation to their relationship to life and especially to faith.

4.2. Philosophical passages

As we have already mentioned, the primary storyline is supplemented by philosophically tuned passages that provide readers with additional interpretative space for this narrative. Wróblewski (2023) argues that philosophical passages in children´s literature about World War II often serve to explore complex themes such as trauma, displacement, and moral responsibility. Franco (2021) highlights how postwar children´s literature addresses the historical circumstances of World War II by focusing on themes of separation and family relationships, helping young readers understand and process the impact of the war. Sainsbury (2017) discusses the use of thought experiments in children´s literature that engage young readers in philosophical reflection and encourage them to consider ethical dilemmas and conditions of power. Krongold (2020) explores the pictorial dynamics in young adult Holocaust literature, noting how these narratives evolve from factual recounting to metaphorical representation, allowing young readers to engage with the moral and historical implications of the Holocaust through creative storytelling.

The following quotations are examples of such passages. “Thomas now saw his mother quite clearly sitting beside him. She seemed to be distressed at the screaming, and Thomas wished to reassure her: ´I forgive you with all my heart.´ ´Thomas don´t forgive me easily. I don´t deserve easy forgiveness,´ she said and disappeared from his sight” (Appelfeld, 2014, p. 31).

“Adam didn´t seem to be concerned. ´The forest still has many gifts for us.´ ´I see you are counting on the forest,´ said Thomas. ´Sometimes the forest is better than people,´ said Adam. Thomas remarked, ´The forest always seems to us like a place of prey animals. Remember, prey animals hunt only when they are hungry. So, it follows that humans are far worse,´ Thomas said, in his father´s manner” (Appelfeld, 2014, p. 57).

As the quotations above show, these transcendentally tuned passages, which permeate Appelfeld´s narrative, are not the main carrier of the plot, but serve as a space to express the author´s views and to explicate his perception of God. To this end, he uses two characters. One of the boys comes from an orthodox Jewish family, the other has a background based on rationalism and pragmatism. These seemingly disparate streams of thought collide against the backdrop of the events of World War II in a forest setting. As the boys get to know each other more and more, they (along with the author) conclude that the two currents can enrich each other and that neither should be seen as definitive or rigid.

4.3. Possibilities of integrating Adam and Thomas into Literary Education

Above we have listed the basic narrative aspects of the *Adam and Thomas* publication. We believe that we have sufficiently explicated the potential that this artistic narrative has in relation to presenting one strand of the events of the Second World War to pupils and students at different levels of education. The multi-layered nature of this Appelfeld publication ensures that it can be worked with at all stages of education, from the first stage of primary school to secondary education. At the same time, in our opinion, it is possible to return to this narrative repeatedly, because with repeated readings (ideally with some time lapses) readers can find additional meanings and symbols in the text.

As the events of the Second World War are not explicitly expressed in the text and are a kind of starting point for which the boys and Mina find themselves alone in the woods, we believe that reading this book should not result in the kind of traumatization of the youngest readers that some teachers who work professionally at the relevant level of education fear. At the same time, however, there may be an internalization of the relevant atmosphere and an effect on the reader in terms of emotions, which, in our opinion, is the main aim of familiarizing pupils with the literary depiction of the events of the relevant line of the Second World War. Ungeheuer-Gołąb (2024) points out that literature, especially when dealing with sensitive topics such as war, can serve as a tool of sensitization or desensitization to help children process difficult emotions and taboo topics in a controlled manner. We believe that Appelfeld´s analyzed narrative also fulfills Ben-Tovim´s (2022) claim that World War II literature highlights the enormous impact of war on literary expression, suggesting that such literature can provide clarity and understanding of the profound effects of war without necessarily causing trauma.

5. Conclusion

The main aim of the paper was to highlight the possibilities of implementing Aharon Appelfeld´s *Adam and Thomas* (2013) artistic narrative in the teaching of Literary Education at different levels of education. This narrative, by its content structure, has the potential to saturate all groups of readers, especially with its relatively simple storyline, which incorporates the author´s reflections on the meaning of life, existence, friendship, family, faith or God.

The book under analysis is proof that, especially in the field of artistic narratives with the theme of the Second World War, the boundaries between literature for children and young people and so-called adult literature are blurring. This fact, in our opinion, can lead to a common reading of these narratives, to sharing of one´s views and ideas arising from their plot and to a sharpening of one´s views on the Second World War period and on the role of people with different social, cultural and geographic backgrounds in it.

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NATURAL TALENT: CREATING OPPORTUNITIES FOR ASPIRING ACTORS IN DRAMATIC ARTS

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Abstract

Natural talent makes the art industry richer with actors and performances. Most of the celebrities we have come from natural talent. The study explored the significance of creating opportunities for aspiring actors in the field of dramatic arts, emphasising the role of natural talent and structured training. The performing arts serve as a crucial medium for self-expression and personal growth, particularly for individuals from marginalised backgrounds. The study adopts Howard Gardner's Theory of Multiple Intelligences as its theoretical framework. Employing a qualitative case study approach twelve purposively selected actors were analysed to explore how dramatic innate abilities influence performance. Data were collected through structured interview questions, which facilitated the identification of key themes through coding and thematic analysis. The findings reveal that despite the significant challenges associated with pursuing an acting career, intense competition and limited resources—various initiatives emerged to support aspiring actors. Programs emphasising local theatre participation, acting workshops, and community-based training provide essential skills and networking opportunities. The study recommends programs prioritising raw talent and ensuring accessibility for marginalised communities. Additionally, in a supportive environment, participants hone artistic skills and develop critical life competencies such as communication and resilience in artists. The findings advocate for the expansion of similar initiatives that recognise and nurture natural talent in aspiring actors. Ultimately, the study highlights the necessity of integrating performing arts education into community frameworks to cultivate future generations of artists, enriching the cultural acting sphere and providing pathways to successful careers in dramatic arts.

Keywords: *Aspiring, creativity, dramatic arts, natural talent, opportunities.*

1. Introduction

The development of talent in the dramatic arts has been a subject of considerable debate, with various models proposed to explain the emergence of successful actors, directors, and playwrights. Natural talent in the dramatic arts can be a powerful catalyst for aspiring actors, but it is often insufficient (Sparling, 2021). The journey toward a successful acting career requires not only innate ability but also the creation of opportunities that allow talent to flourish (Connell, Brown, & Baker, 2020). In today's competitive entertainment landscape, aspiring actors must navigate various pathways to gain experience and exposure. It may include engaging with local theatre groups, enrolling in acting classes, and participating in auditions for multiple productions (Sparling, 2021).

Moreover, the rise of digital platforms has revolutionised how actors may showcase their skills (Connell et al., 2020). Many are now encouraged to create content through short films, web series, or social media performances. The proactive approach enhances their visibility and allows them to define their artistic voice (Malafronte, 2021). As actors like Issa Rae and Emma Stone have demonstrated, leveraging technology and creativity can lead to significant career breakthroughs (Lawal, Ibrahim, Ojodu, & Salvador, 2023). Ultimately, while natural talent is invaluable, the ability to seize opportunities and innovate within the industry truly empowers aspiring actors to succeed in the dramatic arts (Sparling, 2021).

These research questions guided the study:

1. How do aspiring actors perceive the role of natural talent in their journey towards success in the dramatic arts?

2. What opportunities do aspiring actors identify as crucial for developing their craft and advancing their careers in the dramatic arts?

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2. Literature review

2.1. The role of natural talent in acting

Natural talent is often viewed as a foundational element in the acting profession (Connell et al., 2020). While some individuals possess an innate ability to perform, this talent alone does not guarantee success (Malafronte, 2021). Research indicates that natural talent must be complemented by rigorous training and practice to develop the necessary skills for effective performance (Lawal et al., 2023). Actors like Jennifer Lawrence have demonstrated that while raw talent can provide an initial advantage, continuous learning and adaptation are critical for long-term success in the industry (Malafronte, 2021).

2.2. Creating opportunities through education and networking

Education is pivotal in transforming natural talent into professional opportunities (Piirto, 2021). Aspiring actors benefit from formal training programs that teach essential skills such as text analysis, character development, and emotional expression (Plucker & Peters, 2020). Additionally, networking within the industry may be crucial; relationships with casting directors and fellow actors could lead to auditions and roles that might otherwise remain inaccessible (Mohamed Hashim, Tlemsani, & Matthews, 2022). Community theatre or workshops could enhance visibility and provide practical experience (Lawal et al., 2023).

2.3. The importance of continuous development

Continuous personal and professional development is vital for aspiring actors (Jensen & Kim, 2020). The acting industry constantly evolves, and staying informed about industry trends, audition techniques, and performance styles is essential (Hagen, 2023). Actors could embrace lifelong learning through classes, workshops, and self-directed study to refine their craft and adapt to changing demands (Malafronte, 2021). The commitment enhances actors' skills and increases their chances of being noticed by casting directors, ultimately paving the way for successful careers in the dramatic arts (Piirto, 2021).

2.4. Empirical literature

2.4.1. Genetic and interactional perspectives. The study by Kogan (2002) and (Simonton, 1999) provides a foundational understanding of the genetic and interactional perspectives in the development of performing arts careers. Kogan's developmental model considers both intrinsic and environmental determinants, while Simonton's emergenesis model, based on Lykken's behavior-genetic research, emphasises genetic factors. The suggestion that genetic factors may play a role, environmental influences and individual decisions are also critical in acting (Kogan, 2002).

2.4.2. Environmental influences and opportunities. Environmental factors, such as access to quality training and mentorship, play a significant role in the development of aspiring actors (Cherian & Francis, 2021). The heterogeneity in students' prior school and undergraduate experiences highlights the importance of providing diverse and inclusive opportunities for training in the dramatic arts (Subotnik, Olszewski-Kubilius, Khalid, & Finster, 2021). Programs that offer a range of experiences and support can help nurture talent from various backgrounds, ensuring that natural talent is not the sole determinant of success (Malafronte, 2021).

3. Theoretical framework

Howard Gardner's theory of multiple intelligences serves as a foundational framework for studying natural talent in the dramatic arts (McClellan & Conti, 2008). The comprehensive approach emphasises that intelligence is not a singular entity but rather a collection of distinct types, including interpersonal and bodily-kinesthetic intelligence, which are essential for acting (Visser, Ashton, & Vernon, 2006). Interpersonal intelligence enables actors to connect with others and portray characters authentically, while bodily-kinesthetic intelligence allows them to express themselves physically in performance (Lawal et al., 2023). The framework suggests that individuals possess varying degrees of these intelligences, indicating that aspiring actors can cultivate their natural talents through targeted training and practice.

4. Methodology

A qualitative research approach was adopted for the study, allowing for an in-depth exploration of the complexities surrounding acting talent and the various opportunities available to aspiring actors (Creswell, 1999). The method emphasises understanding the subjective experiences of individuals, making it particularly suited for capturing the nuanced realities of actors' lives.

4.1. Data collection and analysis

Open-ended interviews were used to collect data, which was subsequently coded to identify themes. The qualitative approach facilitated rich narratives from participants about their personal experiences and motivations in pursuing acting careers, providing deeper insights into how actors perceive their training and emotional journeys (Zarestky, 2023). Analysing these narratives helped uncover recurring themes that highlight the emotional and psychological aspects of acting.

4.2. Research design

A case study as a research design was utilised for the study. An in-depth exploration of individual experiences and practices within the acting community based on the case study for the research (Poth, 2023). The qualitative approach allowed researchers to focus on specific actors or acting schools, providing rich, contextual insights into how natural talent interacts with various opportunities in the dramatic arts (Wa-Mbaleka & Rosario, 2022).

4.3. Population and sampling

A purposive sampling of twelve actors was utilised. The method was beneficial as the researcher aimed to gather in-depth insights from a targeted group, making it an ideal choice for studying actors in the dramatic arts (Poth, 2023). The approach also facilitates the exploration of nuanced perspectives regarding the role of natural talent in shaping career trajectories (Connell et al., 2020). The method enhanced the credibility and relevance of the findings by focusing on individuals best suited to address the research questions (Poth, 2023).

4.4. Data collection

Data collection for the study was conducted using a structured interview. The method was chosen for its efficiency in gathering comprehensive data and also its analysis of trends and patterns related to talent perception and opportunity identification among aspiring actors (Poth, 2023). The interview questions consisted of both closed-ended and open-ended questions. Closed-ended questions provided quantifiable data, enabling researchers to assess the prevalence of certain beliefs about natural talent and the types of opportunities actors consider most beneficial (Creswell, 1999). The interview tool was distributed online to reach a diverse group of aspiring actors across different backgrounds and locations.

4.5. Data treatment and analysis

The qualitative data derived from open-ended questions was subjected to thematic analysis. Initial coding focused on identifying recurring ideas and concepts related to talent development and opportunity creation (Creswell, 1999). Thematic maps were developed to visualise the interrelationships among the themes, facilitating a clearer understanding of how aspiring actors navigate their careers (McClellan & Conti, 2008). The analytical approach highlights the multifaceted nature of acting as a profession and the interplay between individual talent and external opportunities (Poth, 2023).

5. Findings and discussion

5.1. Table 1: Research question and themes

The table shows themes created that are aligned with the research question.

Table 1.

	Research Question	**Research Theme**	**Sub-theme**
1	How do aspiring actors perceive the role of natural talent in their journey towards success in the dramatic arts?	The Dual Nature of Talent and Training	1. Innate vs. Developed Skills 2. Impact of Training on Performance
2	What opportunities do aspire actors identify as crucial for developing their craft and advancing their careers in the dramatic arts?	Pathways to Professional Development	1. Networking and Industry Connections 2.Educational Opportunities and Skill Development

Figure 1. Perceptions of Natural Talent in Aspiring Actors.

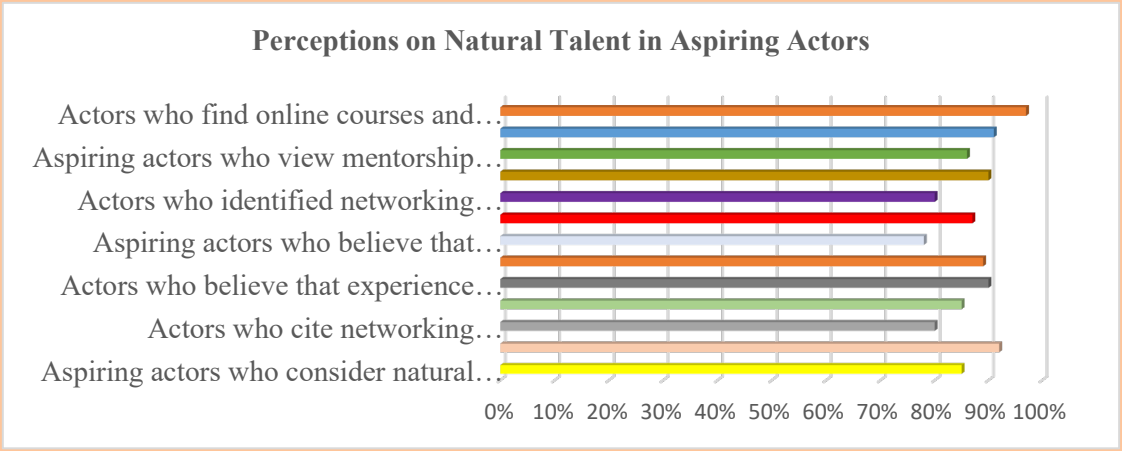

Figure 1: Aspiring actors who consider natural talent as a crucial factor in achieving success 85%, actors who believe that training and skill development outweigh natural talent in their journey 92%, actors who cite networking opportunities as more effective strategy for growth on the industry 80%, actors who feel that hard work and dedication are more significant than innate talent 85%, actors who believe that experience gained through auditions and performances is more valuable than natural talent 90%, actors who think that emotional intelligence and interpersonal skills are more important than raw talent in acting success 89%, aspiring actors who believe that obtaining a degree in drama or performing arts is essential for their career advancement 78%, actors who consider participation in acting workshops and masterclasses as vital for skill enhancement 87%, actors who identified networking events, such as industry meet-and-greets, as crucial for career development 80%, actors who believe that gaining audition experience is critical for improving their chances of landing roles 90%, actors who view mentorship from established professionals as an essential opportunity for growth 86%, actors who consider involvement in community or amateur theatre productions vital in honing their craft 91%, actors who find online courses and resources helpful for developing their acting skills and knowledge about the industry 97%. The research findings provide insights into aspiring actors' perceptions of natural talent and career advancement strategies (Lawal et al., 2023). While participants view natural talent as crucial, they believe training and skill development are even more critical for professional success (Plucker & Peters, 2020). Networking is emphasized as an effective growth strategy, aligning with literature that highlights the importance of relationships in the entertainment industry (Cherian & Francis, 2021; Connell et al., 2020). Additionally, participants recognise the value of experiential learning, particularly audition experience, and highlight emotional intelligence and interpersonal skills as essential for success.

6. Conclusion

The research findings suggest that talent in dramatic arts should be supported by academic education for long-term career sustainability. Education must be encouraged at all levels, from foundational training to advanced courses. While natural talent is important, success relies on a combination of training, experience, and emotional intelligence. Networking and mentorship are also crucial for accessing opportunities. Aspiring actors should actively pursue workshops, community theater, and industry events to enhance skills and expand networks. A holistic approach integrating talent development with rigorous training and strategic networking will cultivate skilled performers ready to thrive in the evolving dramatic arts industry.

7. Recommendations

To enhance talent development in the dramatic arts, integrating ongoing academic education at all levels is essential. Short courses, workshops, and peer feedback can provide structured learning beyond public performance. Establishing certification programs will increase actors' academic credibility and employability in the industry. Future research should explore talent development dynamics to create effective support systems, fostering inclusivity for aspiring actors, directors, and playwrights. Promoting mentorship programs and community engagement through amateur theater will refine actors' skills in supportive settings. Ultimately, a comprehensive strategy emphasizing education, mentorship, and community involvement will cultivate a thriving ecosystem for talent development in the dramatic arts.

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PREDICTING SUCCESS IN ENGINEERING STUDIES: CHALLENGES OF EARLY DETECTION OF WEAK SIGNALS OF STEM-RELATED APTITUDES

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Abstract

The theory of signal detection, originated in the second half of the 19th century in psychophysics, has returned to life a century later when it was discovered that sensations generated by neural noise do not fall below the threshold of conscious awareness. More adequately called the theory of "weak signals" detection, the philosophy and model of this theory was conceptualized by both Gaussian and non-Gaussian models. It proved to be useful when earlier the signals are detected, then better. The applications have extended time spectre – from avoiding a negative phenomenon with rapid evolution (as a situation in medicine or catastrophic earthquakes) to predicting future evolution of a certain system, in a large range of areas: from electronics (circuit analysis) to strategic management (strategic early warning system) and economics (agriculture, market prediction). The decision is also variable as time horizon, depending on area of application, from fractions of seconds to minutes in case of catastrophic events to weeks or months in other cases (agriculture). The scope of work is an area less investigated: education. While the extant literature is rich in many areas (psychophysics, neuroscience, psychology, medicine, electronics and telecommunications, geophysics or economy), the literature related to applications of weak signals theory in education (engineering studies in particular) is rather scarce if not completely missing. Engineering skills – part of STEM (Science, Technology, Engineering, Mathematics) competencies – are trained during costly engineering studies. However, cases of engineers less talented or unhappy with their engineering jobs are sometimes met. Conversely, authors met young people with various non-engineering backgrounds landing in jobs with technical profiles. Probably, the family influence, and perfectible career orientation are blameable for such cases. Therefore, this essay aims at setting a research framework and a suitable procedure to assess and identify emergent STEM-related aptitudes (as weak signals) during pre-university education cycles to increase the chances of better matching the respective students with their future engineering education and, subsequently, with their careers as engineers. As methodology, the study is based on directly observed and/or personal experienced cases in the Romanian engineering higher education as well as pre-university education cycles, which are complemented by pilot tests designed for this purpose. Secondary research (literature survey) marks the literature gap and complement the matter under investigation. Since this is a pioneering effort, several challenges are foreseen. As a long-term endeavour by its nature, this is a risky project (false positive and false negative results might occur), which recommends a step-by-step approach. Nevertheless, the lessons learnt, and implications are important for the main stakeholders: education policy makers and administrators, students and professors alike.

Keywords: *Technical higher education, engineering skills, STEM (science, technology, engineering, mathematics) competencies, STEM-related aptitudes, early detection of weak signals.*

1. Introduction

In public education, early skills have become increasingly important as teachers and other educational stakeholders investigate ways to close the widening national academic achievement gap. Pathways to future academic achievement are, in most cases, shaped in the early years, when children learn essential skills that help create a foundation for later development of a set of academic skills and achievement. Research in the field has highlighted the fact that some individuals start school with certain early skills, this represents an advantage they have over others in terms of achieving academic achievements in the future (Hein, Smerdon, & Sambolt, 2013).

In order to achieve educational and professional success, early detection of skills is essential. In the field of engineering education, identifying STEM (science, technology, engineering, mathematics)

skills from pre-university education can have a positive influence on the career guidance process and help students choose careers that suit them and they bring satisfaction and fulfillment. When these early skills identification mechanisms are missing, individuals end up in unsuitable careers, leading to unfulfillment and burnout. This is supported by research of 210 professional employees working in four global high-tech companies, showing that low-performing employees are those who work in the technical field but prefer the managerial one, and employees who reported the lowest levels of burnout are those who experience a career path match (Biron & Eshed, 2017).

For the early detection of abilities, it is necessary that teachers and other educational actors are able to detect weak signals of students regarding these abilities. Weak signals are not just simple "weak evidence of future changes" but represent starting hypotheses for a lot of future-oriented knowledge processes. Rossel (2012) argues that there are several challenging research topics that lie between the deterministic belief that weak signals are easy to identify and the constructivist position that places weak signals within a complex system. However, despite the fact that weak signal detection theory has been successfully applied in fields such as medicine, economics or telecommunications and strategic management, its application in education, and especially in the field of engineering, is still unexplored territory.

The present study aims to develop a suitable research framework and methodology for the early identification and assessment of emerging STEM-related skills (seen as weak signals) during pre-university education cycles, with the aim of facilitating better correlation between students, their future engineering education and subsequently their engineering careers.

2. Literature survey

The weak signals used in the process of detecting unexpected events, such as diseases, come from the realization that these may be warning signs of accidents or other crises, identified only in retrospect. Often, weak signals are ignored if they go against general expectations about the future or if they are unusual, or if they don't agree with traditional ways of privy to things (Liff & Wikström, 2017).

In most cases, weak signals are emerging phenomena, which are the first potential signs of a major change in the future. Observing weak signals can identify the seeds of change and classify them. The "standard" theoretical base is represented by the Ansoffian perspective. This requires the weak signal watcher to identify linearly progressing problems in their early stages. In the process of formulating the premises of the theory of weak signals, the "standard" version of this theory assumes an emerging problem perceived in its rudimentary form. Weak signals represent not only the identification of a linear emergence, but also the changing positions and contexts of observers (Ahlqvist & Uotila, 2020).

In the field of medicine, the theory of weak signals is successfully used for the early detection of rapid negative phenomena, such as the evolution of diseases. The most pressing challenge facing those responsible for improving and regulating patient safety is how to identify, integrate and act on early warnings and weak signals of risk before they contribute to a catastrophic failure of care. (Macrae, 2014).

Another field in which weak signals are successfully used is that of geophysics, specifically in predicting catastrophic earthquakes. The prediction of an earthquake is challenging, with many countries conducting extensive research on this topic. Using the local cross-correlation tracking method can reflect the correlation between electromagnetic data. Even if very weak signals show anomalies, the method can sensitively detect the anomalies (Xie et al., 2022).

3. Methodological approach

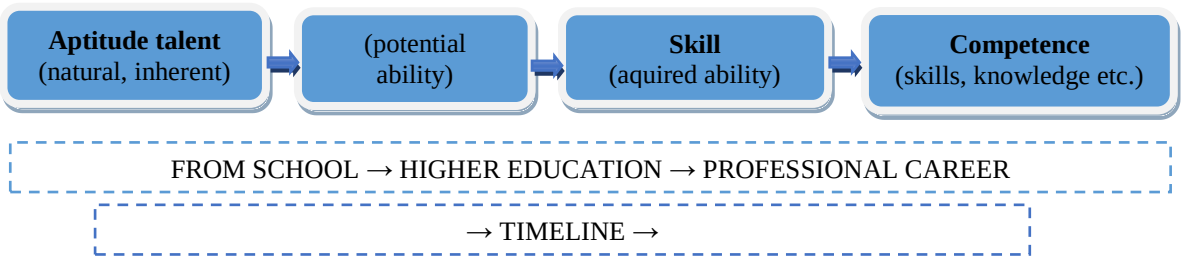
The methodological approach of this study is a mixed one and consists of direct observations and personal experiences of the authors, accumulated in pre-university and university education in Romania. This approach is complemented by the proposal of pillar tests to identify emerging STEM skills (weak signals) among pre-university students. But also, university. Also, the study includes secondary research (specialty literature analysis) that highlights the existing gaps in the profile literature and supports the theoretical framework of the investigation. The adopted methodology is one with an exploratory character, considering the fact that the application of the theory of weak signals in education is too rare, especially in the field of engineering education.

The authors' observations are intended to optimize the orientation of students towards an appropriate engineering education, so that young people are oriented towards a career that suits them according to their potential and interests. This is a pioneering initiative and is only the first step towards a procedure and tools for identifying emerging weak STEM signals. The authors anticipate several challenges, including risks associated with false-positive or false-negative results. Therefore, the methodology proposes a gradual approach, allowing adjustments along the way and learning from

accumulated experiences. The implications of this research are relevant to several stakeholders: educational decision-makers, teachers, students and administrators of educational institutions.

This study contributes to developing a suitable research framework and methodology for the early identification and assessment of emerging STEM-related skills (*Figure 1*), aiming to facilitate *better correlation between students, their future engineering education and their future engineering careers.*

Figure 1. A scheme of research approach.



Source: Authors

4. Findings

A study conducted in 2016 presents a detailed analysis of seven core STEM courses, examining how resources were utilized and their correlation with final grades. Through logistic regression, researchers observed that students who extensively use exam preparation resources have higher chances of achieving good grades, whereas those who rely more on lectures have lower chances (Waddington et al., 2016).

Recent technological advancements can be effectively utilized in Early Warning Systems (EWS) to predict students who are suitable to pursue STEM disciplines further, as well as those who are at risk of not succeeding. In this way, both teachers and students can make informed decisions to support students and guide them towards the most appropriate solutions. By leveraging learning data available on online learning platforms, the use of EWS can predict students with low chances of success before the end of the semester (Yu & Wu, 2021). Such Early Warning Systems could help students remain engaged in the STEM field and ultimately secure employment opportunities within this domain. By identifying struggling students early on, educators can intervene promptly with targeted support strategies tailored to the specific needs of each student. This proactive approach not only increases the likelihood of academic success but also nurtures students' interest and confidence in STEM disciplines. In Chicago, many schools have used early warning indicators to develop strategies for improving student performance. Furthermore, teachers have been able to examine patterns in the indicators to strategically address students' low performance based on specific issues observed in the school (Allensworth, 2013).

Integrating students' behavioral signals and their entry profiles is valuable in anticipating their success in STEM courses. Behavioral signals such as the number of correct responses to in-class questions, slide and video views, can serve as stable predictors of students' success throughout the semester. By utilizing these behavioral signals along with student profiles, it becomes possible to predict students' success. Additionally, early warning systems that leverage diverse student data can aid in developing other innovative predictive features for student success and contribute to designing an enhanced early warning system (Nam, 2019).

Many recent studies advocate for the adoption of early warning systems to identify at-risk students. A study conducted in 2018 examined eight prediction methods and investigated the optimal timing for implementing such a system within a course. The study's findings indicate that the ideal time for implementing an early warning system is around weeks 5-6. (Howard et al., 2018).

To identify talented STEM students in primary school, the authors made direct observations of the students' involvement in STEM-related activities. An example of such activity was the design and 3D printing of key chains. The students worked in teams of two, at the computer, where they designed, based on predetermined models and with the help of specialists, personalized key chains. They also had the opportunity to print them using 3D printers. During the activity, there were students who demonstrated critical thinking, good logical and analytical thinking skills, but also spatial and technical thinking.

These children, if they *benefit from an educational process that supports them in developing these skills, have a high chance of achieving a successful career in engineering*. An example of an activity carried out within the primary cycle is that of building a city from recyclable materials. In this activity, students worked in teams, collected the right materials, designed and built a miniature city. They also had the task of building a bridge that would support the weight of a toy car, but also a simple circuit with batteries and light bulbs that would take the place of the street lighting in their city. The activity

stretched over several hours, and the students had limited resources at their disposal. Students who managed to find innovative solutions and solved the problems encountered during the project were noted. Through this activity, one can observe students who have the ability to solve problems, who have an increased interest in science and technology, but also spatial and technical thinking. It is an activity that can help teachers identify students' weak signals and develop them in the future.

In terms of activities observed in the university environment that can help teachers identify weak signals of students, an example of an activity is represented by problems that put students in difficulty and test their ability to solve problems, think logically and criticism, but also teamwork. One such problem is related to finding an optimal solution for street lighting in their city. The students worked in teams and had access to resources such as course materials and the internet, creating a sustainable street lighting project. In this way, students who have problem-solving, collaboration, teamwork, problem-solving, and spatial and technical thinking skills were noticed.

Participation in conferences and workshops is encouraged. Students are supported to participate in such activities by presenting scientific papers or participating in debates on current technological topics. In this way, students are motivated and can discover or develop their STEM talents or skills. Such informal activities are extremely beneficial for students and add value to the instructional-educational process. It is also in such situations that teachers can identify students who show talent in the STEM field and help them develop further to reach their full potential.

An example of a test used for primary school students consists of a cognitive test and logical thinking activities. To identify the model in numerical sequences, exercises such as: What is the next number in the sequence: 2, 4, 8, 16, …? (The answer is 32, each number being double the previous one). The next item can consist of a problem like "Maria, Ion and Michael participated in a marathon. Maria arrived before Ion, but after Michael. Who won the contest?" The Test can also contain logical association games (bread-baker boxes, clock-battery) or resource distribution problems. The list of items to test students can go on with logical transportation problems, the cube tower test, sorting problems, logic problems, or analogies tests.

As far as hands-on STEM experiments, making a volcano using baking soda and vinegar is one of the activities that get students engaged and engaged. This type of experiment gets students interested in science and technology, but also tests their collaboration, teamwork, or logical thinking skills.In the university environment, game-based activities involving STEM simulations, such as programming robots or solving virtual challenges through educational software, are effective methods of testing students on their STEM talents and abilities. During these activities teachers can gather valuable data about students' talents and how they can help them develop further. Another type of test is one that is based on logical rip-puzzle activities or reasoning problems that aim to assess students' critical and analytical thinking. These activities give teachers the freedom to customize them according to the theme of the course, while also testing the students' skills/weaknesses in the STEM field.

These tests and experiments, based on a representative sample, should provide a clearer picture of the process of identifying weak signals among pupils and students, the results being useful in drafting recommendations for teachers and educational counselors regarding the career guidance of students.

Figure 1 shows the route taken by the students, starting from primary school and ending with a professional career. The authors propose this route model that could be followed in order to identify weak signals of students early, based on the progressive development of their skills. First, it emphasizes the native aptitudes of individuals, that is, those innate traits that reflect natural talent and inclinations. The second step is the analysis from the perspective of the student's potential, evaluating his latent ability to learn and progress in certain areas. Next, the emphasis is on acquired skills, developed through education and practice, thus consolidating what the student has already learned and is able to apply in practice. The end of the path is completed by the achievement of competence, which sums up the skills, knowledge and attitudes necessary to perform successfully. The proposed model provides a clear framework for understanding and supporting student progress from potential to performance, i.e. from low signals to achievement.

5. Limitations and further steps

The present research has a number of limitations, the first one being related to the lack of longitudinal data. In addition, the lack of concrete data on the application of the tests among pupils and students is another major limitation. In addition, false positive or false negative results should be considered in terms of the application of weak signal theory in education. The authors propose the continuation of the process of carrying out a procedure to evaluate and identify emerging skills related to STEM (as weak signals) during pre-university education cycles. The previously presented pilot tests are to be applied among pupils and students, and then the results of the participants will be analyzed for

validation. The authors also propose the development of tools to be applied in pre-university education with the aim of identifying weak signals related to STEM, thus contributing to increased chances that young people who choose to study STEM disciplines in university to have higher chances to be successful while pursuing an engineering career.

6. Conclusions

In the field of education, the theory of weak signals could be successfully applied by teachers, thus helping students to develop their natural talents and thereby form skills and then competencies that will help them in their future careers. The implementation of an early warning system would help in the career guidance process, thus young people would no longer end up occupying positions or different fields that do not suit them. It is necessary that the methods currently used by teachers be adapted to identify students' talents as early as possible and to help them develop skills that will help them in the future. In this way, students will become young people who possess skills and competencies in line with their talents, achieving professional success and fulfillment and having a sense of well-being at work.

The research therefore emphasizes the importance of early identification of STEM skills among pupils and students, considering their impact on educational and professional success. The application of the theory of weak signals in the field of education, especially in engineering education, can positively contribute to the process of adequately orienting students towards careers in the technical field, highlighting the students' potential. The studies presented and the observations made by the helpers contribute to a better understanding of this complex process of identifying weak signals and using them for the benefit of students. Early identification of STEM talents can support students in choosing an appropriate educational and professional path, thus eliminating unfulfillment and burnout. Implementing early warning systems and using practical tests and experiments can help teachers use valuable tools to support the development of these skills. However, as a relatively new approach to education, the application of weak signal theory requires a flexible and adaptable framework that can be adjusted as more experiences and data accumulate.

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EXPERIENCING UNIVERSITY LIFE AWAY FROM HOME: AN EXPLORATORY STUDY ON HOMESICKNESS IN OFF-SITE STUDENTS

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Abstract

Enrolling in university marks an important step toward adulthood, yet for students moving away from home, the experience can be daunting and challenging (Nghiem et al., 2021). Homesickness, a typical reaction to this separation, is frequently experienced by off-site students, particularly among younger individuals and particularly females, and can sometimes lead to negative effects like depression, loneliness, anger, and sleep problems (Biasi et al., 2018; Stroebe et al., 2015). Numerous studies have analyzed contextual, individual, and family factors linked to homesickness, usually through questionnaires. This study, however, aims to explore the psychological experiences of a group of off-site students, focusing on areas where they experience homesickness, using a narrative approach. A sample of forty-seven off-site students (33 female; average age 23; SD=2.6) completed a socio-demographic form and wrote a narrative text about their university experience. They focused on changes in their relationships with family and friends, their emotions, the difficulties they face away from home, and their academic and social lives. Through thematic analysis and Bruner's self-indicators, results revealed that while physical distance does not sever ties with family and friends, students often struggle with adjusting to university life and to the new city without the support of these relationships. Their moods tend to be predominantly negative, with an associated fear of losing friendships due to distance and a feeling of missing out on shared daily experiences. Many students report a strong nostalgia for their "homeland" and feel overburdened by having to manage organizational responsibilities previously dealt with by their parents. Bruner's social self-indicators appeared frequently in the narratives, with female students emphasizing the value of new friendships for adjustment, while male students highlighted the importance of family ties in relation to homesickness. The findings confirm existing research on homesickness in off-site students and shed light on the specific areas it affects, such as family, friendships, and life adjustment. They also suggest that the difficulties tied to the university transition are part of a broader shift toward adulthood. Although limited by sample size, the study contrasts with existing research in finding that female students in this sample tend to use social resources to adapt to the university environment.

Keywords: *Off-site students, homesickness, transition to university, narrative approach.*

1. Introduction

The transition to university occurs in a particular developmental stage, that of "emerging adulthood," in respect to which the literature (Arnett, 2015; Lapsley & Hardy, 2017) has identified both resources and constraints:

- explorations of identity
- sense of possibility and optimism
- increased self-esteem and perception of self-efficacy
- refocusing on self
- instability
- feeling of being "in the middle"
- internalizing and externalizing problems.

It is within this developmental context that the transition to university takes place, a time in which the above-mentioned aspects find ample space and are intertwined for all, but especially for off-site and female students, that is, those who live far from home and their families for study reasons. Entering university is seen as a milestone in the transition to adulthood, but it can be particularly challenging for those leaving home (Nghiem et al., 2021).

For those studying away from home, the transition to university involves leaving old friendships and creating new ones, changing family relationships, and the need for reassurance and social support.

Homesickness is a normal reaction of those who move away from their living environment, (Firmin et al., 2009; Nghiem et al., 2021; Nijhof & Engles, 2007), but it can lead to negative outcomes such as difficulties in concentration and problem-solving, nervousness, anxiety, sadness, obsessive preoccupation with thoughts of home, sleep disturbances and physical health, and academic difficulties (Biasi et al., 2018; Stroebe et al., 2015; Scopelliti & Tiberio, 2010).

Research, mainly conducted through questionnaires, has highlighted individual, contextual and family factors that may influence the perception of homesickness: lack of coping strategies (Ting et al, 2020), temperamental and personality variables (Asendorpf, 2000), social skills and social connectedness (Almocera et al, 2020), parenting styles and parenting support (Uchenna, Onuoha, Opeyemi, & Segun-Martins, 2013), and gender differences (Al-Qaisy, 2010).

2. Objectives

Based on these premises, our study aimed to explore the experience and the homesickness of a group of out-of-home students with respect to:

- Family and friendship relationships
- Emotions and moods
- Difficulties encountered
- Advantages and disadvantages
- Social life
- University experience
- Future job prospects.

3. Methods

To this end, we followed an exploratory and narrative approach, since writing about oneself induces self-reflection, helps bring order to events, and give meaning to the events in one's life. In addition, producing a narrative account allows the emergence of indicators of the Self (Bruner, 1998), such as action, commitment, resources, social reference, localization, evaluation, quality, reflexivity, and coherence.

3.1. Participants

Forty-seven university students living away from home were recruited through a convenience sample (F=33; M=13; Other=1):

- Age 18/28 years (M=23 years)
- Average distance between residence and university: 342 km
- Time away from home: (6<1 year; 41>1 year)
- Field of study:
  - 11 humanities
  - 10 sciences
  - 10 economic-legal
  - 4 technical subjects
  - 12 medical health

3.2. Narrative tool

After collecting general personal data such as age, gender, distance from home, field of study, time away from home, we proposed writing a short text according to the following cue:

"Try to narrate something about yourself and your life about your experience as a university student away from home. You have a minimum of 10 lines and a maximum of 30 lines available. I invite you to focus the narrative on the following points:

- How have your relationships with your family and friends changed?
- What are your emotions and moods?
- What difficulties have you encountered living away from home?
- What are the advantages/disadvantages?
- Has your social life changed?
- How do you evaluate your college experience academically?
- Where do you imagine looking for a job after earning your degree?"

3.3. Analysis of texts

Qualitative content analysis was conducted to identify emerging themes, both in respect to the suggested areas and to others not expected and to search for Bruner's "indicators of the Self".

Analysis was carried out with a step-by-step procedure. We independently read the narratives several times and have reported all the content that we have considered to be significant; then we compared our ideas about the content that had emerged, identifying recurring themes.

Below is an example of the text produced:

"My life as an off-site student has enriched me greatly because it has changed the way I see life and perceive myself. I have understood my parents and their difficulties more. With my lifelong friends not much has changed but the difficulty is to be present despite the physical distance. However, it happens that I feel lonely, misunderstood and homesick. Academically it is definitely a disadvantage because you have concerns about housing and roommates." (26-year-old girl, only child, sciences, 7 years away from home, 550 km away, home every 2 months).

4. Results

Table 1 and Table 2 show the main themes and Self indicators emerging from the narratives.

Table 1. Main themes emerging from the narratives.

PARENTS AND FRIENDS RELATIONSHIPS	EMOTIONS AND MOODS	DIFFICULTIES	ADVANTAGES	DISADVANTAGES	SOCIAL LIFE
Weakened because we see little of each other (both parents and friends) Unchanged, compared to family Improved (family) One appreciates ties more	Loneliness Guilt Nostalgia for the homeland Lack of friends and relatives Desire to return Restlessness/anxiety Perception and fear of loss of relationships Anger toward institutions Ambivalent feelings (happy/tristful; enthusiasm/distrust; pride/fears)	Living alone Not knowing anyone Organization (time, home, study) New responsibilities Self-management New habits Roommate cohabitation Adjusting to new city alone Not knowing how to deal with new situations	Freedom/independence Time (for study and being alone) Autonomy in self-management and self-care Getting away from unpleasant situations More efficient academic facilities and services Gaining new experiences Developing new skills Responsibility Sense of self-efficacy	Doing things on your own Household management Not having opportunities to cultivate one's passions Not finding "warmth" upon returning home New relationships superficial, old ones weakened Economic problems Psychological problems Disorganization Lack of home comforts	Improved (new socializations, maintaining old relationships, more opportunities Worsened (isolation, little time, roommates only, difficulties with fellow students)

Table 2. Main Self indicators emerging from narratives.

EVALUATION	SOCIAL REFERENCE	REFLEXIVITY	RESOURCES	COMMITMENT
It is the most frequent indicator (90) It emerges especially in girls with respect to consideration of the difficulties encountered, advantages and disadvantages of living away from home.	Very frequent indicator (88) It emerges mainly with family members, but also with old and new friends. More frequent in girls, who seem to be more willing to build new social networks.	Very frequent indicator (63) Greater tendency in girls to reflect on their moods, come to terms with advantages and disadvantages, and seek a compromise between positive and negative aspects.	Fairly common indicator (49) It emerges equally among males and females, such as with respect to new skills or conditions acquired off-site, which can then be used in various areas.	Fairly frequent indicator (38) It emerges mainly in relation to plans for the future, whether related to continuing studies or looking for a job.

Summarizing the themes that emerged in general, almost all off-site students have experienced or are experiencing negative feelings related to being away from home. Despite the problems and disadvantages noted, however, most are able to identify resources and a spur to engage in study and future work, while the university experience is largely seen as good and satisfying. Only a few narratives appear to be entirely negative, suggesting individual problems.

5. Conclusions and limitations

The narrative tool provided insights into the experiences of off-site students facing new challenges and encouraged participants to work on introspection. Some of the aspects emphasized in the literature about emerging adults were revealed from the narratives, such as self-efficacy, sense of possibility, exploration in the social, but also ambivalence, instability, being in the middle, and the search for re-centering and coherence**.**

Our study has some limitations. Data were collected via an online platform, so there was no opportunity to meet and interact directly with the students involved. This is an exploratory study with a limited number of participants, unbalanced by gender, recruited by convenience sampling and therefore not representative of the population. However, it has provided insights that encourage us to continue the research in this direction.

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I COULD NOT HAVE SAID IT BETTER MYSELF – STUDENT INSIGHTS INTO ORAL EXAMINATIONS IN HIGHER EDUCATION

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Abstract

The traditional written examination has long been the cornerstone of student assessment in higher education. A student needs to show his/her progress by answering a premeditated question/s. However, this method often fails to capture the full spectrum of a student's knowledge, critical thinking, and communication skills. In higher education there are also so called metaskills to be embraced. This paper explores the efficacy of oral evaluations as an alternative assessment method in higher education. Oral evaluations, which involve students verbally articulating their understanding of the subject matter and responses to questions, offer a dynamic and interactive approach to assessment enabling to gain teachers deeper understanding of the big picture. This paper examines the benefits and challenges associated with oral evaluations. Benefits include the ability to assess students' verbal communication skills, immediate feedback opportunities, and the potential to reduce academic dishonesty. Oral evaluations can also foster a deeper understanding of the subject matter, as students must engage in critical thinking. Also, coherent articulation of their thoughts is required, and if necessary, also connecting the issue at hand to its larger context. Additionally, this method can accommodate diverse learning styles and provide a more comprehensive evaluation of student performance. However, the use of oral evaluations has its challenges. Logistical issues such as scheduling for one, the potential for subjective grading, and the increased time required for each assessment are noteworthy. The study also addresses concerns about student anxiety and the need for training both students and educators to effectively participate in oral evaluations. Data for this study were collected through interviews with students and faculty members who have experienced both written and oral evaluations and reflecting the findings to literature. The findings suggest that while oral evaluations may not completely replace written exams, they can serve as a valuable complementary, or occasional compensatory assessment tool. The paper concludes with recommendations for integrating oral evaluations into higher education curricula, including possibilities for preparation, execution, and grading. By highlighting the strengths and addressing the challenges of oral evaluations, this paper aims to contribute to the discourse on innovative assessment methods in higher education. The ultimate goal is to enhance the assessment process, ensuring it is fair, comprehensive, and reflective of students' true capabilities, while also taking staff's resource use into the equation.

Keywords: *Higher education, assessment, oral examination.*

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1. Introduction

Higher education is about teaching the subject matter. Originally executed by the teacher reading the material out loud from a book and the students trying to take notes and/or remember the essence and simultaneously already starting to internalize the content. At those times the mere existence of books scarce. Today the situation is something completely different, development has been and is constant (Berggren et al., 2015; Entwistle and Entwistle, 1991; Hellsten and Kallionpää, 2023). The methods have evolved during the past years into something unprecedented. The universities and teachers therein have had to come up with new ways of executing their task (Kallionpää and Hellsten, 2023). Information is there in abundance. One thing has still remained similar though. In order to pass a course or a program the students are required to show and verify their newly acquired knowledge.

The traditional written examination has long been the primary method of assessing student performance in higher education. While this approach allows students to demonstrate their knowledge by answering premeditated questions, it often falls short in capturing the full range of a student's abilities, including critical thinking and communication skills. In an era where the so-called metaskills are increasingly valued, there is a growing need to explore alternative assessment methods that provide a more

comprehensive evaluation of student performance (Muukkonen and Lakkala, 2009; Prasittichok and Klaykaew, 2022).

This paper investigates the efficacy of oral evaluations as an alternative assessment method in higher education while taking the students' viewpoint into consideration too. The notions and the mere viewpoint to the issue are versatile. Both sides need to be taken into account. Oral evaluations require students to verbally articulate their understanding of the subject matter and respond to questions, offering a dynamic and interactive approach to assessment, whilst the staff member need to be able listen and evaluate what is been said. This method not only allows for the assessment of verbal communication skills but also provides immediate feedback and reduces the potential for academic dishonesty. The conversational approach may offer new possibilities to assess the knowledge about the subject matter. By examining the benefits and challenges associated with oral evaluations, this paper aims to contribute to the ongoing discourse on innovative assessment methods in higher education, ultimately seeking to enhance the assessment process to better reflect students' true capabilities.

2. Design

Our master's program at the university has certain compulsory courses, as they do. The basics that the latter studies build on are brought in most part already in the bachelor phase. As it is possible to apply directly to the master's program, should one have already a suitable bachelor's degree, person may not have the necessary basics required for a successful completion of the master courses. Having said that, the study program is rather packed. We came up with an alternative solution. We offer the students of the master's program a possibility to independently study two of the basic courses and take an oral exam.

The courses *Basics of Information and Knowledge Management* and *Information Systems Management* make up the very basics and are prerequisites for the upcoming courses. First of the courses is lectured during the first autumn season consisting of 14 lectures and two assignments. The latter one right in the beginning of the second fall season. The question arises how is this mode and opportunity perceived by the students and also partly commented by the staff.

The paper scrutinizes the students' viewpoint and gives some notions on the approach the teaching staff have towards this execution. All the 35 of the students of class 2024-2025 were approached by a questionnaire of 22 questions and the two involved teachers were interviewed to gather empirical matter over the area under scrutiny. The questionanire has scaled questions (1-5) and clarifying open ended questions. Due to unforeseen schedule-related issues the number respondents remained at 15 as the views of the participants were inquired. Having said that, already at this point the answers began to saturate, thus giving reliability to the existing findings.

3. Background

The Tampere University community was established through the merger of the former Tampere University of Technology, University of Tampere, and Tampere University of Applied Sciences. This merger took effect at the beginning of 2019, coinciding with the transfer of ownership of the University of Applied Sciences from the city of Tampere to the newly formed Tampere University. The individual universities were founded in the 1960s, while the origins of the University of Applied Sciences date back even further.

The newly formed university encompasses nearly all internationally recognized fields of study, with a strong focus on research and education in technology, health, and society. Tampere University is one of the most multidisciplinary universities in Finland, boasting a community of approximately 32,000 students and over 5,000 staff members across seven faculties. The university operates on three main campuses in Tampere, Finland's third-largest city, and has three university centers in Lahti, Pori, and Seinäjoki to address more localized needs.

This paper focuses on the teaching activities at the Hervanta campus, which was primarily the domain of the former University of Technology. It is important to note that the university has made significant efforts to ensure uniformity across all campuses, so the observations in this paper are likely applicable to other parts of the university as well, even if the cultural difference between the campuses is occasionally said to be there.

The daily routines of the teaching staff often include research work and research-related tasks, with few individuals able to focus solely on one area. The pedagogical and didactic expertise of the staff varies, as many individuals come from research backgrounds. Similarly, the technical proficiency of staff members ranges from those who use basic tools like PowerPoint and PDFs to those who are adept with advanced features of learning platforms. The tasks of the staff can be broadly categorized into teaching (the

main focus of this paper), research, and administrative duties. The latter category is somewhat ambiguous, as it may or may not be connected to the other two areas.

4. Findings

The respondents have a bachelor's degree, meaning that they have already experience on examinations from various classes and courses. Twenty per cent of the respondents had taken oral examinations prior to the occasion under scrutiny now. The general opinion was positive, that is pro oral examinations, a little over half of the respondents agreed strongly with the statements that they would prefer oral exams over written. Also, the rest agreed with the statement or were indifferent about their preference. The responses regarding the question how the different types of exams are to be prepared for varied quite a bit. The answers to this statement varied quite a bit. The open-ended questions shed some light on the answers: seems that the personal touch, the examiner being present, sitting opposite to the students that is, causes more pressure to do a proper job and willingness to prepare more thoroughly for the task. Still, only one student reported mild anxiety due to the 'pressurized situation' while majority, the rest, disagreed with that statement. This was mostly complied by the examiner interviews. Conversational approach was said to preferred also due to the nature where one could better express oneself. Oral examination was also described as 'lighter'.

Two out of three students believed that oral exams enabled a better way to demonstrate their knowledge base than the written ones. Remaining third were indifferent to this statement. Similar distribution was a result when the viewpoint of oral communication skills was inquired. The students are of the opinion that this way they are able also to brush up their skill set in this area. All respondents welcomed the direct oral feedback on the executed exam on the spot instead of the delayed feedback they may or may not receive for a written one. As to the fairness of the two ways of executing the examination, the possibility to express oneself more freely and perhaps eloquently seemed to be an asset. The flexibility in answering orally enables broader answering and hinders the effects of possible deficiencies, should one feel having such features in one's written skills, such as possibilities to misunderstandings based on poor choices of words or momentary lapses of remembering details in a written examination. However, the written exams were admitted having more time in disposal to reflect over the answer or returning to a previously written answer. The presence of both parties was also seen as a risk, should there be personal issues of any kind for either side of the table. Chemistry, and being on the same 'wave-length' was brought up in one of the open-ended mentions, as the verbal skills play a role in oral examinations. The oral exams' assessments were considered to be a bit less objective than those of the written ones.

When asked their own assessment on their performance in oral exams compared to written, the respondents answers were distributed in a form of a pyramid. Some feel they are more likely to do well allowed to express themselves orally and some feel slightly intimidated by the social encounter with the examiner. Some feel that the more traditional way is the way we should abide by. Majority of responses still acknowledged positive feelings towards oral examinations. Regardless of the mode of execution, the preparations is the key, giving self-confidence and security.

Just a notion, web-based oral examinations were not received as well as opposed to face-to-face meetings. So even if technically possible this is not seen as good a way to learn and show one's proficiency. Responses said even that the respondent wouldn't take part in such an exam. Whereas the 'normal' oral examination was agreed to be also a learning event rather strongly. The formulation of the answers, binding the details to a bigger picture, explaining the interconnections of the concepts, conversing with the examiner, but also to condense one's answer into concise sentence, etc., the useful skillsets expected to be required later in working life as well. This was credited at least partly to the conversational approach. This may have a lot to do with the examiners style and way how the exam is conducted.

5. Concluding summary

From teachers' point of view, the preparation of oral examination requires similar amount, and type of work as it does for a written one. Obviously, it differs in details. The questions, or themes, and their respective answers need to be well pre-thought. By answers it may be advantageous to have lines of issues covered what the correct and good answer must and should include. Centric themes, if one will. Also lines of extension through which a good answer becomes very good or even excellent. Similarly, the pre-thinking should have a key to prioritize the issues not critical for the answer, i.e. giving the answer breadth but not necessarily hitting the exact spot. This also means that the examiner needs to really concentrate on the moment and on the activity at hand.

The organizing of the oral exam may prove to be a laborious task. To open one's calendar will require good and thorough thinking, because the actions caused by reserved exam slots should be executed

in an organized manner. On some learning platforms there are tools to facilitate this. Similarly good preparation and perhaps rehearsed execution is required to ensure objective and fair running of the examination session.

The oral option seems to be well-liked by the students. Both in delivering 'the achievement' but also for getting simultaneous feedback on it and in some cases even simultaneous grading if planned for this. The individual feedback is a feature that is wished and also often asked for. General opinion seems to me more in favor of oral examination than against it.

Seems that oral examinations are well-placed choice for a realization of assessment for a course with moderate number of students, should there be such an option. There is a thought though to consider whether the oral examination gives better chances for the type of students that are more extrovert than introvert and more eloquent in the expression of their thinking. Having said that, it may be argued that this a one of the metaskills sought after also in the working life after studies, thus it may be argued that this is also something the students are actually advised to train.

This paper clarifies the attitudes, and the views the students have regarding the oral examination used in higher education assessment. Higher education is about teaching the subject matter. Having said that, in the area of information and knowledge management it is not uncommon that the questions to be asked and their required answers are not such that there would be only one absolutely right answer and all the others being wrong. For the students it is debatably more important to remember the essence and to internalize the content in its context to see and understand the bigger picture this seems to be easier to convey orally than in written form.

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NEW APPROACH TO MATHEMATICS TEACHING BASED ON THE CULTURAL ONTOLOGY

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Abstract

Curricular tradition often distills teaching to convey only the "correct" knowledge for a specific domain at a particular level, time, and place, as seen in commonly used textbooks. The development of knowledge, if mentioned at all, typically outlines steps leading to specific knowledge while avoiding debate with alternatives. For instance, in teaching geometry, figures like Euclid, Pythagoras, and Thales are highlighted, whereas Lobachevsky, Bolyai, and Riemann are often omitted, despite their significant contributions. By excluding these figures, we deprive students of a deeper understanding of the discipline they are learning. A linear, distilled curriculum presents correct knowledge as an undisputed path to learning. However, this approach is flawed regarding meaningful learning. The disciplinary policy frequently contrasts the tradition of scientific progress (e.g., Matthews, 2015) and contradicts essential learning conditions (e.g., Marton, 2015). In this study, eight third-year undergraduates—future junior high mathematics teachers—were asked to define mathematical contexts shared by mathematics and physics (e.g., derivatives), contexts relevant only to one discipline (e.g., irrationality in mathematics), and content lacking consensus across different mathematical theories (e.g., parallel lines). They then learned about various historical definitions of the concept of angles and how these definitions influence current mathematics curricula and textbooks at all school levels. The DC-Structure (Tseitlin & Galili, 2005) defines the term "ontology" in both philosophical and computational senses (Zhitomirsky-Geffet, 2016) and provides examples of cultural ontologies in Euclidean and Non-Euclidean Geometries (CCK - Content Knowledge). Undergraduates were asked to add the basic concepts, axioms, and results of Non-Euclidean Geometry to the existing structure, distinguishing it from Euclidean Geometry. After this learning experience, they redefined the mathematical contexts they initially defined. The results demonstrated varied complexity. Some students found it challenging to recognize differences within the mathematical content, while others acknowledged the importance of such recognition for future mathematics teachers. They appreciated the experience for fostering meaningful learning of disciplinary knowledge and its impact on teaching practices. Some undergraduates reported that the experience helped them recognize connections between their courses and shifted their views and perceptions of the knowledge they acquired. The research was conducted based on constructive-qualitative methodology (Shkedi, 2011).

Keywords: *Discipline culture, ontology, meaningful learning, geometry.*

1. Introduction

Conceptual understanding goes beyond rote memorization or the mechanical application of procedures. It entails grasping core ideas, enabling the transfer of knowledge to analyze new scenarios and adapt it to different contexts. Rather than accumulating isolated facts or methods, it requires organizing knowledge elements into a coherent structure. This structure should have a clear hierarchy, define their relationships and affiliations, and establish their validity and reliability, fostering deeper insight and practical application.

The curricula of school geometry often fall short of meeting modern educational demands. Confronted with an exponential growth of knowledge, educators frequently resort to requesting additional teaching hours to accommodate more content. However, while this approach appears reasonable, it is insufficient to address the broader challenge of the information explosion. We propose adopting a new educational paradigm that transforms a discipline into a discipline-culture (DC) (Tseitlin & Galili, 2005).

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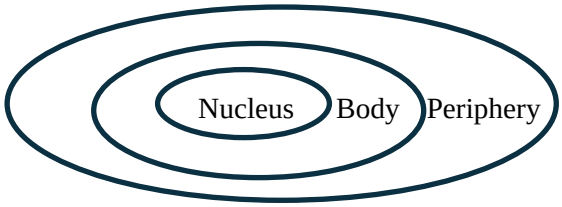
According to Galili and Tseitlin physical theory is an inclusive construct incorporating a large number of knowledge elements within certain paradigm with certain domain (e.g. classical mechanics, electromagnetism, optics, etc.) The authors claimed (ibid.) that:

> Any fundamental physical theory arranges all statements in a centralized structure, a sort of quasi-culture, with its own values, language, conceptions, norms, etc. This structure, like a cell, has nucleus, body, and periphery.

Figure 1. Symbolic representation of areas of knowledge elements within Discipline-Culture structure of a fundamental theory (Tseitlin & Galili, 2005).



In this structure (Figure 1), the nucleus of the theory includes fundamental principles, ontological and epistemological, and the paradigmatic model of the theory. Body elements are all those knowledge elements coherent with the nucleus (theoretical and empirical) and explained by it. The periphery includes the elements of knowledge at odds with the nucleus (alternative accounts and concepts from other disciplines, old and new, unsolved problems, unexplained phenomena). It is the periphery that introduces a dialogue between different theories making disciplinary knowledge cultural. It also makes explicit the limits of validity of the particular theory. Thus, while learning the Newtonian account of motion in mechanics, the students become aware of the alternative concepts of motion in earlier accounts by Aristotle and Philoponus as well as the pertinent ideas from relativistic and quantum theories. This way the considered concepts learned obtain a space of conceptual variation essential for conceptual understanding (Marton, 2015). Our understanding consolidates in comparison with alternatives, discerning the essence of the concept from the differences. A key feature of this paradigm is its structured hierarchy, which organizes knowledge and fosters conceptual discourse on the essential content of each discipline. Emphasizing the creation of Cultural Content Knowledge (CCK) (Galili, 2012) promotes conceptual understanding. In teaching geometry, figures like Euclid, Pythagoras, and Thales are highlighted, whereas Lobachevsky, Bolyai, and Riemann should be presented with their significant contributions to geometry. CCK approach uncovers and clarifies the underlying principles and meanings, guiding learners toward deeper comprehension and a more integrated perspective of their studies.

This research focuses on developing cultural ontologies (NCO) for geometry, grounded in the theoretical framework of the "Discipline-Culture" paradigm proposed by Galili and Tseitlin (2005). The term "cultural" emphasizes the plurality of perspectives, highlighting the conceptual variation inherent in disciplinary knowledge. This pilot study aims to explore the impact of the Cultural Content Knowledge (CCK) approach on teaching geometry to pre-service mathematics teachers.

2. Research

2.1. Research design and methods

The research applies the new DC paradigm to the disciplines of the school curriculum in geometry. The Euclidean and non-Euclidean geometry could be introduced the triadic discipline-culture structuring of the curricula varying in the contents and nature of primarily the nucleus constitutional elements, yet sharing the principle of facilitating conceptual understanding through the comparative analysis of knowledge elements with peripheral alternatives.

The research questions address applicability of the DC paradigm, the quality of conceptual understanding of the subject matter, and pre-service mathematics teachers views on the nature of the knowledge they learn.

In terms of specific points, we may mention the following:

1) The development of learning-teaching materials for their conceptual understanding based on the developed DC paradigm and cultural ontology. In the field of geometry.
2) The development of a course for pre-service teachers introducing them to the new DC paradigm, the building of cultural ontology, and forms of teaching of the pertinent materials.
3) Experimental training of teachers for the new educational paradigm in colleges of education for per-service high school mathematics teachers.

4) Measures for assessment of quality of the developed learning materials and cultural ontology, and its effectiveness and contribution to conceptual understanding of the pre-service high school mathematics teachers.

2.2. The research questions

The research questions will address the applicability of the DC paradigm in the geometry, the quality of conceptual understanding of the subject matter, and pre-service high school mathematics teachers' views on the nature of the knowledge they learn, changed due to the creation of cultural content knowledge.

1) Whether and to what extent does the DC paradigm promote conceptual understanding in geometry?
2) What is the quality of conceptual understanding of the subject matters promoted by the DC paradigm?
3) How have the pre-service teachers' views on the nature of the knowledge they learn changed due to the creation of cultural content knowledge?

2.3. Methodology

2.3.1. Empirical data collection and analysis. The qualitative research which is based on criteria-focused methodological patterns, placing increased emphasis on the analytical research skills and expertise at the expense of intuition was conducted. The significance of this fact is that the researchers work and rely on a system of external criteria (theory, principles, and categories) throughout the whole study. This pattern is close to basic positivistic assumptions in quantitative research, but does not repeat them (Shkedi, 2011, p. 118). The criteria-based methodology reflects intuitive and impression-based resources. In the realm of qualitative research, researchers use analytical skills but seek to express phenomena in verbal terms often turning to philosophical aspects. The methodology presented here belongs to qualitative research and includes all the methodological components that characterize such research (Shkedi, 2011).

2.3.2. Cultural ontology of geometry was construction. This research focuses on developing a methodology and guiding principles for domain experts to create a network of interlinked cultural ontologies (NCO) for geometry based on the theoretical framework of "Discipline-Culture" proposed by Galili and Tseitlin (2005).

The methodology consists of several stages. Initially, we constructed a single-theory or single-viewpoint ontology. The ontology is drawn from subject knowledge and notable references, such as textbooks and encyclopedias. The ontology comprises a nucleus (the fundamental elements of a discipline's theory) and the body of knowledge built upon the nucleus.

The existing generic domain ontologies were extended to achieve this. For example, in Mathematics, the upper-level ontology OMDoc (Lange, 2013) includes concepts like Math Knowledge Item, Theory, Axiom, Definition, Proof, and Statement. The semantic relationships between ontology classes include hierarchical connections (e.g., subclass-superclass), inclusion (e.g., part-of, substance-of), and entailment (e.g., cause-of, use-of). Finally, all ontology elements were annotated with newly introduced properties, "nucleus" and "body," based on their position within the theoretical knowledge structure.

3. Results and discussion

3.1. First stage questionnaire

Eight third-year undergraduates—future junior high mathematics teachers—were asked to define mathematical contexts shared by mathematics and physics (e.g., derivatives), contexts relevant only to one discipline (e.g., irrationality in mathematics), and content lacking consensus across different mathematical theories (e.g., parallel lines). The answers they provide show that there was no awareness of the plurality of mathematical theories, variation of definitions and diachronic discourse.

3.2. Second stage learning

1) Eight third-year undergraduates learned about various historical definitions of the concept of angles (Barabash, 2016) and how these definitions influence current mathematics curricula and textbooks at all school levels.
2) They were introduced to the DC paradigm and CCK examples (Vinitsky & Galili, 2014a, 2014b, e.g. Levrini et al., 2014).

3) They were introduced to the NCO and the example provided by the lecturer (Zhitomirsky-Geffet, M., & Eden, 2014). The lecturer had to write a reflection on the process she was going through with students. The students were surprised since they were used for polyphonic representation of the disciplinary content.

3.3. Third stage implementation

Eight third-year undergraduates were asked to imply the knowledge they were exposed to by doing a summary assignment in the course (Figure 2).

Figure 2. Summary Assignment in the Course: Teaching Geometry.

Summary Assignment in the Course: Teaching Geometry

The purpose of this assignment is to actively involve you in constructing a multi-viewpoint ontology in geometry.
You are provided with an Excel file in which I have begun creating a multi-viewpoint ontology encompassing Euclidean Geometry, Synthetic Geometry (as covered in the axioms section of the course), and Lobachevskian Geometry. Your task is to expand upon this work by starting the construction of an ontology for Spherical Geometry.

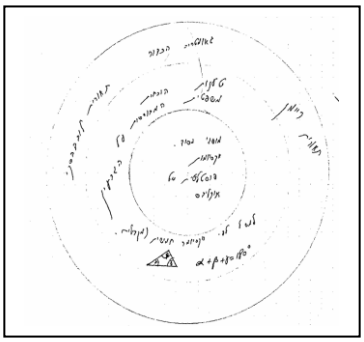
1. *List the fundamental concepts of the theory, if applicable.*
2. *Document the axioms of the theory, if they exist.*
3. *Write three propositions that hold true in both Synthetic Geometry and Spherical Geometry, if applicable.*
4. *Write three propositions that hold true in Synthetic Geometry but not in Spherical Geometry, if applicable.*
5. *Write three propositions that do not hold in Synthetic Geometry but do hold in Spherical Geometry, if applicable.*
6. *Indicate any "derives-from" relationships between the propositions and axioms, if applicable.*
7. *Specify relationships such as "inclusion," "overlap," and so on, if applicable.*

Good Luck!

The students were divided into three work groups for this assignment, with group sizes of 3, 3, and 2. All the groups successfully completed the task, though they noted that it posed significant challenges from the mathematical perspective. To overcome these difficulties, they frequently consulted a variety of academic sources.

The students' performance in this assignment highlighted how Discipline-Culture (DC)-based materials foster dialogue between ideas, encouraging learners to engage in the discourse of geometric knowledge. Below is an explanation from one of the students about how they utilized the DC structure to organize their understanding:

Figure 3. Participant 5, DC- structure of geometry.



"*We can organize the knowledge for the students in the way that when they learn something new (a definition or theorem) we check where it is placed (in DC) and understand how it is connected to the principles…. If we change a definition of a principle we get another geometry – Non Euclidean…" (participant 1)*

"The nucleus-basic consepts of the Euclidean geometry. The body – sum of triange engles 180 degerres. The periphery - spherical geometry, "Riemannian geometry"..." (participant 5, Figure 3)

Correct answers and successful performance on the assignment reflect the pre-service teachers' conceptual understanding. The cultural ontology, grounded in multiple theories and approaches, provided them with exposure to diverse definitions and connections across various geometries. These differences, along with the hierarchical structure of the discipline, were evident through the ontology database. Based on the pre-service teachers' responses, their views and perceptions of the nature of the knowledge they were learning underwent a noticeable shift.

4. Conclusion

This pilot research encompassed three stages, during which we observed the transformations undergone by pre-service high school mathematics teachers. Although the mathematical component of this course was challenging for them, the students (who were pre-service teachers) gained significant benefits from the cultural approach in several aspects:

1) They learned in an open-minded and cultural learning environment which will place the knowledge in context and see the holistic picture of knowledge and possible practical applications of the acquired theoretical knowledge in different related disciplines.
2) By mining the ontology, they explored intra- and inter-disciplinary relationships and were able to comprehend the foundations and evolution of theories and learn about cross-theory relationships.
3) They were exposed to a diversity of theories and viewpoints and learnt the grounds and reasons for similarities and differences between them.

This study is one among several that will soon follow, featuring a larger sample size, exploring various mathematical subjects, and addressing different research objectives.

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EXPLORING PRE-SERVICE ECONOMICS TEACHERS' PERCEPTIONS OF MICRO-TEACHING: INSIGHTS AND CHALLENGES IN TEACHER PREPARATION

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Abstract

Micro-teaching allows pre-service teachers to practice pedagogical skills through structured feedback. This qualitative case study explores third-year Economics pre-service teachers' perceptions of micro-teaching. Interviews with three participants revealed confidence building, enhanced content knowledge, and feedback-driven development as major benefits. However, limited resources and time constraints posed significant challenges. The findings recommend earlier integration and extension of micro-teaching sessions to enhance teacher preparation. These findings contribute to the discourse on the effectiveness of micro-teaching in Economics education and its potential to equip teachers for real-life classroom environments.

Keywords: *Micro-teaching, pre-service teachers, economic education, teacher preparation, qualitative case study.*

1. Introduction

Effective Economics education requires adequately trained educators. Challenges in South African Economics education include inadequate pedagogical content knowledge and insufficient training. Micro-teaching offers structured practice with constructive feedback, yet research on pre-service Economics teachers' perceptions remains limited. This study addresses this gap through Social Cognitive Theory (Bandura, 1986), focusing on self-efficacy and observational learning.

This study addresses this gap by examining the experiences of third-year pre-service Economics teachers at a South African university. By shedding light on the role of micro-teaching in fostering confidence, enhancing pedagogical competence, and addressing instructional challenges, this research aims to inform policy and practice in Economics teacher education. The findings contribute to the broader discourse on enhancing Economics education and provide actionable recommendations for strengthening pre-service teacher preparation, ultimately supporting the sustainability of the subject in schools.

The study responded to the following research questions:

1. What are the perceptions of pre-service Economics teachers regarding the role of micro-lessons in their teacher education?
2. What challenges do pre-service Economics teachers experience during micro-lessons?

1.1. Understanding micro-teaching in initial teacher education (ITE)

Micro-teaching is a focused and innovative teacher training technique designed to provide pre-service teachers with opportunities to practice and refine their pedagogical skills in a controlled, low-stakes environment (Lozgka, 2024; Reddy, 2019). Originating in the 1960s and developed by Dwight W. Allen, micro-teaching involves short, structured lessons presented to a small audience, often peers, followed by detailed feedback and reflection (Reddy, 2019; Bada & Akinbobola, 2022). This method allows novice teachers to develop essential teaching skills, such as lesson planning, classroom management, and effective communication, while bridging the gap between theoretical knowledge and practical application (Bakir, 2014; Reddy, 2019). For Economics education, where abstract concepts must be translated into engaging content, micro-teaching provides pre-service teachers with a unique opportunity to enhance subject-specific pedagogical skills and build confidence (Azizah & Rahmi, 2019).

The role of micro-teaching in initial teacher education is multifaceted. It provides a structured environment for pre-service teachers to experiment with teaching strategies, integrate pedagogical content knowledge, and receive constructive feedback (Laghari et al., 2021; Kroeger et al., 2024). This iterative

process—planning, teaching, observing, and reflecting—enables pre-service teachers to identify their strengths and areas for improvement (Fischetti et al., 2021). For Economics teachers, this methodology is particularly critical as it helps them develop strategies to communicate complex economic principles effectively and manage diverse classroom needs. Additionally, micro-teaching contributes to professional development by fostering essential self-reflection and encouraging evidence-based teaching practices, ensuring teachers are better prepared for real-world classroom challenges (Mufidah, 2019; Manzi & Moreeng, 2023).

1.2. Challenges pre-service teachers face in microteaching

Pre-service teachers encounter several challenges during microteaching that can hinder its effectiveness as a preparatory tool. Limited practice opportunities are a significant concern, as Hama and Osam (2021) noted, who argue that the restricted exposure pre-service teachers have to microteaching limits their readiness for real-world classroom scenarios. Moreover, the simulated nature of microteaching environments, which often lack real-life learners, constrains creativity and the application of diverse teaching strategies (Reddy, 2018). This artificial setting may lead to a disconnection between the skills practised during microteaching and the dynamic demands of actual classroom environments, leaving pre-service teachers inadequately prepared for real-life teaching challenges (Bada & Akinbobola, 2022).

Language barriers and performance anxiety are additional challenges that pre-service teachers frequently face during microteaching. Makafane (2020) highlighted that teaching a second language, such as English, often results in communication difficulties for pre-service teachers, leading to diminished confidence and effectiveness. Stage fright and anxiety, exacerbated by the requirement to perform in front of peers or supervisors, further impede their ability to deliver lessons effectively (Makafane, 2020). These factors collectively affect the ability of pre-service teachers to manage classrooms, develop engaging lessons, and establish rapport with their audiences. Such barriers can create a gap between their theoretical understanding and practical execution, complicating their transition from pre-service to in-service teaching roles (Manzi & Moreeng, 2023).

The challenges pre-service teachers face in microteaching underscore the need for further investigation into how these experiences influence their preparedness and perceptions of teaching. While existing literature explores microteaching as an effective tool for skill development, there is limited focus on the specific obstacles pre-service Economics teachers encounter (Mukuka & Alex, 2024). This gap necessitates studies like the present one, which aims to uncover the nuanced perceptions of pre-service Economics teachers regarding microteaching, shedding light on potential solutions to enhance its effectiveness and better prepare future educators for the realities of classroom teaching.

1.3. Theoretical framework

Social Cognitive Theory (SCT), developed by Bandura in 1986, highlights the reciprocal relationship between behaviour, cognition, and environment in shaping human learning and development (Govindaraju, 2021; Koutroubas & Galanakis, 2022). Central to SCT is observational learning, which explains how individuals acquire and maintain attitudes and behaviours through interactions with their environment and feedback mechanisms (Nwosu et al., 2022). A key component of SCT, self-efficacy, is particularly relevant to this study as it explores pre-service Economics teachers' confidence in their teaching abilities, which is shaped by mastery experiences, mediated learning, and feedback during micro-teaching sessions (Jenkins et al., 2018; Krcmar, 2020). Bandura's self-efficacy concept asserts that individuals' belief in their capabilities influences their motivation, persistence, and performance (Wilkerson et al., 2023), making it a crucial factor in understanding how pre-service teachers develop pedagogical skills. This framework provides insights into their classroom management strategies, teaching behaviours, and professional development, offering a lens through which the cognitive and environmental influences on pre-service teachers' engagement with micro-teaching can be examined (Luszczynska & Schwarzer, 2020).

2. Methodology and design

This study employed a qualitative approach within an interpretivist paradigm to explore pre-service Economics teachers' perceptions of micro-teaching. A case study design was chosen to facilitate an in-depth analysis of participants' lived experiences within a real-life educational context, enabling a nuanced understanding of their attitudes, challenges, and engagement with micro-teaching (Kumatongo & Muzata, 2021; Schoch, 2020). Purposive sampling was used to select three Bachelor of Education students enrolled in an Economics methodology module, ensuring participants had direct experience with micro-teaching. Data collection involved semi-structured interviews, allowing for detailed insights while exploring emerging themes flexibly (Moser & Korstjens, 2018). Thematic analysis was conducted following Braun and Clarke's six-step framework to systematically identify recurring patterns in the data,

including confidence-building, content mastery, and pedagogical challenges (Castleberry & Nolen, 2018; Dawadi, 2020). This methodological approach thoroughly explored how micro-teaching influences pre-service teachers' professional development and readiness for real-world teaching.

3. Results and discussion

3.1. Theme 1: Perceptions of pre-service economics teachers regarding micro-lessons

The study found that pre-service Economics teachers generally perceived micro-teaching as a useful preparatory tool that allows them to practice and refine their teaching strategies in a controlled environment. Participants described micro-teaching as a platform that helped them build confidence, structure their lessons effectively, and gain familiarity with classroom management techniques.

3.1.1. Confidence-building and skill development. Participants reported that micro-teaching was vital in increasing their confidence in lesson delivery. The simulated teaching experience allowed them to refine their teaching approaches and practice classroom engagement strategies in a controlled environment before real classroom exposure. Pre-service teachers described micro-teaching as:

> *It's very nice. It's like knowing something to a certain extent and then being able to practice it (PST1).*
>
> *It allows me to test my teaching strategies and see how students react (PST2).*
>
> *I feel more prepared to handle a real classroom after micro-teaching sessions (PST3).*

Participants also emphasised its role in refining their teaching:

> *I think micro-teaching is a form of preparation. It allows us to see what it would be like to teach in real life, even though it's not the same (PST1).*
>
> *Micro-teaching prepares us for how to conduct lessons and structure our teaching. And it teaches us how to organise a lesson from introduction to conclusion (PST2).*

This finding aligns with prior studies that emphasise the role of micro-teaching in improving self-efficacy (Jenkins et al., 2018).

3.1.2. Bridging theory and practice. Participants noted that micro-teaching served as an essential link between theoretical knowledge gained in coursework and its practical implementation in the classroom. The sessions helped them transition from understanding content to effectively communicating it to learners. It served as Kroeger et al. (2024) peers and supervisors, which helped them refine their teaching and lesson-delivery techniques. Pre-service teachers commented:

> *I think it's an improvement in my content knowledge and how to deliver the subject better. And the feedback we get from peers and lecturers is very useful in improving my teaching (PST1).*
>
> *Constructive feedback gave me insights into areas I need to work on (PST2).*
>
> *Understanding how to convey complex economic concepts became easier. It also helps us refine how we deliver subject content effectively (PST3).*

These perceptions align with existing literature highlighting the micro-lesson role in fostering pedagogical competence and self-efficacy, further reinforced by studies emphasising the benefits of feedback in teacher development (Bandura, 1986; Bakir, 2014; Kroeger et al., 2024).

However, some participants also felt that while micro-teaching was beneficial, it was not always sufficient in preparing them for real-life classroom challenges, as it did not fully replicate the challenges faced in actual classrooms. Pre-service teachers mentioned:

> *Micro-teaching helps, but it does not fully prepare us for dealing with real learners in a real classroom setting (PST2).*
>
> *It was not that bad, but it was not enough and should be more structured (PST3).*

3.2. Theme 2: Challenges Pre-service Economics teachers face during micro-lessons

Despite its perceived benefits, participants identified several challenges in micro-teaching that affected their ability to maximise the experience. The following sub-themes emerged:

3.2.1. Time constraints. A common concern among the pre-serve teachers was the limited time allocated for micro-lessons. They felt the sessions were too short to cover lesson content comprehensively and practice and refine their teaching skills effectively. The pre-service teachers noted that:

I feel like the time given is too short to deliver a proper lesson. (PST1).

I had to rush through my lesson and couldn't focus on student questions (PST2).

More time would allow better practice and feedback application (PST3).

This is consistent with research indicating that limited time in micro-teaching restricts experiential learning (Hama & Osam, 2021).

3.2.2. Classroom management and student engagement issues. The pre-service teachers found maintaining discipline and keeping students engaged during lessons challenging. They shared:

In class, class management and sometimes keeping the students engaged was difficult (PST1).

Students sometimes lose focus, and I struggle to bring them back (PST2).

Handling different learning paces in the same classroom is challenging (PST3).

These findings align with Reddy (2018), who identified classroom management as a critical hurdle for novice teachers.

3.2.3. Language barriers and student diversity. Language barriers emerged as a significant challenge, particularly in schools where English is the medium of instruction, yet students are more comfortable in their native languages. Some pre-service Economics teachers mentioned difficulty teaching Economics concepts due to language differences. They stated:

The policy only permits us to teach in English, but most students understand better in their mother tongue (PST1).

Explaining economic concepts in a way that students from different backgrounds can understand is difficult (PST2).

Some students struggle with English terminology, making engagement harder (PST3).

This challenge is well-documented in South African educational research, emphasising the need for multilingual instructional strategies (Makafane, 2020).

3.2.4. Formalities and rigidity in lesson planning. The pre-service teachers found the structured nature of micro-teaching sessions restrictive. They felt that the lesson planning process lacked flexibility and did not allow them to experiment with different teaching strategies. One pre-service teacher noted:

I wouldn't say I like the formalities. It would be better if we had more flexibility in lesson delivery (PST1).

4. Conclusion and recommendations

The findings of this study underscore the benefits of micro-teaching in enhancing pre-service Economics teachers' confidence, lesson planning, and pedagogical skills. However, several limitations hinder its effectiveness, including time constraints, a lack of real-world teaching exposure, and rigid lesson planning structures. Participants emphasised the need for extended session durations to allow for more practice and refinement of teaching strategies. Additionally, integrating real classroom environments with actual learners, rather than solely teaching peers, was suggested to better prepare pre-service teachers for real-world teaching challenges. Greater flexibility in lesson planning was also recommended to encourage experimentation with diverse teaching methodologies. These insights contribute to the broader discourse on improving teacher training programs and ensuring that micro-teaching adequately prepares educators for the complexities of the classroom.

To enhance the effectiveness of micro-teaching, several targeted improvements are proposed. Extending micro-teaching session durations will provide pre-service teachers with sufficient practice to refine their instructional techniques. Enhancing classroom management training by incorporating specialised student engagement strategies can equip teachers with essential skills to handle diverse learning environments. Integrating technological tools, such as digital teaching aids or simulation, can create dynamic micro-teaching environments and support interactive and practical lesson delivery. Implementing multilingual teaching strategies, including code-switching and bilingual instructional materials, can help bridge language barriers and improve comprehension. By adopting these recommendations, teacher training programs can optimise micro-teaching as a critical component of pre-service teacher education, ultimately improving the quality of Economics education and preparing future educators for successful classroom practice.

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ACTION RESEARCH AS A DRIVER OF PEDAGOGICAL INNOVATION: A COMPARATIVE STUDY OF ITALIAN AND SPANISH TEACHER EDUCATION MODELS

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Abstract

Scientific thinking skills (STS) are a foundational element in initial teacher education across disciplines, serving as essential prerequisites for creating an educational environment centered on co-generating meaningful experiential learning. These skills encompass the capacity to observe, analyse, document, evaluate and critically reflect on information. The integration of an interdisciplinary approach within the context of teacher education is identified as a pivotal element, thereby nurturing a socio-critical paradigm within the teaching-learning process. Action research is recognised as a particularly participatory and reflective methodology designed to foster positive change within specific contexts. Action research, as pioneered by Kurt Lewin in the 1940s, is a methodology that involves active participation from members of the relevant community or institution, facilitating collaboration through a cycle of planning, action, observation, and reflection. This iterative process is repeated until a practical, effective solution is reached, aiming to improve a given situation through systematically posing questions, planning, observation-based inquiry, analysis, rediscovery of prior knowledge, and the promotion of co-learning. The present study aims to compare the pathways for qualifying secondary school teachers in Italy and Spain, specifically examining whether and to what extent these programs incorporate and encourage the development of scientific thinking through the use of action research methodology. The overarching objective of this study is to enhance the teaching-learning process, thereby supporting the holistic development of individuals.[*]

Keywords: *Action research, pedagogical innovation, teacher training, comparative study, Italy, Spain.*

1. Introduction

The enhancement of scientific thinking is considered a pivotal objective in the context of effecting transformations in established educational practices. In this context, it is essential to adequately value action research so as to integrate it into the advancements of every scientific discipline and educational community, thereby contributing relevant knowledge to each educational pathway (Elliott, 2009).

In this contribution, we examine scientific thinking as a political, social, collective and strategic tool to safeguard the human rights of all individuals, thereby supporting the democratisation of knowledge. This perspective necessitates a critical examination of the contemporary promotion of scientific thinking in educational settings, particularly in the context of initial teacher training. The present study is anchored in the observation that recent years have been characterised by the growing influence of technology in almost every sphere of daily life.

This phenomenon underscores the importance of access to scientific and technical knowledge, which has become a crucial element and one of the primary factors in current inequalities. Scientific thinking is not confined to the academic sphere, but offers numerous advantages in daily life and in the comprehensive development of the individual. Scientific thinking has been shown to stimulate reasoning skills, promote the interconnection of simple and complex concepts, facilitate problem-solving in real-life situations, contribute to the construction of learning, enhance deductive capacities for strategy formulation, and improve perception of spaces, shapes, parts, and wholes. Consequently, scientific thinking is inextricably linked to the capacity for autonomous action and the navigation of daily challenges, thereby facilitating a more nuanced comprehension of the interrelationships among facts, concepts, causes, and effects (Ritchhart, 2015).

[*] This contribution is the synergetic fruit of the three authors. Specifically, Donatella Donato is the author of paragraph 1, Maria Concetta Carruba is the author of paragraph 2 and Alessandro Barca is the author of paragraph 3.

Educational communities are therefore under an obligation to play a fundamental role in promoting values such as democracy, solidarity, interdependence, responsibility, and, most importantly, critical thinking. As emphasised in numerous studies (Zulyusri et al., 2023), critical thinking not only fosters reflection but also demands social transformation within our communities. The development of academic models that effectively integrate research, teaching, and the connection between universities and society is becoming increasingly crucial. Such models must adopt a cooperative and interdisciplinary approach, facilitating the recovery of other forms of knowledge and competencies while enriching the necessary debates regarding higher education and universities. In this context, the issue of access to knowledge emerges as a pressing concern, as it is essential to protect knowledge as a public good to be equitably distributed across society in a free, collaborative, and, most importantly, non-commercial manner. This approach is identified as a pivotal factor in the effective mitigation of inequalities and poverty, while concurrently promoting and fortifying democratic participation (Salmon & Barrera, 2021). Action research is a methodological approach that combines the principles of scientific inquiry with the practical application of knowledge, thus offering a valid alternative for addressing both theoretical and practical issues. This methodology strengthens the connection between the creation and application of scientific knowledge, offering an integrated approach to social science practice. This approach examines its role in the functioning of human society and has been widely applied in various contexts, from education to community settings. Action research is regarded as an ideal form of scientific inquiry whenever there is a necessity to understand and transform a social reality. The term was first coined by Kurt Lewin in 1944 to refer to a type of research that combined the experimental approach of the social sciences with social action programs (Elliott, 1991; 2007).

This approach would achieve theoretical advancements and social change in a simultaneous manner. Lewin's model of action research is recognised as a methodological approach for the social sciences, and a wide range of approaches to its application have emerged from his concepts and applications. The foundation of Lewin's approach to action research is rooted in three fundamental elements that emerged from his oeuvre as a social researcher.

- Field theory;
- The notion that the most efficacious manner in which to study a system is to attempt to transform it;
- His interest in the application of social sciences to solving social problems.

The guiding principle for transitioning from one phase to another in the research cycle is exploration, evaluation and understanding of what emerges from action. The new cycle is defined by continuous analysis and information about the results of actions in specific contexts, thereby generating knowledge about change. The central proposition is, therefore, that of active science, integrating social action with the production of knowledge derived from such action. This approach does not seek to establish universal truths applicable to all contexts as rigid laws, but rather to investigate specific situations to generate practical and evolving knowledge.

Furthermore, interventions in the daily lives of individuals and groups are only justified when those involved wish to improve their reality. Consequently, science must open itself to the perspective of individuals, who are the true protagonists, and rely on their participation to understand reality. This requires sharing knowledge, recognizing limitations, conducting self-assessments, and relinquishing the position of power that knowledge can confer. We therefore consider action research fundamental in the context of education for multiple reasons. It enables critical reflection on teaching methodologies, fostering improvements based on concrete data. This process of self-reflection and continuous adaptation is essential for ensuring high-quality teaching standards. Additionally, through action research, teachers can identify the specific needs of their students and develop tailored teaching strategies. Such a student-centred approach fosters a more inclusive and effective learning environment. Action research has been shown to stimulate innovation, allowing classrooms to explore new teaching methods and techniques, potentially leading to significant discoveries that enrich the teaching-learning process (Efron & Ravid, 2019). It also promotes collaboration among educators, creating opportunities to share experiences and knowledge (Hine, 2013). This collaborative spirit can contribute to building a stronger and more cohesive educational community, supporting teachers' professional development by equipping them with advanced skills in research and evaluation. This enhancement of teaching practice is accompanied by the opening up of new professional perspectives. In summary, educators can utilise action research to design and evaluate targeted teaching interventions and to foster scientific thinking as the foundation of meaningful, experiential, and co-generated learning, enhancing the capacity to observe, analyse, document, evaluate, and critically reflect on information.

2. Action research in teacher qualification pathways in Italy and Spain

Action research is an increasingly valued pedagogical and formative methodology in teacher qualification pathways in both Italy and Spain. Empirical evidence has demonstrated its efficacy in promoting critical reflection and enhancing educational practices. This is achieved by directly involving teachers in research activities tied to their specific school contexts. However, the integration of action research into teacher training programmes varies between the two countries. The action-research methodology in teacher education systems in Italy and Spain is implicitly connected to educational and academic policies shaped by the context of globalisation and the Bologna Process. The Bologna Declaration of 1999 initiated a process that led to the establishment of the European Higher Education Area (EHEA), with the aim of standardising university programmes and professional qualifications across European countries. The Bologna Process has been interpreted as a form of academic "colonial planning" in Italy and Spain, a term used to describe the deliberate imposition of a particular educational model on a region or population, often with the aim of standardising educational practices and systems. The term "academic colonial plan" is intended to convey the notion that national educational systems have been adapted to meet supranational standards, which are designed to address global needs rather than local realities. This has resulted in the promotion of standardised training models that, in some cases, may dilute each country's cultural and educational specificities.

Italy: The university pathway for teacher qualification, including the master's degree, 24 CFU, and the new 60 CFU programme, aligns with European directives to standardize qualifications and professional access requirements. The CFU system follows the European Credit Transfer and Accumulation System (ECTS), ensuring international compatibility and recognition. Action research is integrated into mandatory internships and qualification pathways, influenced by Anglo-Saxon and European models that promote the teacher as a reflective practitioner, emphasizing a "technical" view of teaching.

Spain: Similarly, Spain's *Máster Universitario en Formación del Profesorado* is part of the European harmonisation framework, introduced through the Bologna Process. The MAES reflects European educational policies aimed at enhancing teacher training to improve competitiveness and education quality across the EU. It includes modules on educational research and action-research projects, aligning with European standards to produce teachers with an international profile and transferable skills within the European labor market.

2.1. Critiques of the colonial plan

- Cultural homogenization is evident in both educational systems, which have been influenced by training models and methodologies derived from diverse external sources. The adoption of training models and methodologies derived from different contexts has been observed in both educational systems, which may not always align with the cultural and social specificities of Italy and Spain.
- Regulatory dependency: National educational reforms are often shaped in response to supranational directives, leaving limited room for solutions tailored to local needs.
- Excessive standardisation: The harmonisation of university pathways and methodologies (including action research) risks reducing the diversity of educational approaches, and replacing local pedagogical traditions with standardised models imported from other contexts.

2.2. Italy

Action research has a significant presence in teacher education, especially during internships and practical experiences within qualification pathways. Primary Education Science Degree for teachers in early childhood and primary education: Action research is frequently integrated into the internship component of the Primary Education Science degree programme. Students are encouraged to design, implement, and evaluate educational interventions in partner schools, reflecting critically on their practices. This methodology is taught as a tool to observe, analyse, and improve teaching practices.

2.2.1. University qualification pathway (60 CFU) for secondary education. In the new qualification pathway that was introduced in 2022: Action research is emphasised in methodological-didactic training, particularly in the domains of lesson planning and assessment. The mandatory direct and indirect internship programme offers opportunities for the practical application of this methodology in real-world contexts, thereby fostering a reflective and critical approach.

2.2.2. Educational research projects. In Italy, action research is frequently promoted through collaborative endeavours between educational institutions, including schools and universities. I n-service teachers are encouraged to participate in educational research projects, for example, as part of professional development and continuous training programs. Action research is utilised to introduce innovative teaching strategies, particularly in areas such as inclusion, digital education, and sustainability education.

2.3. Spain

In Spain, action research occupies a central role in both initial and ongoing teacher training, largely due to the mandatory integration of educational research components in qualification pathways.

2.3.1. Máster Universitario en Formación del Profesorado (MAES). The MAES, a prerequisite for secondary school teachers, comprises the following modules: Modules dedicated to research methodology in education, where action research is presented as a key tool to improve teaching quality. The MAES culminates in the submission of a thesis, often requiring the application of an action-research project, where students must design, implement, and evaluate educational interventions based on observation and critical reflection.

2.3.2. School internship (prácticum). During the period of the mandatory internship: Students are encouraged to develop small-scale action research projects in their host schools, often in collaboration with school and academic tutors. The objective of this initiative is to cultivate the critical faculties of prospective educators, empowering them to discern the intricacies of the educational milieu, recognise deficiencies, and formulate action-oriented resolutions.

2.3.3. Continuous professional development. In the Spanish education system, the Ministry of Education and the Autonomous Communities promote action research as part of continuous teacher training. Teacher Training Centers (Centros de Formación del Profesorado, CEP) are responsible for the organisation of courses and workshops with a focus on this methodology. Furthermore, educational innovation projects frequently incorporate action research groups, thereby enabling teachers to develop new teaching strategies or address specific educational challenges.

3. Comparative analysis conducted

This study undertakes an analysis of the academic guides of programmes established in Spain and Italy for access to secondary education teaching at the lower and upper secondary levels. The objective of this study is to identify programmes that incorporate action research into initial teacher training. In Spain, the current legislation stipulates that access to regulated teaching professions in various areas of secondary education is contingent upon possession of a university degree or an equivalent qualification, in addition to pedagogical and didactic training at the master's level. The Master's in Secondary Education Teaching confers the professional qualification required by the Education Administration to teach in secondary education institutions, both public and private. The master's programme is structured into multiple specialisations, each of which is aligned with a distinct area of secondary education. The programme provides a thorough training curriculum for those aspiring to pursue a career in secondary education, in addition to offering distinct preparation in one of the professional domains.

The sources consulted for this research were the academic guides available on the Master's in Secondary Education Teaching programme website of the Universitat de València. The investigation conducted for this study focused on data collected between November and December 2024. The findings were meticulously organised into a series of tables, with each table addressing a distinct dimension outlined in the aforementioned guides: a) Summary; b) Previous knowledge; c) Competencies (RD 1393/2007); d) Learning outcomes (RD 822/2021); e) Content description; f) Teaching methodology; g) Evaluation; h) Bibliographic references.

An analysis of the course syllabuses for the 30 cfu qualification courses at Pegaso University reveals that the research-action methodology is not uniformly addressed in the teaching programmes of the competition classes. However, its presence is explicitly or implicitly referred to in some areas. For the sake of brevity, only those subjects in which the value of research action clearly emerges are listed here:

Experimental Pedagogy: Action research is evidently embedded within the programme, serving as a pivotal methodology for integrating practical action and critical reflection. This approach is described as central to improving educational processes and applying empirical and interpretive study models. Educational Methodologies and Technologies: Action research is addressed through the analysis of active teaching methodologies (e.g., cooperative learning, problem-based learning) and the use of educational technologies, demonstrating how these practices can be fertile ground for action research-based interventions. General Psychology: The course's objectives and content, including critical reflection on educational action, the iterative approach, and the management of complex scenarios, allude to the principles of action research.

In the field of Educational Psychology, the research methods covered in the course include approaches similar to action research. Design and Evaluation of School and Digital Systems: the course content includes empirical methodologies and case studies that demonstrate parallels with action research.

Finally, Special Pedagogy emphasises inclusive and operational strategies that align with the principles of action research applied to the educational context.

The analysis yielded several key findings, including the observation that numerous programmes make only indirect references to the value and importance of action research, without engaging in a thorough discussion of the subject. In conclusion, the following recommendations are proposed:

- The integration of action research in educational programmes should be promoted, emphasising its importance for improving educational quality and the active involvement of school actors.
- The link between action research and other methodologies, such as cooperative learning and problem-based learning, should be made explicit, encouraging methodological synergy.
- The practical application of action research should be encouraged through projects, workshops and case studies that involve the trainees themselves.

4. Conclusion and discussion

This comparison highlights how both countries incorporate action research into their educational systems, with some differences in implementation and emphasis. However, this choice is not solely driven by internal needs but is part of a broader supranational framework (the Bologna Process) that promotes the standardisation of training programmes according to a model of global governance in higher education. This framing within the academic colonial plan highlights how national education policies are often shaped by external directives, offering advantages (e.g. international mobility, shared standards) but also posing risks of overlooking local necessities and peculiarities. Action research is thoroughly embedded within the teacher training curriculum in both countries, though with certain distinctions: In Italy, its integration into teacher training is more closely tied to internships and school-based projects, with an increasing role in qualification pathways (particularly in the new 60 CFU programme). In contrast, in Spain, it is a core component of the MAES, where it assumes a formal and mandatory role, especially through the final thesis and educational research modules. In both systems, action research serves as a fundamental strategy to promote reflective and evidence-based teaching, adapting to the needs of diverse educational contexts.

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QUANTITATIVE ANALYSIS OF THE IMPACT OF HIGHER PROFESSIONAL TECHNICAL COURSES ON NEET YOUTH FROM VOCATIONAL EDUCATION PATHWAYS

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Abstract

This study examines the role of Higher Technical Professional Courses (CTeSPs) in addressing the NEET (Not in Education, Employment, or Training) issue among young people in Portugal, specifically those aged 16-34. Using data from the National Institute of Statistics (INE) and the Directorate-General for Higher Education (DGES), the research focuses on analyzing how CTeSPs offered by both public and private higher education institutions affect NEET rates. The study employs statistical techniques to explore the correlation between CTeSP participation and the reduction of NEET individuals. The results reveal that the CTeSPs offered by higher education institutions significantly contribute to the reduction of the NEET population. When analyzing the data separately for public and private offerings, it is evident that the reduction in the number of young people in this situation continues to decrease significantly with the increase in the number of available courses. The results suggest that CTeSPs play a crucial role in addressing youth unemployment and disengagement, emphasizing the importance of expanding these programs. The study advocates for the reinforcement of public course offerings within these areas to further reduce NEET rates.

Keywords: *NEET (not in education, employment, or training), CTeSPs (higher professional technical courses), education, youth.*

1. Introduction

In Portugal, the increase in the total number of students in higher education is particularly related to the creation of short higher education courses, such as the Higher Professional Technical Courses - CTeSP (Heitor, 2022).

Higher Professional Technical Courses were initially regulated by Portuguese law with Decree-Law No. 43/2014, of March 18, with the aim of offering an alternative to university education, focused on practical and specialized training. CTeSP is a higher education cycle that does not award an academic degree, with 120 ECTS credits and a duration of two years, the successful completion of which leads to the award of a higher professional technician diploma (DGES, 2024). According to Decree-Law No. 43/2014, this training offer aims to: "a) ensure that the graduate has comprehensive, specialized, factual and theoretical knowledge, in a specific area of study or work, and awareness of the limits of this knowledge; b) provide the graduate with a comprehensive range of cognitive and practical skills necessary to design creative solutions to abstract problems; c) develop the graduate's management and supervision skills, in study or work contexts subject to unpredictable changes, and to review and develop their own performance and that of third parties".

These courses (CTeSP) can be a viable option for young people who fall into the NEET category, offering them the opportunity to acquire specific skills and improve their employability.

The term NEET - Not in Education, Employment, or Training - demonstrates a complex approach, being a definition studied across various age groups, including those between 15 and 24, 29, or 34 years old (Eurostat, 2024; INEa, 2024). In the context of the Europe 2020 Strategy, the European Commission introduced the NEET rate (Young people Neither in Employment nor in Education and Training) to monitor trends in youth labor market participation and facilitate comparisons between European Union member states (INE, 2013). The NEET term has become increasingly popular in discussions on labor market issues and the challenges of integration and marginalization faced by young people (IOL, 2015; Mussida & Sciulli, 2018; Mussida & Sciulli, 2023). Therefore, NEET refers to young people who are not engaged in education,

employment, or training programs. Over time, the concept has been widely studied in both public policies and academia, undergoing significant changes (Alonso et al., 2022; Mascherini, 2019).

Eurostat (2024) examined the situation of NEET youth in Europe, emphasizing the importance of ensuring a smooth transition from education to work for these young people, while also highlighting the risks of being neither employed nor engaged in education or training. The study concludes that in 2023, 11.2% of young people aged 15 to 29 in the European Union were neither in employment, education, nor training. The situation is more favorable for Portugal, where the lowest rates, already below the 9% target, were also observed in the Netherlands, Sweden, Malta, Slovenia, Ireland, Luxembourg, Denmark, Germany, and Portugal. These countries thus reached the long-term EU target for 2030 as early as 2023 or even earlier.

2. Design

This research follows a quantitative approach, based on analysing secondary data from the National Institute of Statistics and the Directorate-General for Higher Education. The aim is to assess the impact of Higher Technical Professional Courses on reducing the number of young people who neither study nor work.

The data was selected from official statistical databases, considering the number of indicators related to the rate of young NEETs and the implementation of the CTeSP, in a generalised way and then analysing it in terms of public and private higher education provision. For the analysis, descriptive and inferential statistical techniques were used, namely correlations, allowing trends and possible relationships between the expansion of the CTeSP and the variation in the NEET population to be identified.

3. Objectives

The main aim of this study is to analyse the impact of Higher Technical and Professional Courses on reducing the number of young people who neither study nor work in Portugal.

More specifically, the aim is to:

1. Identify the evolution of the rate of young NEETs and the performance of CTeSP courses since their creation in 2014;
2. Assess whether the CTeSP offer contributes to reducing the rate of young NEETs;
3. To assess whether the CTeSP offer in public and private higher education contributes equally to the reduction of young NEETs;
4. Contribute to reflection on the effectiveness of vocational education policies as a promoter of reducing youth unemployment and further education.

4. Methods

For the analysis carried out, the most recent data (last trimester of 2024) was taken into account, by NUTS II: rate of young people aged between 16 and 34 not in employment who are not in education or training (INE data), employment rate by age group (INE data) and number of Higher Professional Technical Courses registered with the Directorate-General for Higher Education (DGES data). Then, available by institution, were later grouped by NUTS II and by type of offer, i.e. public or private higher education. Finally, descriptive statistics techniques were applied, the normality of the data was checked and the inferential methodology of Spearman and Pearson correlation was used. The NUTS II in Portugal are intermediate-level territorial units for statistical and regional planning purposes, dividing the country into five regions: North, Center, Lisbon Metropolitan Area, Alentejo and Algarve, as well as the Autonomous Regions of the Azores and Madeira.

5. Results and discussion

To answer the question about the evolution of the rate of young NEETs and the performance of CTeSP courses since their creation in 2014, it is necessary to examine a few key points: the evolution of the rate of young NEETs (*Table 1*), the number of students enrolled in CTeSP courses offered by public and private higher education institutions (*Table 2*), as well as the number of CTeSP courses by NUT II- Northern, Centre, Lisbon Metropolitan Area, Alentejo, Algarve, Azores Autonomous Region and Madeira Autonomous Region (*Table 3*).

The analysis of NEET from 2014 to 2024 reveals a national trend of reduction, falling from 15.3% in 2014 to 9.2% in 2024. Regionally, the Centre region stands out, with the lowest NEET rate in 2024 at 7.8%, showing consistent improvement from 12.7% in 2014. The Northern region also saw a significant

reduction, dropping from 15.6% in 2014 to 9% in 2024. However, the Algarve region presents a more challenging reality, with the highest NEET rate in 2024 at 11.4%, possibly reflecting difficulties related to the seasonality of tourism and the lack of stable jobs for young people. The Azores and Madeira regions continue to have the highest NEET rates, with the Azores remaining around 12.9% in 2024, although showing a slight decrease. These data indicate that, despite the progress, there are still significant challenges in some regions of Portugal, particularly in the islands and the Algarve, where access to education and employment opportunities remains a critical factor - *Table 1.*

Between 2014 and 2021, the total number of students enrolled in polytechnic higher education, both public and private, showed continuous and significant growth. Public polytechnic higher education, which started with 345 students in 2014-2015, reached 12.742 students in 2020-2021, demonstrating a substantial increase. On the other hand, private polytechnic higher education, with just 50 students at the beginning, reached 4.348 students in 2021. Despite the growth in the private sector, the public sector still holds a dominant share, although the gradual increase in enrolment in private higher education shows a trend of expansion - *Table 2.*

Table 1. Evolution of the rate of young NEET by place of residence (NUTS II) based on the 4th quarter of each year.

NUT II/ Year	2014 (%)	2015 (%)	2016 (%)	2017 (%)	2018 (%)	2019 (%)	2020 (%)	2021 (%)	2022 (%)	2023 (%)	2024 (%)
Portugal	15,3	14,4	13,7	11	10,4	10	10,9	10,4	10,2	10	9,2
Northern	15,6	14,8	13,3	11,6	9,5	8,3	9,9	9,6	10	10,1	9
Centre	12,7	13,6	12,9	9,4	9,8	9,5	9,7	9,9	10,1	9	7,8
Lisbon Metropolitan Area	13,7	11,9	12,8	9,6	9,5	10,4	10,3	10,4	8,8	9,2	9,2
Alentejo	18,1	14,2	13,4	12	14,3	12,6	8,9	10,1	10,5	10,2	11,3
Algarve	18,2	19,8	17,6	12,9	13,4	12,3	18,4	12,8	14,5	13,1	11,4
Azores Autonomous Region	25,7	22,1	21,8	20,9	19,6	17,2	20,7	20	16,5	16,5	12,9
Madeira Autonomous Region	25	23,6	20,4	15,5	14,6		21,2	13,4	14,7	13,3	10,7

Source: INE (2024b)

Table 2. Evolution of the total number of students enrolled in CTeSP, excluding international mobility.

Higher Education Institution/ Years	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Public Higher Education – Polytechnic	345	5369	9168	10169	11753	12998	12742
Private Higher Education – Polytechnic	50	1061	1880	2608	3668	4383	4348
Total	**395**	**6430**	**11048**	**12777**	**15421**	**17381**	**17090**

Source: DGEEC- RAIDES (2017-2018; 2019-2020)

To address objectives 2 and the remaining ones, we need to analyze *Table 2* and the following. As can be seen in *Table* 2, there are 1.109 CTeSPs spread across the country, with the highest concentration of courses in the Northern region (35%), followed by the Centre (31.1%), Lisbon Metropolitan Area (17.6%), Alentejo (10.4%), Algarve (3%), Madeira Autonomous Region (2.3%), and Azores Autonomous Region (0.5%). Regarding public higher education, the Centre (40%) has the highest prevalence of CTeSP offerings, while the Azores Autonomous Region (0.8%) has the lowest. In the private sector, the distribution is notably different, with the northern region (52.4%) offering the highest number of CTeSPs, contrasted by 8.6% in the Centre, and no offerings in the Azores Autonomous Region. As for the NEET rate, the Azores Autonomous Region has the highest rate (12.9%), while the Centre has the lowest (7.8%). It is worth noting that four regions (Alentejo, Algarve, Azores Autonomous Region, and Madeira Autonomous Region) have NEET rates above 9%, which is the national average for Portugal.

Table 3. Number of CTeSPs; Number of CTeSPs by Public and Private Higher Education; NEET Rate; Youth Employment Rate.

	CTeSP (total offer)		CTeSP (Public H. E.)		CTeSP (Private H.E.)		NEET	Youth Employment
	Nº	%	Nº	%	Nº	%		
Northern	**389**	35.08%	225	28.27%	164	52.40%	9%	56,3%
Centre	**345**	31.11%	318	39.95%	27	8.63%	7.8%	54%
Lisbon Metropolitan Area	**195**	17.58%	100	12.56%	95	30.35%	9.2%	58,8%
Alentejo	**115**	10.37%	99	12.44%	16	5.11%	11.3%	54,6%
Algarve	**33**	2.98%	30	3.77%	3	0.96%	11.4%	57,8%
Azores Autonomous Region	**6**	0.54%	6	0.75%	0	0.00%	12.9%	58,8%
Madeira Autonomous Region	**26**	2.34%	18	2.26%	8	2.56%	10.7%	56,3%

Source: DGES (2024); INE (2024a)

The results obtained through Pearson's and Spearman's correlations indicate a significant association between the offer of CTeSPs and the reduction of the NEET rate. The negative correlation observed between the number of available CTeSPs and the NEET rate suggests that as the offer of these courses increases, the number of young people in this situation decreases. Specifically, the correlation between the total number of CTeSPs and the NEET rate showed a value of $R_P = -0.875$, with a p-value of 0.010, indicating a strong and statistically significant association between these two variables. This suggests that an increase in the offer of CTeSPs may have a considerable positive impact on reducing the NEET rate, supporting the idea that vocational education can serve as an effective tool to reintegrate young people into the educational system or the labor market. When analyzing the public and private offers of CTeSPs separately, it is observed that both sectors significantly contribute to the reduction of the NEET rate. For public higher education institutions, the correlation was $R_P = -0.869$ with a p-value of 0.011, showing a strong and significant relationship between the increase in the offer of CTeSPs and the reduction of the NEET rate. This result suggests that public institutions play a crucial role in decreasing educational and professional exclusion among young people. On the other hand, the correlation for private institutions, with $R_S = -0.857$ and p-value of 0.014, also showed a significant relationship, albeit slightly weaker, indicating that the private offer of CTeSPs also plays a relevant role, but with a somewhat smaller impact compared to the public sector- *Table 4.*

Table 4. Correlation between the NEET rate and the offer of CTeSP courses.

Total Number of CTeSPS	$R_P = -0,875$ $p = 0,010$
Number of CTeSPS (Public Higher Education)	$R_P = -0,869$ $p = 0,011$
Number of CTeSPS (Private Higher Education)	$R_S = -0,857$ $p = 0,014$

Source: own elaboration

6. Conclusions

The term NEET has been widely debated by both academia and various governments, as young people play a crucial role in ensuring the functioning of the economy and the sustainability of the state. Their relationship with short-duration training programs within higher education in Portugal, although recent, needs to be increasingly explored. This type of offer presents an important opportunity to reduce the rate of young people who are not engaged in education or the labor market, serving as an incentive for their reintegration into education or productive activities.

These findings reinforce the idea that the expansion of higher professional technical courses, both in the public and private sectors, could be an effective strategy for reducing the NEET rate. The strong association between the offer of CTeSPs and the reduction of this rate suggests that higher vocational education could be an effective response to mitigate youth unemployment and promote the qualification of young people for the labor market, while also offering opportunities for continuous education.

However, it is important to highlight that, although the correlations show a significant relationship, other factors may influence the results, such as the quality of the courses offered, the alignment of training

with labor market needs, accessibility, and the support provided to students. Therefore, public policies aimed at vocational education should be accompanied by ongoing analysis of the supply and demand for skills in the labor market to ensure that CTeSPs are aligned with the socio-economic context and contribute effectively to reducing the NEET rate.

Based on the results presented, it can be concluded that the offer of CTeSPs plays a crucial role in reducing the NEET rate, both in public and private higher education. The strong correlation between the offer of courses and the decrease in educational and professional exclusion suggests that public policies encouraging the expansion of higher vocational education could be an important tool in combating youth unemployment and promoting the qualification of young people for the labor market.

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SCAFFOLDING IN-SERVICE SCIENCE TEACHERS FOR DEVELOPING EPISTEMIC EMPATHY

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Abstract

Epistemic empathy refers to understanding and appreciating someone's cognitive and emotional experiences during an epistemic activity that involves constructing, communicating, and critiquing knowledge (Jaber et al. 2018). To foster a greater understanding of epistemic empathy among primary and lower secondary education teachers, a training program was implemented during the past schooling year 2023/2024. The program was designed to develop new habits in teaching practices by encouraging educators to adopt the Investigative Science Learning Environment (ISLE) approach, in their science classrooms. This initiative, supported by research from Etkina et al. (2017; 2023) and Brookes et al. (2020), aims to create effective and engaging inquiry-based learning experiences for students in the field of science. In this research, we aimed to achieve two key objectives. First, we sought to highlight the connection between the development of new habits and the concept of epistemic empathy, aligning the two frameworks. Second, we explored the degree to which the teachers participating in our training program became aware of these developments. We examined their reflections and insights regarding the relationship between habit development and empathetic understanding in their teaching practices. To accomplish our objectives, we conducted a comprehensive survey at the conclusion of the program. We meticulously analyzed the responses provided by the teachers, carefully examining how the various activities they engaged in aligned with and contributed to the attainment of the training program's goals. This in-depth analysis allowed us to draw meaningful connections between their experiences and the overall effectiveness of the training initiatives. Here we present the key findings of our analysis and how they reflect the alignment of the two frameworks for the professional training of in-service science teachers. We eventually turned our attention to how a program centered on epistemic activities can positively contribute to teachers' development of new and effective habits.

Keywords: *Epistemic empathy, inquiry-based learning, teacher professional development, habits of practices.*

1. Introduction

The concept of Epistemic Empathy refers to a teaching approach that requires educators to value the cultural, emotional, and linguistic resources and experiences of students in science and mathematics education, promoting inquiry and problem-solving (Warren et al., 2001).

Responsive teaching promotes autonomy, equitable participation, and active student engagement through an instructional approach that values and understands students' cognitive and emotional experiences in the learning process (Jaber et al., 2018; Jaber, 2021), fostering a more inclusive and equitable STEM education (Gutiérrez & Rogoff, 2003).

The main challenge of responsive teaching is recognizing and valuing students' unconventional insights, even when they deviate from accepted knowledge (Warren & Rosebery, 1996). This process requires teachers not only to have disciplinary expertise but also to actively listen and interpret students' thinking without forcing it into predefined frameworks (Hammer et al., 2005). In this context, epistemic empathy emerges as a crucial resource, helping teachers step outside their own perspectives to understand students' cognitive and emotional experiences and support authentic learning (Jaber et al., 202). Epistemic empathy is fundamental to this process as it involves not just recognizing students' ideas but also understanding how they make sense of them, both intellectually and emotionally (Jaber et al., 2018).

Empathy in education is often considered crucial for teacher-student relationships and awareness of students' cultural and social experiences (McAllister & Irvine, 2002; Tettegah & Anderson, 2007). However, research has overlooked its epistemic dimension, i.e., how teachers empathize with students'

cognitive experiences when formulating and discussing ideas. Epistemic empathy helps teachers value students' reasoning, even when it deviates from expectations, and recognize emotions related to the learning process (Sikorski, 2016).

This perspective promotes an approach based on students' strengths, treating them as competent thinkers and valuing their contributions (Gutiérrez, 2013). Additionally, epistemic empathy can foster more equitable learning environments by distributing power and authority, so that students feel actively involved in constructing knowledge (Segal & Wagaman, 2017).

With the present study, we aim to contribute to theoretically aligning the framework of epistemic empathy (Jaber et al., 2024) with one for developing new habits (Etkina et al., 2017) and to conduct an investigation utilizing a mixed-method research approach aimed at assessing the effectiveness of our training program in enabling teachers to achieve this objective.

2. Responsive teaching from a socio-constructivist perspective

Rather than viewing the body of canonical knowledge as the sole goal, responsive teaching starts from students' reasoning and values it, while also nurturing the disciplinary practices of learning (Hammer et al., 2012).

The socio-constructivist approach views learning as an active process in which students are actively involved in constructing knowledge, acting as epistemic agents who take responsibility for disciplinary norms and dispositions (Bruner, 1992; Fleer, 2015; Fragkiadaki et al., 2021; Stroupe, 2014). The learning context becomes the site of knowledge construction, where students do not simply learn things because information is transmitted to them, but they learn through observation, inquiry, and discovery (Scardamalia & Bereiter, 2014). Teaching practices must therefore evolve in this direction to facilitate students in this process and embrace ideas and initiatives that emerge from the group.

Students are seen as bearers of resources, and the teacher's task is to explore and provide space for these resources, supporting students' curiosity and initiative. Disciplinary knowledge is not evaluated based on conformity to a predetermined learning goal but is gradually built starting from students' initial ideas and progressively enriched and supported by the teacher in a responsive manner (Richards & Robertson, 2016).

Research shows that responsive teaching can support disciplinary learning: it values the contribution of all students by recognizing that everyone is capable of constructing meaning while also giving students responsibility and placing them at the center of their learning journey (Scardamalia, 2000; Coffey et al., 2016).

3. Professional development of teachers

Promoting a responsive teaching approach requires teacher training that starts by considering teachers' initial conceptions about teaching scientific disciplines (Robertson & Richards, 2017). Shifting from a traditional knowledge transmission-based pedagogy to an approach based on the active construction of knowledge by students undoubtedly requires a significant shift in perspective, as well as a space for reflection and experimentation that allows teachers to reflect on their practices and find guidance in experimenting with different approaches (Radoff et al., 2018).

Training pathways should be designed to provide teachers with both conceptual knowledge about innovative teaching and experiential learning paths, where they can test practices that equip them with tools to manage classroom activities (Kennedy, 2006; Thompson et al., 2013; Cartier et al., 2013; O'Connor & Michaels, 2019).

Literature highlights that one of the effective strategies for teacher training involves experiential learning, where teachers are directly involved in scientific inquiry, experiencing the teaching activity as if they were students, while trainers model responsive teaching, encouraging teachers to develop activities based on their own questions and explorations (Atkins & Frank, 2016; Dini et al., 2021; Hammer & Van Zee, 2006). This approach helps teachers recognize and value the emerging scientific thinking of students (Watkins et al., 2017, 2020).

The Development of Habits through Cognitive Apprenticeship (DHAC) framework effectively includes the features mentioned earlier (Etkina et al., 2017; Etkina & Planinsic, 2024). It has been well-tested in both in-service and pre-service teacher training programs focused on incorporating the ISLE approach into teaching practices.

In this study, we aimed to theoretically understand the alignment between the Epistemic Empathy teaching approach and the implementation of ISLE. The tasks of teaching (Ball et al., 2008; Etkina et al., 2017) involved when adopting this approach in classrooms are intertwined with the one emphasized in the epistemic empathy framework. Table 1 summarizes the connections between the two frameworks. This

connection prompted us to adopt the DHAC framework for the professional development of in-service science teachers, focusing on enhancing their epistemic empathy in relation to the ISLE teaching adoption.

Table 1. Epistemic empathy and DHAC frameworks alignments.

Epistemic Empathy (Jaber et al., 2024)	**Tasks of Teaching adopting the ISLE approach** (Etkina et al., 2018; Etkina & Planinsic, 2024)
Noticing and appreciating students' epistemic affect *(Recognizing students' intellectual and emotional engagement in learning, such as excitement, frustration, or curiosity)*	Recognising student interest and motivation around particular science content and practices
	Engaging all students to express their thinking about key science ideas and encourage students to take responsibility for building their understanding, including knowing how they know
	Developing a climate of respect for scientific inquiry and encourage students' productive deep questions and rich student discourse
	Encouraging broad participation to ensure that no individual students or groups are marginalised in the classroom
	Engaging students in meta-cognition and epistemic cognition
Explaining and justifying students' lines of reasoning *(Seeking to understand and clarify why students think in a certain way, even if their reasoning is unconventional or incomplete)*	Helping students consider multiple alternative approaches or solutions, including those that could be considered to be incorrect
	Encouraging students to explain features of representations and models (their own and others') and to identify/evaluate both strengths and limitations
	Encouraging students to create, critique, and shift between representations and models with the goal of seeking consistency between and among different representations and models
	Modelling scientific approaches to explanation, argument, and mathematical derivation and explain how they know what they know
Identifying merits in students' ideas *(Finding the productive beginnings in students' thinking, even if it's not fully correct yet)*	Eliciting student understanding and help them express their thinking via multiple modes of representation
	Employing multiple strategies and tools to make student thinking visible
	Interpreting productive and problematic aspects of student thinking and mathematical reasoning
	Providing students with descriptive feedback
Anticipating students' ideas or feelings *(Predicting common misconceptions or struggles students might have and preparing ways to support them)*	Anticipating specific student challenges related to constructing scientific concepts, conceptual and quantitative reasoning, experimentation, and the application of science processes
	Addressing learners' actual learning trajectories by building on productive elements and addressing problematic ones
	Designing or selecting and sequencing learning experiences that focus on sense-making around important science concepts and practices, including productive representations, mathematical models, and experiments in science that are connected to students' initial and developing ideas
	Using interpretations of student thinking to support instructional choices both in lesson design and during the course of classroom instruction
Expressing curiosity and interest in students' reasoning *(Demonstrating genuine interest in how students think rather than just whether they are "correct")*	Prompting students to collectively generate and validate knowledge with others
	Encouraging broad participation to ensure that no individual students or groups are marginalised in the classroom
	Scaffolding learner flexibility and the development of independence
	Promoting negotiation of shared understanding of forms, concepts, mathematical models, experiments, etc., within the class
Channeling personal experiences to connect with students' intellectual and emotional experiences *(Reflecting on one's own learning struggles and using them to empathize with students)*	Creating opportunities for students to use science ideas and practices to engage real-world problems in their own contexts
	Helping students make connections between their collective thinking and that of scientists and science communities
	Making explicit distinctions between science practices and those of everyday informal reasoning as well as between scientific expression and everyday language and terms
	Providing opportunities for students to pose their own questions and investigate them experimentally

4. Methodology

We engaged a group of 75 teachers from primary and low secondary education in a training program designed to familiarize them with the ISLE approach. The course was organized into three modules: a starting module, an intermediate module, and an advanced module, with each one lasting four hours. Then, teachers could adopt the ISLE activities in their classes, sometimes being tutored or coached by a trainer researcher. In total, approximately 80 classes participated in these activities- half tutored and half coached- resulting in 229 hours of teaching practice focused on ISLE.

We followed a structured procedure to evaluate the impact of the training program and its effect on teachers' development of new habits. We created a comprehensive survey aimed at capturing various aspects of the training program. This included questions on teachers' self-assessment of new habits, their engagement throughout the training, and perceived changes in their teaching practices. We identified a representative sample of teachers who participated in the training program (54 participants over 75). This ensured that our results would reflect a broad range of experiences and perspectives. The survey was distributed to the selected teachers through an online platform. We encouraged participation by emphasizing the importance of their feedback in shaping our research project. Once the responses were

collected, we conducted a thorough analysis to identify trends, patterns, and correlations. This included quantitative analysis of scaled questions and qualitative analysis of open-ended responses. The analysis was conducted using AILYZE software (www.ailyze.com, 2025, AILYZE Inc.), employing an inductive approach to identify themes across the entire dataset. This method avoids the limitations of traditional coding by capturing broader themes and complex discussions, ensuring consistent theme detection and speeding up the analysis process. Finally, we synthesized the data into a report that outlines the training program's effectiveness in facilitating new habits among teachers. This procedure ensures a systematic approach to evaluating the program and provides valuable insights into its effectiveness.

5. Discussion and conclusions

As a first insight, the key findings reveal significant changes in teaching practices among educators. A notable emphasis has been placed on encouraging conceptual construction grounded in observation, with 68.1% of respondents highlighting this approach. Additionally, the promotion and explicit formulation of hypotheses and the use of hypothetical-deductive reasoning have also been prioritized, with the same percentage of 68.1% reporting this shift.

This is aligned with the feature of epistemic empathy of recognizing students' intellectual and emotional engagement in learning, such as excitement, frustration, or curiosity (Jaber et al., 2024). Furthermore, the high adoption of supporting students' intuitive ideas (57.4%) reflects a commitment to understanding their reasoning, even when incomplete. This aligns with the idea that teachers should explore why students think a certain way, assisting them in refining and justifying their thought processes rather than dismissing unconventional reasoning.

A key change is the emphasis on experiment design to test hypotheses, identified as critical by 63.8% of educators. This highlight leveraging students' initial, albeit imperfect, thoughts to foster scientific inquiry, recognizing that their thinking holds valuable insights worth exploring. Interestingly, only 10.6% of teachers reported a stronger focus on anticipating students' difficulties.

The ISLE approach promotes responsive teaching, but there are gaps in anticipating students' struggles. Addressing this could enable teachers to offer better support for common misconceptions and emotional barriers to learning. The ISLE training appears to have strengthened teachers' ability to notice, validate, and build upon students' reasoning processes. However, there is room for growth in anticipating students' struggles and intuitive resources, which could further enhance their ability to provide targeted support..These preliminary results suggest that our training program effectively develops new habits and enhances teachers' epistemic empathy.

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STUDENT-CENTERED APPROACHES IN PRESERVICE TEACHER ASSESSMENT: VOICES AND EXPERIENCES FROM ZIMBABWEAN TEACHER-TRAINING COLLEGES

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Abstract

The concept of educational assessment in the digital age has practitioners grappling with what works for the current era. This paper explores the implementation of student-centered approaches in pre-service teacher assessments, focusing on the experiences and voices of student teachers in Zimbabwean teacher-training colleges. As teacher education evolves towards the demands of 21st-century classrooms, an increasing emphasis on participatory and reflective assessments that align with diverse needs of student teachers is evident globally. This study explores student-centered assessments vis-à-vis its contribution to professional growth and alignment with Zimbabwe's Education 5.0 framework, which emphasizes innovation and competency-based education. A hybrid framework that combined connectivism and transformative learning theory informed the study. Using a qualitative research design, the study gathered data through semi-structured interviews, focus group discussions and document analysis involving preservice teachers and administrators from five teacher training institutions in Zimbabwe. The findings reveal that while student-centered assessments, such as peer reviews, self-assessments, and portfolio-based evaluations, foster critical thinking, self-reflection, and collaborative learning, challenges such as inadequate resources, lack of consistency, and resistance to change, hinder their effective implementation.

Keywords: *Educational assessments, Education 5.0, collaborative learning, self-assessment, pre-service teachers.*

1. Introduction

Assessment is a critical concept in the shaping of learners at all levels of learning. For teacher education, assessment is a tool that affects professional competences of preservice teachers (Alt & Raichel, 2022). From the traditional pedagogical perspective, assessment for teacher education was essentially tutor-driven, based on summative evaluation and standardized tests (Asad & Malik, 2023). These assessment models have lost compatibility with the demands of the 21st century requisite skills for graduates and have lost alignment with global trends in teacher education curricular (Nobutoshi, 2023). Worldwide, higher education in teacher training is calling for models of assessment that focus on competency-based models that have student-centered approaches involving reflection and are participatory in nature (Rodrigues, 2023; Morgan, 2024; Asad & Malik, 2023.). The idea is to make students actively engage in their own development and progress.

Higher education curricular on teacher training is experiencing a paradigm shift globally towards learner driven models of assessments, centered on collaboration, self-regulation, critical thinking and reflection (Rajaram, 2023; Sosibo, 2019; Nobutoshi, M. (2023). Curricular are leaning more towards a constructivist model of teaching and learning for enhanced student-centered pedagogy. Assessment is one of the three pillars of the education system besides curriculum and pedagogy (Coombs et al, 2018), as such it plays a critical role in pedagogical processes. Therefore, arbitrary assessment implementation results in poor products (Alt & Raichel, 2022). This has actuated the modifications of assessment models which are seen around the world and Zimbabwe is no exception (Fahad, 2023; Alt & Raichel, 2022; Ministry of Primary and Secondary Education (MoPSE), 2024).

1.1. Philosophy and assessment

Zimbabwe's Education 5.0 built upon the Heritage-based phylosophy that explains how the country's total heritage should inform innovation and industrialization for economic growth (Muzira & Muzira, 2020). An educational philosophy is critical in the shaping of assessment even for teacher education as it guides the designing process, implementation and the subsequent evaluation of the

assessment methodologies for desired outcomes (Shakemore et al., 2023). An educational philosophy influences assessment focus, whether its traditional methods of rote learning or its collaborative or technology integrated. The Heritage-based 5.0 Education has constructivist aspects and emphasizes portfolio evaluations, formative assessments and reflective journals (Mwembe & Moyo, 2024). Additionally, it has Afrocentric, student –centered elements running through it which advocate culturally relevant assessment models cognisant of diverse pedagogical contexts (Ndebvudzemene, 2020). Thus, Education 5.0 demands assessment methods that not only test skills and knowledge but prepares student teachers to be competent, responsive and reflective, which skills are 21st century compliant (Mwembe & Moyo, 2024). This study asserts that through the engagement of formative assessment models, trainees are nurtured into self-regulated, adaptable and collaborating tech-survey teachers. Coupled with contextualized practical assessments, it ensures alignment with Zimbabwe's educational goals that are for innovation and industrialization for economic development as espoused by vision 2030 (Ndebvudzemene, 2020).

2. Theoretical framework

A hybrid framework that combined connectivism and transformative learning theory informed the study. Connectivism was developed by George Siemens and Stephen Downes in 2009 as a theory for digital learning based on the belief that knowledge exists in the world rather than in the head of an individual (Ottestad, 2013). They argued that learning is a process of creating and navigating knowledge networks through social and digital connections (Siemens & Downes, 2009). Transformative learning theory on the other hand is an andragogical theory developed by Jack Mezirow (1923 -2014) in the late 20th century. The theory focused on how learners engage in critical reflection on their experiences to change their perspectives for innovation in both skills and thinking processes (Klein & Wikan, 2019). The emphasis in this theory is on self-examination through deep reflective thinking especially on assumptions that lead to significant changes in understanding and reorientation and new perspective adoption (Klein & Wikan, 2019). Both connectivism and transformative learning align well with the Zimbabwean Heritage –based curriculum and Education 5.0 as they advocate shifting from traditional rote learning models to critical thinking, ICTs, problem solving, innovative education (Downes, 2012; Mabwe & Mabhanda, 2023). In assessing trainee teachers, the theory supports the equipping of future teachers with skills for practical knowledge in diverse classrooms through collaborative learning and real-world application of digital tools for pedagogy.

3. Methodology

The study used a qualitative methodological research design informed by phenomenology as it is ideal for the study aim of exploring the perceptions and lived experiences of preservice teachers vis-à-vis student centered assessment. (Gill, 2020). The study gathered data through semi-structured interviews, focus group discussions and document analysis involving preservice teachers and administrators from five teacher training institutions in Zimbabwe. 10 preservice teachers were purposively selected from each of the purposively selected five colleges. One administrator from each of the colleges under study were also selected.

3.1. Data collection and analysis

The semi-structured interviews were done one-on-one with 10 participants from each college. These were face-to-face and were recorded for accuracy of reporting, transcribed and saved in cloud ready for analysis (Hassan, 2024). From the same participants of 10, five were selected through a volunteering process to participate in focus group discussions. The five administrators, one from each college were all interviewed. Document analysis looked at institutional guidelines, student portfolios and policies as a way of evaluating the implementation of learner-cantered assessments in the Zimbabwean preservice teacher training colleges.

For data analysis, we employed a rigorous protocol of coding, inductive analysis, triangulation, external audit and member checking to ensure trustworthiness and credibility (Creswell, 2014). This involved all the data from interviews and focus group discussions emphasizing aspects of what preservice teachers and their educators experienced in assessment protocols in use in their colleges and how they contributed to their professional development. The following outlines the process of data analysis (Hassan, 2024): The data analysis process began with transcription of interview data and coding it for thematic relevance. The whole process of transcription was done by the researchers themselves as it helped to make us understand the data intimately. We began the process of identifying common recurring themes as they emerged using cross-case analysis (Peel, 2020). The two researchers each generated categories individually and then discussed the wording of the categories before we started ascribing core ideas into their categories.

4. Results and discussions

4.1. Reflective practice and professional growth

Assessment of preservice teachers according to the new semesterization program for teacher's colleges has taken a paradigm shift from traditional examination that tested memory only to a two-pronged system that tests the practical aspect of a module in a continuous assessment mode together with examinations (Saleem et al., 2022). The final assessment has a 40% rating for examination and 60% practical rated on a continuous assessment model and they have to be passed separately. Such an assessment model demands student centered approaches in assessment (Yigzaw, 2013). *Self-assessment has made me aware of my strengths as well as those areas needing improvement. Unlike the traditional examination system that just tested memory, this way of assessment forces me to do a reflection every time during practice and work to improve my teaching methods.*

On peer evaluations, participants commented: *My friends have made it very easy to correct and improve my practice especially in activities like peer teaching and reports on peer evaluations of teaching and learning materials development as well as actual teaching and learning activities.* Another student praised the way they are assessed through portfolio-based assessments. *I really appreciate the way portfolio assessment has enhanced my performance as a preservice teacher. It takes away stress and fear when you know that assessment is continuous and you can improve as you listen to your friends evaluate your piece of work or your teaching and learning activity. It is quite enriching and helps one develop a collegial relationship with peers.*

Such findings were in line with what scholars say about how use of e-portfolios tend to improve the process of empowerment for preservice teachers as they acquire technological, pedagogical as well as content knowledge of given learning areas (Yigzaw, 2013; van Wyk, 2017). This enhances self-directed learning for students. Utilizing such complex technological integration in pedagogy as the Eportfolio, documents and demonstrates the preteachers' professional growth and development (Saleem, 2022). Effective student centered assessment that includes technology integration, peer assessment and self-assessment is enabled by necessary conditions especially a supportive institutional environment (Lopes & Cunha, 2017). This innovative pedagogical assessment is gaining prominence in modern education and scholars are in agreement that it has the potential for addressing the constrains of the traditional models of assessment (Zainuddin et al., 2019), one focus group noted: *When we are doing an assessment of each other's work, we are learning from each other. I get to observe different ways of lesson planning and classroom management, this improves my skills*

The records of assessment together with the course syllabi also highlighted the same three main student-centered assessment approaches done in teacher training colleges, portfolio based assessment, project based assessment, the peer and self-assessments. *Portfolio based assessment*: This type was evident across all the five colleges under study. These provided students with opportunities for self-reflection which ultimately led to professional growth (Rodrigues, 2023). However, there were variations in the way each college implemented it. Sad to note was the evidence of reliance on traditional grading systems by some lecturers in several of the colleges that were the undermining self-directed nature of portfolio evaluation. *Self and peer Assessment*: Policy documents analyzed indicated that self and peer assessments support self-regulated and collaborative learning. This is what happens when effectively done as espoused by research (Alt & Raichel, 2022). However, findings of the study through an analysis of assessment rubric showed inconsistences in grading criteria and they lacked structured peer assessment training. *Project based assessment*: This was evident across all five colleges. Preservice teachers were exposed to project based assessment. The rubric was clear as to the assessment process and marks allocation. However, there was a lack of comprehensive digital integration which tended to limit the effect of this assessment type especially for 21st century requisite skills for assessment.

4.2. Implementation challenges

There were several challenges that participants, the students, sighted as hindering the effective implementation of the student centered assessment. A recurring theme among administrators was that of the need for a strict standardization for all teachers' colleges which led to discrepancies in the assessments applied. One of the interviewees, an administrator highlighted that: *While there is an attempt at enforcing student-centered assessment across all teacher training colleges, there remains gaps limiting uniformity in the assessment framework. Other lecturers are still more inclined towards traditional examinations models. It is required that final assessment should comprise 60% of continuous assessment that houses student centered assessment but there is no clarity or uniformity on what is to be done. However, the 60% demands that educators implement some form of student centered approaches to assessment which is a giant step towards the right way of assessment.*

4.3. Education 5.0 alignment

The findings of this study indicated that while student centered assessments are well aligned with Education 5.0 framework of Zimbabwe, full integration must get policy reinforcement and systemic support. Administrators generally acknowledged the approach promotes competency-based learning and innovation, core tenets of Education 5.0. However, they also underscored the need for enhanced structured institutional backing. One of the administrators observed: *The nature of Education 5.0 is pushing us to embrace competency-based assessment, but there is need for increased workshops and support systems that help lecturers transition fully to student centered models of assessment.*

Upon examining the five colleges documents including course guidelines and assessment policies, it was evident that student centered assessment approaches were clearly acknowledged and stated as part of the Zimbabwe's Education 5.0 requisites for a competency-based innovation and industrialization education model. Document analysis revealed an emphasis on portfolio evaluations, peer assessment and self-assessment as a way of fostering reflective practice and critical thinking. However, practical application of these documented approaches was clearly inconsistent.

4.4. Benefits of student centered assessment

This study findings highlighted the potential transformative features of student-centered assessments for Zimbabwean teacher-training colleges. Participants overwhelmingly supported this assessment framework that is premised on self-assessment, portfolio-based evaluations and peer reviews as fostering critical thinking, collaborative learning and self-reflection. One student teacher remarked: *Assessing myself helps me take responsibility of my learning, making me more aware of my strengths and weaknesses. I can go on to take charge and work towards my own improvement in my profession.* The same sentiments were echoed by administrators. One of them stated: *The student centered assessment model helps create a new breed of teachers who are reflective practitioners. This is a critical component for positive progressive professional growth.*

A very significant and important contribution came from a participant in a focus group discussion about how student centered assessment fosters student agency, autonomy and ownership of learning. They all agreed that they develop autonomy and a thorough preparation for real world practice in the teaching field. One of them explained: *Feedback from colleagues coupled with the opportunity to reflect on one's teaching and learning experiences make me grow in confidence and become more effective and efficient in my profession and teaching skills. The idea of self-directed work ethic becomes a reality in such settings.* However, findings from the study showed that a lot of institutional support and nurturing is much more needed in this framework as compared to the traditional model (Walker et al., 2023). There is much more continuous assessment and mentoring to direct students towards intended goals and avoid wondering.

4.5. Policy and institutional support

The study revealed the need for more focused institutional support and policy frameworks to sustain this new way of assessment that is student centered (Driscoll & Wood, 2023). A recurring theme from administrators was that of standardizing student centered assessment across all colleges. *We need capacity building programs for both educators and students to ensure proper execution of the framework and uniform at that.* The issue of digital infrastructure in institutions was repeated by both administrators and students. An administrator suggested: *The framework needs support in terms of comprehensive digital infrastructures for enhanced accessibility and efficiency of carrying out such assessments as portfolio-based evaluations.*

4.6. Implications for teacher training institutes

The study findings indicated that preservice teacher training institutions in Zimbabwe need improved assessment frameworks that align with Education 5.0 policies of student centered approaches and not only on paper but through actual practice. To achieve this, findings indicated the need to invest in digital tools and infrastructures that support peer and self-assessment, formal training of lecturers on how to implement student centered assessment models. There should be well defined alignment between college policies and their practical implementation for consistency across colleges.

5. Conclusion

The purpose of this study was to explore the implementation of student-centered approaches in pre-service teacher assessments, focusing on the experiences and voices of student teachers in Zimbabwean teacher-training colleges. The findings showed that there is transformative potentials of student-centered assessments in teacher education for Zimbabwean teacher-training colleges. By fostering self-reflection, critical thinking and collaborative learning, assessment becomes aligned to the goals of Zimbabwe's

Education 5.0 whose priority is competency-based education and innovation that leads to industrialization. With peer reviews, eportfolio evaluation and self-assessments, it demonstrates how assessment can transcend rote memorization and develop reflective adaptable educators instead. However, the study also highlights persistent challenges, which include inconsistencies in implementation, resistance to change and resource constraints which need to be addressed for effective implementation of these assessment strategies.

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ARTIFICIAL INTELLIGENCE IN TEACHER TRAINING: BENEFITS, CHALLENGES AND TOOLS

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Abstract

The use of artificial intelligence has emerged as an important tool for teacher training, providing new approaches to the development of pedagogical skills, classroom management, and the personalization of teaching. This research aims to identify the most relevant AI tools for teacher training and to examine the benefits and challenges of integrating AI into teacher training, with a focus on the advantages of personalizing teaching and the difficulties associated with adopting new technologies in the educational context. The methodology used is a literature review, in which studies, scientific articles, and reports on the application of AI in teacher training are analyzed to identify the technological tools available for teaching. The results suggest that AI has enormous potential to transform teacher training, offering tools that make it possible to personalize the training process, adapting it to teachers' needs and learning styles. However, the implementation of these tools faces challenges such as the need for ongoing teacher training, resistance to adopting new technologies, and the lack of technological infrastructure in some educational institutions.

Keywords: *Artificial intelligence, digital technologies, essential tools, teachers, teaching training.*

1. Introduction

The use of AI in teacher training makes it possible not only to personalize the training process, adapting it to teachers' learning styles and rhythms, but also to offer resources that enhance the development of pedagogical skills in line with the demands of contemporary education. In addition, AI technologies can provide real-time feedback, automate administrative tasks, and promote greater interaction between teachers and students. However, the implementation of these tools faces major challenges, such as resistance to adopting new technologies, the need for ongoing teacher training, and limited technological resources in some educational institutions.

This research aims to identify the benefits and challenges of integrating AI into teacher training, focusing on the advantages of personalizing teaching and the difficulties associated with adopting new technologies in the educational context. In addition, it seeks to identify the most relevant AI tools currently available to support teacher training.

Studying these two objectives in conjunction is essential to gain a comprehensive understanding of the current and potential role of AI in the professional development of teachers. While identifying the tools allows us to map the practical resources that can enhance training processes, analyzing the associated benefits and challenges offers a critical perspective on their real impact and feasibility in diverse educational settings. This dual approach not only highlights the opportunities for innovation and improvement in teacher education but also informs decision-makers and educators about the structural, pedagogical, and ethical conditions necessary for successful AI integration.

To achieve this objective, the article is organized as follows: the first section presents the literature review on the use of AI in education and teacher training; then the methodology adopted to carry out the research is described; subsequently, the main results obtained from the analysis of the selected studies are discussed; finally, the conclusions are presented, highlighting the practical implications and suggestions for future research.

2. Literature

The research was carried out through a literature review with the aim of identifying the main benefits of integrating AI into teacher training. Amorim et al., (2023) Highlight several advantages, such

as more effective planning, implementation, and evaluation, the development of critical and ethical skills, curriculum reformulation, the adoption of transversal practices in AI governance, innovation in assessment models, and the automation of teaching management processes. These aspects reinforce the importance of seeing AI as an instrument for transforming teacher training.

The personalization of learning, the expansion of teachers' skills, and the creation of more dynamic and adapted educational experiences are also pointed out as relevant benefits. AI makes it possible to adapt teaching to students' needs, support the analysis of educational data, and collaborate in the construction of richer pedagogical experiences (Duque, Monteiro, et al., 2023).

According to Duque et al., (2023)AI, AI contributes to the development of teaching skills, the personalization of teaching, and the promotion of innovation in pedagogical practice. Similarly, Oliveira (2023) states that AI supports the personalization of teaching, the analysis of educational data, and the automation of administrative tasks, optimizing teachers' time for planning and individual support for students.

Santos (2023) adds that AI provides pedagogical and technological support, promotes innovative learning environments such as gamification and the use of videos, and contributes to a more fluid and personalized educational experience. Cardona et al. (2023) Highlight the importance of AI in creating personalized educational systems, assessing student performance, collaboration between teachers, and promoting AI literacy.

Oliveira (2023) reinforces the role of AI in data analysis, objective assessment, and support for students outside of school hours, as well as the automation of routine tasks, reducing bureaucracy and optimizing processes. Mahendran Maniam (2023) argues that AI makes it possible to personalize teacher training, simulate real-life scenarios, make data-driven decisions, and prepare for an AI-driven world.

Salas-Pilco et al., (2022) Highlight the possibility of visualizing behaviour, predicting dropouts, supporting self-study, and assessing teaching skills with intelligent systems. Tammets & Ley (2023) State that AI can help teachers better understand what is happening in the classroom, promoting real-time adjustments and evidence-based decisions.

Gunawan et al. (2021) highlight AI's contribution to lesson planning, real-time feedback, and improving teaching practices. Jamal (2023) Adds that AI facilitates access to quality resources, promotes continuous professional development, and provides personalized feedback.

Kusmawan (2023) Mentions that AI democratizes access to training, enables simulated practice with avatars, and provides real-time data to improve teaching performance. Ruizhe et al. (2023) point out that AI contributes to more effective and up-to-date teaching methods.

Al-Zyoud (2020) Adds the development of AI-based educational software, the creation of training paths, integrated educational databases, and support for career advancement. Tunjera & Chigona (2023) Reinforce that AI can improve equal access to education, personalize educational content, and promote technological skills in teachers, while also highlighting the importance of collaboration between all educational agents.

Finally, Wu et al. (2023) state that AI can improve the quality of teaching, combine technology with traditional methods, and reduce the costs associated with teacher preparation.

After presenting the benefits of AI in teacher training, it is equally essential to consider the main challenges that this integration still faces. The evidence available in recent literature points to a series of technical, pedagogical, institutional, and ethical obstacles that need to be overcome if the potential of AI in education is to be realized effectively.

One of the central challenges is teachers' resistance and lack of motivation to incorporate AI into their pedagogical practices. This reluctance is generally related to fear of professional substitution, technical insecurity in handling the tools, and a perceived increase in workload (Guimaraes et al., 2025; Júnior et al., 2025; Veras et al., 2024).

In addition, there is a general lack of technical and pedagogical training for teachers. Most teachers do not have adequate training to operate AI tools, interpret the data generated by algorithms or adapt their teaching methodologies to the use of these technologies. The rapid evolution of AI intensifies this gap, especially when educational institutions do not offer continuous and up-to-date training programs (Santos & Silva, 2024; Guimaraes et al., 2025; Júnior et al., 2025).

Another significant obstacle concerns limited infrastructure. The lack of appropriate technological resources, such as up-to-date equipment, stable connectivity, and adequate technical support, is a common obstacle, especially in less developed regions, considerably limiting the potential for applying AI in the educational context (Guimaraes et al., 2025; Júnior et al., 2025; Veras et al., 2024).

Added to these factors are ethical and social challenges, including concerns about the privacy of student data, the possible biases embedded in algorithms, and the risk of dehumanizing teaching processes. These issues require specific preparation for teachers so that they can use AI responsibly and critically (Guimaraes et al., 2025; Júnior et al., 2025; Veras et al., 2024).

The integration of AI also requires a profound pedagogical restructuring. Teachers need not only to master technological tools, but also to rethink their teaching strategies, adapting them to more dynamic and personalized models, which can lead to insecurity and professional overload (Ernandes et al., 2024)

Finally, there is a lack of robust public policies and consistent institutional support. The lack of educational guidelines that promote continuing training in AI and support the effective implementation of these technologies is an obstacle to their widespread adoption (Guimaraes et al., 2025; Grigorio, 2025).

Taken together, these challenges point to the urgent need for ongoing, contextualized, and motivating teacher training programs. These programs should cover both the technical, ethical, and pedagogical aspects of using AI, as well as being accompanied by investments in infrastructure and public policies that support the digital transformation in education.

3. Methodology

This research was conducted using a qualitative approach, focusing on a literature review, to identify and analyze the main scientific contributions related to the application of AI tools in teacher training. The choice of this methodology is justified by the need to understand, based on theoretical evidence, how AI has been used to support teacher professional development, as well as the benefits and challenges arising from its integration into educational processes.

To address the first objective — identifying the main benefits and challenges of integrating AI into teacher training — a literature search was conducted in recognized databases such as RCAP and Google Scholar. Keywords used included “artificial intelligence in teacher training”, “AI tools in education”, “educational technology”, and “teacher professional development”. Studies published between 2020 and 2025, in Portuguese or English, and directly addressing the use of AI-based technologies in the context of teacher training were selected for analysis. Papers that focused exclusively on AI use by students, lacked full-text access, were opinion-based, or did not present empirical data or a systematic review were excluded.

After the initial screening, the selected documents were subjected to a qualitative content analysis, seeking to identify not only the tools mentioned but also the application strategies described, the impacts reported on teaching practice, and the obstacles faced in adopting them in real teacher training contexts. This analysis made it possible to bring together a representative set of theoretical and practical contributions, providing a solid basis for discussing the results and for critical reflection on the role of AI in improving teacher education.

In order to achieve the second objective of the research - to identify AI tools aimed at teacher training - an exploratory web search was carried out. This stage consisted of consulting specialized websites, educational repositories, academic blogs, educational technology platforms, and institutional reports to map AI tools actually used or recommended for training contexts. The selection of tools took into account their applicability to teacher training, their functionalities (such as personalization of learning, analysis of educational data, simulation of pedagogical scenarios, and automation of tasks), and the clarity of the information provided by the developers or users themselves.

4. Results

4.1. Benefits and challenges of integrating AI into teacher training

The analysis of the literature reveals a consistent set of benefits provided by the integration of AI in teacher training. Of particular note is the possibility of improving the planning, implementation, and evaluation of teaching, as well as the personalization of learning, adapting methodologies and content to the profile and pace of students. AI supports the development of professional skills, including the analysis of educational data, the use of technological tools, and the adaptation of pedagogical practices to contemporary challenges. Other benefits include the automation of administrative tasks, the creation of innovative and immersive learning environments, such as gamification and the use of intelligent tutors, and the simulation of classroom scenarios for practical training. AI also favors equitable access to quality training, especially in remote contexts or with fewer resources, and promotes collaboration between teachers by sharing practices and resources. In addition, it contributes to efficiency and innovation in the training process, offers real-time feedback, and allows for more informed pedagogical decisions. The results point to the great potential of AI to transform teacher training, making it more personalized, effective, data-driven, and aligned with the demands of a constantly evolving education system.

Although the integration of AI into teacher training brings significant benefits, such as the modernization of pedagogical practices and the development of critical and ethical skills, it still faces a number of challenges. Among the main obstacles identified are teachers' resistance and lack of motivation, lack of technical and pedagogical training, limited technological infrastructure, ethical and social concerns, the need for pedagogical restructuring, and the absence of consistent public policies. These factors point to the urgency of continuous, contextualized training programs accompanied by investments in infrastructure and institutional support to ensure the effective and ethical adoption of AI in education.

4.2. IA tools for the teacher training

AI is transforming teacher training by offering tools that facilitate everything from lesson planning to personalizing teaching and automating administrative tasks. Below are some of the main categories and examples of tools that can be used to train teachers and improve their professional practice.

- Content planning and creation: Tools such as TeachMate AI, Eduaide.Ai, TeacherMatic, Teachy, Canva, Genially, and Adobe Express make it easier to plan lessons and create personalized, visual, and interactive materials. Platforms such as Curipod and Eureca help to create dynamic and gamified lessons, while apps such as NotebookKLM and Napkin practically organize ideas.
- Automated assessment and feedback: Solutions such as Gradescope, Quizizz, Classcraft, and Diffit.me automate corrections, transform assessments into games, and offer personalized feedback. Tools such as Cognii generate automatic questions and answers, streamlining the teacher's work and promoting fairer and more inclusive assessments.
- Personalization of teaching and monitoring: Platforms such as CENTURY Tech, Carnegie Learning, SchoolAI, and Eureca adapt content and learning paths to the pace of each student, facilitating progress monitoring and promoting more efficient pedagogical interventions. Classcraft also uses gamification to motivate and monitor student performance.
- Writing, research, and communication assistants: Tools such as ChatGPT, Gemini, Perplexity, Mettzer, and Grammarly assist in the production and revision of texts, in addition to facilitating research. Solutions such as Otter.ai, Speechify, and Dragon Speech Recognition improve accessibility through transcription and text-to-audio conversion, benefiting teachers and students with special needs.

The results show that AI is transforming teacher education by facilitating planning, personalizing teaching, and automating tasks. These tools increase efficiency and inclusion, offering a variety of resources that meet current education needs. To harness the full potential of AI, it is essential to invest in teacher training and adequate infrastructure, ensuring more innovative and effective pedagogical practices.

5. Conclusions

The integration of AI into teacher training has proven to be a revolution in the educational process, providing significant advances in planning, personalizing teaching, and automating administrative tasks. AI tools facilitate the creation of personalized teaching content, automated assessments, efficient monitoring of student progress, and support in the production and review of texts. In addition, they promote innovative learning environments, such as gamification and simulations, and expand equitable access to training, especially in remote regions or those with limited resources. These resources contribute to the modernization of pedagogical practices, making training more effective, inclusive, and aligned with contemporary educational needs.

On the other hand, the full adoption of these technologies faces significant challenges, such as teacher resistance, lack of adequate technical and pedagogical training, limitations in technological infrastructure, and ethical and social concerns related to the use of AI. To overcome these obstacles, it is essential to invest in ongoing training, robust infrastructure, and consistent public policies that support the ethical and effective implementation of these tools. This will make it possible to harness the full potential of AI to transform teacher training, promoting innovative, collaborative, and student-centered pedagogical practices, prepared for the challenges of a constantly evolving educational system.

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EMOTIONAL EDUCATION AS PART OF THE CURRICULUM: A MODEL BASED ON THE SEDONA METHOD OF EMOTIONAL RELEASE

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Abstract

This research proposes a structured model for integrating emotional education into school curricula using the Sedona Method of Emotional Release. A pilot program demonstrates its effectiveness in improving emotional regulation, reducing student stress by 25%, and enhancing peer relationships. Globally, educational systems recognize the importance of emotional intelligence in addressing student well-being. In Europe, integrating emotional competencies into formal education is increasingly essential. The Sedona Method, known for its structured and accessible approach, stands out as a practical tool for helping students release negative emotions and develop self-awareness, acceptance, and emotional clarity. Aligned with experiential learning, this model incorporates role-playing, guided visualization, and journaling, adaptable for all education levels—from guided imagery for young students to peer-led workshops at the university level. Studies highlight its positive impact on academic performance and student well-being, emphasizing its potential as an alternative to mindfulness and cognitive-behavioral techniques. Key benefits include stress reduction, improved focus, academic engagement, and emotional intelligence development. Encouraging empathy and collaboration, emotional education fosters a more inclusive learning environment. Policymakers should prioritize pilot programs to validate its benefits and establish scalable frameworks. This approach redefines education by positioning emotional well-being as a fundamental component. Schools can equip students with lifelong skills for resilience, stress management, and social success. The proposed pilot program outlines qualitative and quantitative assessments, defining teacher and student roles while utilizing structured emotional intelligence scales and stress inventories.

Keywords: *Emotional education, Sedona Method, stress management, emotional intelligence, experiential learning.*

1. Introduction

The study will use validated tools like the Emotional Intelligence Scale (EIS) and Student Stress Inventory (SSI), along with teacher and student feedback. Emotional intelligence is increasingly recognized as essential for personal and academic success, making emotional education a priority in school programs. The Emotional Release Method helps identify and release negative emotions, addressing stress and emotional challenges while fostering empathy and interpersonal skills. Integrating this method into curricula can create a supportive learning environment that enhances well-being and resilience. This article proposes a structured implementation plan, emphasizing its potential for student growth. Policymakers should initiate pilot programs to assess feasibility, addressing challenges such as cultural resistance or resource limitations through targeted training and materials.

2. Definition of emotional education and its significance in the educational process

Research highlights the importance of emotional education in today's evolving school environment, as it helps students develop emotional skills, manage stress, and foster positive relationships. Emotional well-being is closely linked to academic success. Integrating the Sedona Method enhances these benefits by providing structured techniques for emotional release and resilience-building. This approach creates a supportive learning environment, promoting both academic achievement and personal well-being, ultimately strengthening social harmony in schools.

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3. Overview of the Sedona Method and its benefits for emotional well-being

The Sedona Method helps students manage stress by recognizing, accepting, and releasing negative emotions, improving mental clarity and resilience. Its structured approach enhances emotional regulation, aiding in conflict resolution and stress management. Studies show it strengthens emotional understanding and relationships, reinforcing the link between well-being and academic success. By integrating this method, schools equip students with essential skills for both academic and personal challenges. (Hull, 2019).

4. Objective of the article: Proposing a model for curriculum integration

Integrating emotional education into curricula strengthens the link between emotional well-being and academic success. Using the Emotional Release Method, this approach addresses student stress while fostering social skills and resilience. A structured curriculum integrates stress reduction and emotional awareness into existing lessons, enhancing mental health and school performance (Kyker, 2012).

Studies confirm that emotional intelligence significantly impacts school success and social interactions, making its inclusion essential (AL-Shayaa, 2004). The Emotional Release Method aligns with modern, student-focused teaching and supports experiential learning models. For example, role-playing exercises help students practice emotional release techniques in a controlled environment, reflecting Kolb's experiential learning cycle. Research highlights that such techniques improve mental health outcomes and create supportive, engaging classrooms where both cognitive and emotional growth thrive.

5. Necessity of emotional education in contemporary curricula, supported by research

The growing pressures on students and rising mental health concerns highlight the need for emotional education. Research confirms that programs focused on emotional skills significantly enhance students' ability to manage emotions, improving both academic performance and social interactions (DigitalCommons@University of Nebraska - Lincoln).

Emotional intelligence is essential for learning, not just an added benefit. The Emotional Release Method provides effective strategies for stress management and emotional clarity, helping teachers cultivate supportive classrooms that foster resilience and well-being (O'Connor, 1974). Beyond addressing immediate emotional needs, this approach equips students with lifelong skills for personal and social success.

6. Core principles of the Sedona Method and its educational relevance

Integrating emotional education requires effective methods like the Sedona Method, which helps students release negative emotions, build resilience, and develop emotional intelligence. Its core principles—awareness, acceptance, and letting go—enhance coping skills, stress management, and social interactions. Research confirms its benefits, linking emotional release techniques to improved mental health and academic performance (Maurer, 2011).

Beyond reducing stress and anxiety, these techniques foster social trust and cooperation, creating supportive learning environments (Taylor University Fort Wayne, 1994). Studies show that structured emotional release activities also benefit teachers, increasing student engagement and academic success (Kyker, 2012).

A pilot program incorporating the Sedona Method into secondary health education demonstrated a 25% reduction in student stress and improved peer relationships. Teachers observed increased participation and fewer behavioral issues, highlighting the method's transformative potential in schools.

7. Proposed integration model

An effective integration plan for emotional education should focus on real-world applications of the Emotional Release Method, aiming to reduce stress, enhance focus, and improve student relationships. Reflection activities and simple emotional release techniques help students manage their emotions, while teacher resources—such as handouts, worksheets, and videos—provide essential support. Research confirms that structured emotional intelligence programs significantly enhance student well-being and academic success (Kyker, 2012; Hull, 2019).

This model is adaptable across educational levels:

- **Primary Education:** Simple exercises like guided imagery or storytelling to help young students recognize emotions.

- **Secondary Education:** Structured journaling prompts to explore and release academic stress.
- **Higher Education:** Peer-led workshops fostering collaborative emotional release and community support.

These adaptations ensure accessibility and relevance across developmental stages, making emotional education a key component of modern curricula.

8. Structure of a teaching module based on the Sedona Method

A Sedona Method-based teaching module should align emotional learning with student well-being and success. It includes clear goals such as stress reduction, stronger social connections, and improved focus. Practical exercises help students release emotions, while educational aids like guides, worksheets, and videos support both teachers and learners.

This structured approach not only addresses immediate emotional challenges but also fosters a long-term culture of emotional awareness and resilience, benefiting the entire school community.

9. Practical exercises for emotional release and introspection in the classroom

Practical exercises for emotional release and self-reflection can benefit both students and teachers. The Sedona Method, which emphasizes awareness and emotional release, helps create a structured yet adaptable environment for personal growth. Techniques like guided visualization, breathwork, and sharing circles provide students with opportunities to process emotions in a supportive setting, improving well-being, learning, and social skills (Chusniah et al., 2016). Teachers who facilitate these exercises model emotional regulation, fostering trust and openness in the classroom.

By aligning with modern teaching approaches, these methods equip students with essential emotional and social skills for navigating life's challenges.

10. Educational resources to support teachers and students in implementation

Successful implementation of the Emotional Release Method in schools requires comprehensive resources for teachers and students. Classroom guides, worksheets, and multimedia tools enhance understanding and practical application.

Teacher training is crucial, equipping educators with effective emotional education strategies. Research supports the need for professional development in K-12 settings, emphasizing workshops with role-playing exercises to build confidence in facilitating emotional release techniques.

Integrating case studies and hands-on activities bridges theory and practice, ensuring both teachers and students can apply the method effectively in real-life situations.

11. Expected impact

Integrating emotional education through the Sedona Method is expected to lower student stress, improve focus, and enhance academic performance. Strengthening emotional intelligence and empathy fosters a supportive school community. Research on self-care in high-stress environments suggests similar benefits for student well-being and engagement (Lowe, 2022).

Studies confirm that emotional release techniques help students manage challenges, leading to clearer thinking, better focus, and improved behavior (Undergraduate Research Center, 2018). Additionally, emotional intelligence development equips students with essential relationship and teamwork skills (Powers, 2015). These benefits contribute to a healthier, more engaged student body that thrives both academically and socially (AL-Shayaa, 2004).

12. Development of emotional intelligence and positive interpersonal relationships

Emotional intelligence is essential for building strong relationships in schools. The Sedona Method helps students understand and express emotions while fostering empathy and connection.

Research shows that emotional education enhances self-awareness and self-control, improving students' ability to navigate social interactions (Hull, 2019). Letting go of negative emotions strengthens peer relationships, reduces conflicts, and promotes teamwork (Lowe, 2022).

Integrating emotional education into curricula not only develops emotional intelligence but also cultivates a supportive and harmonious school community.

13. Creation of a healthier, more inclusive educational environment

Integrating emotional education fosters academic success and inclusivity by creating a safe space for students to express emotions. The Emotional Release Method enhances well-being, resilience, and peer relationships. Studies confirm that emotional support programs reduce stress and improve classroom dynamics (Kyker, 2012). Research on workplace stress highlights that prioritizing emotional health increases student engagement and motivation (Lowe, 2022).

Emotional education is not optional, it is essential for building a healthier, more inclusive learning environment that values emotional well-being.

14. Conclusions and recommendations

Strong evidence supports integrating emotional education into school curricula. Education leaders should prioritize the Emotional Release Method, as it enhances students' emotional well-being and academic performance. Future research should examine long-term effects, while pilot programs in diverse school settings can provide practical insights and promote emotional awareness (AL-Shayaa, 2004; Maurer, 2011). These initiatives will improve school environments and contribute to a more emotionally aware society.

Policymakers must make emotional education a mandatory component. By implementing pilot programs, they can validate its benefits, not just academically but also in overall student well-being. Collaboration between educators, psychologists, and curriculum developers is essential to creating a scalable, standardized framework.

15. Summary of the benefits of integrating the Sedona Method into education

Integrating the Sedona Method in schools enhances student well-being and academic performance. By fostering emotional awareness and resilience, it helps students release negative emotions, reducing stress and improving focus. Guided emotional intelligence practices promote empathy, strengthen relationships, and create a supportive classroom environment. The method’s emphasis on self-reflection enhances social skills, teamwork, and respect among peers. Ultimately, incorporating the Sedona Method prepares students for both academic success and personal growth.

16. Suggestions for future research and educational policy development

Future research should explore the long-term impact of emotional education, particularly the Emotional Release Method, on student well-being and academic success. Policymakers can learn from models like Tucson, Arizona, where community input shaped educational policies (AL-Shayaa, 2004).

Teacher training is crucial for effectively integrating emotional education, fostering both learning and emotional well-being. Research should focus on these aspects to develop strong policy recommendations that establish emotional education as a core element of school curricula, promoting holistic student development (Kyker, 2012).

17. Call for pilot implementations in schools and universities

Schools and universities should implement pilot programs integrating the Emotional Release Method to address mental health challenges and enhance emotional intelligence. These initiatives can reduce stress, improve social skills, and create supportive learning environments that benefit both academic and personal development. Pilot studies will provide valuable data on the effectiveness of emotional release techniques, guiding educators and policymakers in refining implementation. Successful programs could drive systemic changes, embedding emotional education into academic life and fostering a healthier educational environment.

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IS EDUCATION A HUMAN RIGHT?

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Abstract

Education is directly related to knowledge, and knowledge in turn is the guarantee of our development. The potential of the life we can live depends on this knowledge, its transmission to future generations and its development by them. Education is a very important part of the transmission and development of knowledge. It is no coincidence that it is in the public focus not only when we talk about prosperity, but also when we talk about dealing with hunger and disease. Does all this mean that education is a basic human right, acquired at birth?! When we talk about "rights", we should mainly strive to refrain from interfering in certain areas, not to oblige someone to act in a certain way. In the case of education, it means that it is unacceptable to take away someone's right to be educated, but it does not imply the obligation to do everything in our power to educate them. The desired degree and form of education cannot be universal. Information that is diverse in content and meaning is needed, allowing for the formation of an independent opinion. This also means eliminating the forced imposition of some theses and the prohibition of others.
This article will analyze the right to education, but also describe examples of abuse through the imposition of dubious and sometimes false claims. Specifically, the "history-changing" of the Black Lives Matters movement, the green "ideology" based on claims about Global Warming, and the LGBT+ attack in schools and universities that has been observed in a number of leading universities in Western Europe and the United States.

Keywords: *Education, knowledge, human rights, ideological education, prevention.*

1. Introduction

When we talk about universal human rights, it is first of all good to think about whether and under what conditions they exist. The UNIVERSAL DECLARATION of Human Rights (UDHR) adopted by the UN is based on values professed by our, Western, civilization. But researchers point out that there are others – according to one, five (Matthew 1991), according to others – seven (Samuel 2011). The common thing is that self-determination is based on religion, history, language, ancestors, customs and institutions formed over the centuries, and not on the basis of political and economic forms. That is, there is no single, common view of life formed by philosophy, values and social relations of different civilizations.

Unique to European civilization is the combination of values that formed its core. These are Greek philosophy and rationalism, Roman law (secular power is subject to some external coercion), Christianity, the Latin language, the division between secular and spiritual power, and individualism. This does not include controversial concepts present in the UDHR such as social justice, the right to work, to recreation, to life development, education, etc.

Yet is it possible to define any universal human rights? Bell (2002) argues that there are many universal human values, starting with life itself and culminating in the maxim of treating others as we would like to be treated. Indeed, when we talk about the attitude towards life as a value, we can find common ground between different civilizations, which can give us a basis for forming universal human rights.

2. Methods

Thomas (1970) states that the degree of objectivity of science depends both on its type and on the structures, culture, and diversity of the communities that produce it. Sciences that study natural phenomena can achieve a high degree of objectivity. In social sciences, which study the cultural, social and individual development of man and human society, objectivity is possible only after clearly defining goals and values.

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That is, objectivity in science is not absolute, but conditional, it is more “a posteriori” than “a priori” and is possible only after choosing certain values and perspectives (Lozanov 2017).

This study is based on the value system and moral foundation described above that form the core of European civilization, and more specifically, that when we talk about "rights," we should strive primarily to refrain from interfering in certain areas, rather than obliging someone to act in a certain way. Applied to education, this means that it is unacceptable to take away someone's right to education, but it also does not imply an obligation to do everything in our power to educate them.

3. Discussion

3.1. The universal declaration of human rights

In the first articles of the UNIVERSAL DECLARATION of Human Rights, we can clearly recognize the beginning of the US Declaration of Independence from 1776, which states: "...that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness". To this we must add the extremely important text of Article 3 defining the right to “security of person” and Article 4 prohibiting “slavery and serfdom”. These rights are a natural extension of the values that constitute the core of European civilization, but to some extent they can be accepted as universal.

To get to the case of education, let us examine and compare the approach in the first (ending with article 21) and second (beginning with article 22) parts of the UNIVERSAL DECLARATION of Human Rights. Let us also note that this is a document from 1948, which is part of our recent history, and what is written reflects a new concept of human rights. This concept places a priori restrictions on what government can do. It requires setting limits on government intervention and protecting citizens from oppression by the rulers. In other words, it assumes that human rights are freedoms from state control and interference, such as the rights to life, liberty, and the pursuit of happiness. With Article 22 and after it, the idea of freedom from state control radically changes towards claims on the State, which it can satisfy only through proactive actions (Roger 2017). Specifically in this direction is Article 26, which states:

"Everyone has the right to education. Education shall be free, at least in the primary and secondary stages. Primary education shall be compulsory...";

The meaning of freedom from state interference is that it cannot prevent those who wish to be educated. This entry is exactly the opposite – it charges the State with educating everyone. Moreover, it defines primary and secondary education as mandatory. Can a right be mandatory? And assuming that it is the State's duty to educate everyone, don't we attribute to it the right to use its repressive instruments to fulfill this requirement?! And since Article 1 also states that "All human beings are born free and equal in dignity and rights" why is the right not to be educated taken away? Paragraph 3 of Article 26 states that: “Parents have the right, with priority, to choose the type of education their children will receive”, which means that the choice of no education or of receiving non-traditional education is confronted with the mandatory nature of paragraph 1 of this article. To this we add the requirement that education be free, which only means that it will be paid for by everyone, through their taxes. So regardless of whether or not they want education for their children, and whether they even have any, people will pay – again imposing an obligation on the State to collect and distribute, which is contrary to the spirit of the UNIVERSAL DECLARATION set out at the beginning. Finally, let us dwell on the goal set, namely "Education should be directed towards ... carrying out the activities of the United Nations for the maintenance of peace". Here again, we are not talking about a right, but an obligation that is imposed on every educator and recipient to cooperate with the UN. Furthermore, this requirement directly contradicts previous articles of the Declaration, such as Article 2, which states that: "Everyone is entitled to all the rights and freedoms set forth in this Declaration, without distinction of any kind, such as ... political or other opinion...", in particular opinions different from those of the UN!

3.2. Education – A right or an obligation

It has already been noted that according to the UDHR, the contradiction of “rights” that are “obligatory” appears. Let us delve deeper into this difficult-to-explain contradiction. From a legal point of view, a Right is an opportunity for behavior permitted and guaranteed by the state. That is, the State must guarantee the legal entity the opportunity to determine its own behavior. The key word here is opportunity, or more precisely, a person has a guaranteed right to a certain behavior, but what actions he will take to realize this right are left entirely to his personal discretion (Kolev 2005). Therefore, it is entirely up to the individual whether to take advantage of this right or not.

Obligation is the opposite of right. It, the obligation, requires specific behavior from a legal subject. That is, the individual does not have the right to independently judge whether to fulfill the obligation or not, and in case of non-fulfillment he is subject to a sanction (Kolev 2005).

In this way, the UDHR actually takes away the right of the individual (and his parents) declared in it and replaces it with an obligation, the failure to fulfill which will lead to a sanction, that is, a type of repression by the State.

Since the UNIVERSAL DECLARATION requires that education be compulsory, it is to some extent expected to be free. Not so obvious, but practically inevitable, is that compulsory education cannot but be unified. But the Declaration itself speaks of each man as a person, that is, carrying a certain individuality. Imposing a general model for how a person should develop their personality is also deeply controversial. Educational psychology has long known that different learners have different educational needs, both within a specific program and as a holistic approach (Sternberg 2009). At the same time, the question of why we assume that the State knows better what is important and what is not for the personal growth of the individual remains open. Formally, the Declaration states that parents can choose for themselves, but the requirement for free education practically eliminates the entire private sector, in particular competing educational philosophies and techniques. Another negative of this requirement is that the system is supported by money collected from taxes, and not by money paid by users of the service. The problem with the repressive nature of this type of financing has already been noted. But it also creates an additional and very significant problem, namely that there is no feedback on the results of this education.

3.3. Education – Personal responsibility

The preamble to the Universal Declaration of Human Responsibilities (UDHResp.) of 1998 states that people "...are capable of free, but also responsible, choices..." and further that"...given that both the human search for meaning and the human capacity to make choices freely and responsibly are essentially 'infinite', i.e. their horizons extend infinitely, the dignity of the human being is correspondingly 'infinite'...". Two things become very clear from this text: first, that each nam is personally responsible for the choices he makes, and second, that the choices that an individual can make are infinitely many.

Let us begin with the first, namely, that each person bears personal responsibility for the choices he makes, or, more honestly, that each person bears special responsibility for the success or failure of his own life, in particular whether he wants to receive a given education and what it should be. This personal responsibility is directly related to self-interest, recognized as a powerful driving force. According to the UDHR, the individual has the right to develop his or her personality and self-realization, that is, to pursue his or her own self-interest. This action is often discredited as being equated with selfishness and perceived as hindering the common good. In fact, self-interest combined with personal responsibility is an effective tool for enhancing personal well-being, thereby contributing to the public good (Perloff 1987). It is precisely our self-interest and responsibility for the success or failure of our lives that can determine our desire for education. Therefore, we cannot assume that education can be forced upon us. Let us look at the second conclusion that the Declaration of Human Responsibilities emphasizes – diversity. It clearly shows that even if we decide to educate ourselves, the need for knowledge that we require is infinitely different, as are the methods by which we obtain that knowledge.

3.4. What kind of education do we need

Knowing what your interests are and being able to take responsibility is also something that can be learned. It should naturally start with parents and continue later, possibly in school. The education system in most countries today does not offer such training, in fact, it seems to teach us the exact opposite. We are successful in school if we get high grades, which directly depends on the teachers and the curriculum. But studying subjects to get high grades is far from guaranteeing that we have learned what we will need later in life. Even less does it guarantee that we will be successful, let alone happy.

- Does knowledge gained at school provide skills for a successful life?

Most of the information and knowledge you get in school will not be useful to us in real life. But to be successful (according to the school's understanding) we have to learn it, whether we like it or not. Besides not benefiting us, this process creates a habit – of doing things we don't like but not thinking about it. Going out into the field of life with this habit, we may do work we don't like but still not think about it. The result would range from dissatisfaction to unhappiness.

Of course, there are also students who do not follow this path, they are more creative and free-thinking and are not liked by the education system, respectively they are not "successful". But unlike the "successful" ones, they do not make an effort to learn things that do not interest them and concentrate on what they like, which is a prerequisite for doing this even after they finish their education (or even not finishing it).

- Does lack of education mean the end of a successful life?

Of course, here we must first define a successful life. If we assume that happiness is the best indicator, we will encounter a serious difficulty, because it is arduous to objectify and is too individual. Success is usually understood as material and/or power advancement. It is often said that millionaires are

"school underachievers" and examples of Steve Jobs and Jim Carrey are given, thereby emphasizing the idea that success in school does not always mean success in life. The assumption is that those "excluded" from the educational process have encountered real life earlier and have started doing what they like, while the rest of the school, making an effort to be successful in this system, do not have time to think about life's problems, that is, school graduates leave unprepared for real life.

There is probably a lot of truth in this statement, but what do the statistics show? If we assume that the most successful (according to the above criterion) people are the billionaires, rated by Forbes magazine as influential, and the participants in Davos, then we will see that quite a few of them have higher education and cognitive abilities – about 31% of the self-made billionaires and 71% of the influential men, 58% of the influential women, and 55% of the participants in Davos have attended elite schools around the world (Wai 2014).

This shows that education should not be underestimated. Indeed, from the perspective of self-made billionaires, the percentage is not so impressive, but it is still almost one in three, while among influential men and women, the superiority of the educated is obvious. Moreover, this is usually a very limited group of children. Here comes one of the most serious challenges for education – how to develop some without hurting others. One of the keys here is to encourage not only critical thinking, but also risk-taking.

- Does education stimulate critical thinking?

Students are different and one of the differences is to what extent they are able to think and ask critical questions to the teacher or, respectively, blindly follow the tasks and instructions. It is natural that not all of them can demonstrate critical thinking, initiative, leadership, etc. And every risk potentially leads to failure. Education should show that failure is a part of life and we should not be afraid of it, but we should be persistent in our realization. Something that is more or less not observed today. Quite the opposite - the grading system rather pushes us to be afraid of making a mistake that will get us a lower grade.

The three issues examined are far from exhausting the issues of education, but they provide some general direction for further reflection on whether education should be a right or an obligation. From the point of view of it being a "Right", it should be up to the student (or his parents) to choose the education that they believe will best prepare him for real life. For example, if parents have discovered leadership qualities in their child, the ability to think critically, etc., they should direct them in one direction. Conversely, if, for example, they see abilities for constant and monotonous work, they should direct them in another direction. But do these different training systems exist? Given the mandatory nature of education, such profiling is extremely difficult, if not impossible.

3.5. Distortion of the education

Education is not protected from the intrusion of distorted information and even from ideologizing that would shape certain thinking and behavior. Its mandatory nature hides the risk of mass instillation of a given worldview. The problem was well known to those who studied under communist regimes in Eastern Europe, and its effects persisted for generations. Today, a similar trend is increasingly visible in the educational systems of Western countries. The distortion of history by the ideology of Black Lives Matters, the imposition of scientifically unproven but politically justified blame for climate change by the ideology of environmentalism, the erasure of biology by the LGBT+ ideology are specific threats that are gaining strength.

Tabel (Tabel 2010) explores how an active minority imposes ideological and political dictates on a passive majority. Adding the authority and power of the teacher over the student, the “asymmetry of choice” can take on monstrous proportions.

- In the 1970s, the so-called “Critical Race Theory” (CRT) began to take shape in the United States, which set itself the goal of reconsidering history (and not only) from the perspective of race. This began as scientific papers and university assignments, which in principle was good for science. The problem comes from the fact that science is actually giving way to activism, which is taking over universities and later schools, in the form of curricula that teach distorted to false history. In practice, historical interpretation is replaced by ideology (Murray 2023). In addition to distorting the curriculum, psychological pressure is also being exerted on students and teachers. Some schools are introducing a program on ethical issues of "countergenocide" against white Christians, and some teachers are accused of "killing the spirit" of black children. White students are also being tested for “hidden prejudice” (Murray 2023). The parallels with communist education are disturbing, and the results are likely to be no less damaging.
- A document adopted by the Council of Europe and popularly known as the “Istanbul Convention”, in its initial definition of “Sex” changes what biology knows. The Oxford English Dictionary states that “Sex […] is a characteristic of organisms that are specialized in producing one of two types of gametes (sex cells) – male or female” (Stevenson 2011). That is, “Sex” refers to the biological status of a person and means male or female, boys or girls, with clearly expressed anatomical and physiological dimorphism. But the doctrine enshrined here requires States that have ratified this document to introduce into education

"... measures for ... the eradication of prejudices, customs, traditions ... of stereotypical roles for women and men". Thus, through education, the existing is destroyed in order to build something new – exactly what we observed under communism (Dimov 2025).

- The indoctrination of the thesis of "Global Warming" and the derivation of a single scientific assumption as a fact also instills a certain ideology in schools and universities. Science is a sequence of stated hypotheses, their denial, challenge, improvement, modification, and so on (Dimov 2023). This process can be introduced in schools regarding the topic of Global Warming, by examining and debating the different scientific theories. This would help students in developing their cognitive abilities. The opposite is the introduction of education subordinate to ideology.

4. Conclusions

I share the opinion published on the home page of END 2025 that "...every experience has a formative effect on the constitution of the human being, on the way a person thinks, feels and acts" and that "one of the most important contributions is in what and how we learn by improving educational processes, both in formal and informal settings." Therefore, the article aims to draw attention to some of the problems related to education as it is now. The contradiction between "right" and "obligation" creates a problem that can only be avoided with a clear distinction between the right of the individual and the obligation imposed on the state. The wording in the European Convention on Human Rights (ECHR) is considerably more precise than that in the UDHR. Article 2 of Protocol 1 to this Convention states: "No one shall be deprived of the right to education. In the performance of the functions assumed by it in the field of education and teaching, the State shall respect the right of parents to ensure that their children receive education and teaching in conformity with their religious and philosophical convictions". It is appropriate to replace the obligation with an incentive for education. This way we will not take away someone's right to be educated, but we will allow the individual and/or their parents to focus on what they consider most necessary for their own growth. The commitment that a third party has an obligation and makes an effort to provide education will also be eliminated. Positive effects will be the development of a number of alternative educational systems, the direct feedback between the user of the system and its effectiveness, and last but not least, the assumption of personal responsibility, which is the basis of a successful life. Avoiding the mandatory and unified nature of education also prevents the possibility of its indoctrination and/or politicization.

The proposed direction also has its problems and challenges. The educational system is among the most inert and the results are visible after a long period. Sharp and quick adjustments do not guarantee success, quite the opposite, which is why the State has all the controlling functions.

Stepping on the UDHR, whose first paragraph states: "All human beings are born free and equal in dignity and rights...", we can deduce a primary goal for the education system - the growth and happiness of the individual.

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EXPLORING THE ESSENTIALS OF HIGH-QUALITY STUDENT RECRUITMENT IN UNIVERSITIES: A MULTIVARIATE ANALYSIS OF GEOGRAPHICAL AND INSTITUTIONAL DYNAMICS

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Abstract

The advancement of world-class universities hinges on three interdependent factors: a high concentration of talent, substantial resources, and effective governance. Among these, the caliber of students, encompassing distinguished faculty and high-quality students, plays a pivotal role in shaping academic excellence. Factors such as institutional costs, reputation, academic rigor, and career prospects are crucial in attracting top-tier students from around the globe. In China, cultural nuances significantly influence these dynamics, with student geographical distributions and diverse academic offerings emerging as primary determinants of student quality. Despite their importance, the mechanisms by which these factors influence student quality and their interactive effects remain poorly understood. This study addresses this gap through a comprehensive analysis involving factor analysis, cluster analysis, and cross-tabulation analysis, centered on a prominent Chinese university renowned for its global outreach. Our findings delineate the geographical distribution patterns of high-quality students and identify their preferences for academic programs, revealing insights that resonate with effective student recruitment strategies. Furthermore, the cross-tabulation analysis explores the interactions between student geographical distributions and academic program offerings, providing a nuanced understanding of how recruitment strategies can be tailored to attract diverse student populations. The results not only offer a framework for understanding the determinants of student quality but also deliver strategic insights for higher education institutions worldwide seeking to enhance their student profiles. This research underscores the critical importance of student quality in shaping the future of higher education, emphasizing its relevance both in China and beyond. By fostering a deeper understanding of these dynamics, we aim to inspire collaborative efforts among institutions to cultivate talent and drive innovation in higher education recruitment strategies.

Keywords: *Student quality, higher education, academic preference, geographical influences, recruitment strategy.*

1. Introduction

Quality students are recognized as the foundation of world-class universities and play a critical role in the development of academic excellence. Over the past decade, leading global institutions have made significant efforts to understand the factors that influence student quality. While institutional reputation, academic rigor, and career prospects have been widely studied in Western higher education systems (Wilkins & Huisman, 2011; Miotto et al., 2020), the dynamics in culturally diverse contexts such as China present a unique challenge and opportunity. In China, regional disparities and cultural values play a significant role in shaping educational decisions. The uneven distribution of educational resources across regions leads to significant geographical differences in student quality of students. In this context, the geographical distribution of students has a direct impact on the caliber of applicants recruited to educational institutions (Han et al., 2023). Moreover, the cultural emphasis on career prospects leads Chinese families to give preference to academic programs that offer promising employment prospects. This in turn affects the quality of students attracted to certain degree programs (Zhao, 2022).

Despite extensive research on student recruitment, there are still critical gaps in understanding how the geographical distribution and program offerings affect student quality and how they interact to attract high-quality students. For example, while regional differences in student academic performance are well documented (Guo & Li, 2024), the geographical distribution patterns of high-quality students, particularly their concentration in elite educational institutions, remain poorly understood. Although it is known that the availability of diverse academic programs attracts students (Resch, 2023), whether this is true in the Chinese context has not been thoroughly investigated. Furthermore, the interplay between these offerings

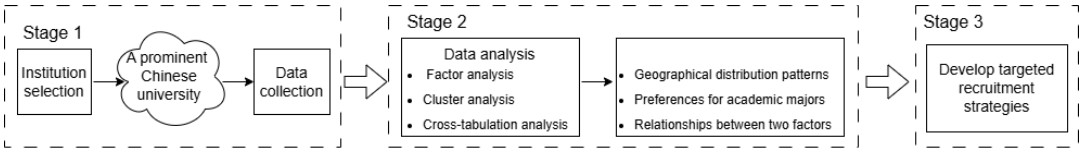
and the geographical distribution in China is unknown. These gaps emphasize the need for a deeper understanding of their interaction and their impact on student quality in China.

To address these limitations, this study focuses on a prominent Chinese university known for its global reach and applies a comprehensive analysis involving factor analysis, cluster analysis, and cross-tabulation analysis. Specifically, the research aims to (a) explore the interactions between student geographical distributions and academic program offerings and their impact on student quality, and (b) develop tailored recruitment strategies and provide strategic insights for higher education institutions.

2. Design and methods

This research employs a three-stage methodological approach centered on a case study university in China. As shown in Figure 1, Step 1 establishes the empirical foundation through comprehensive data collection from a globally recognized institution (Times Higher Education Ranking 301-350, "Double First-Class") that serves as a representative case reflecting challenges common across Chinese higher education. The dataset includes approximately 10,500 records of student admissions between 2022 and 2024 and captures key metrics such as geographic origin, academic performance indicators and academic program preferences. Step 2 employs a multi-method approach to analyze student distribution and academic program preferences. Factor analysis is applied to map the geographical distribution patterns of high-performing students while preserving underlying relationships through dimensionality reduction. Cluster analysis using the K-Means algorithm, selected for its computational efficiency and interpretability (Jain, 2010), identifies distinct patterns in degree program preferences. The cross-tabulation analysis examines the correlations between geographical distribution and choice of degree program. Building on these empirical findings, Step 3 develops data-driven targeted recruitment strategies that address the identified patterns. This multi-method approach not only provides a robust framework for understanding the determinants of student quality across geographical and disciplinary dimensions, but also generates actionable insights that higher education institutions can implement to optimize their recruitment approaches in China's evolving educational landscape.

Figure 1. Research Design.



3. Analysis and results

3.1. Factor analysis

The factor analysis utilized 10 indicators (as shown in the first column of Table 1) to assess geographical disparities in student quality. The indicators are identified based on existing literature and annual reports of the case university. The results confirmed the suitability of the data for factor analysis, with a Kaiser-Meyer-Olkin measure exceeding 0.6 and a statistically significant Bartlett's test of sphericity ($p < 0.001$). Table 2 presents the provinces with outstanding student quality from 2022 to 2024 among the 31 administrative regions analyzed in mainland China. These provinces are selected based on their consistent performance, as their three-year average student quality rankings placed them within the top 10, underscoring their sustained excellence and making them particularly noteworthy for further analysis.

Figure 2 illustrates the spatial distribution of high-performing provinces and shows clear geographical patterns in student quality across China. Analysis of these patterns reveals three significant regional disparities. First, there is a pronounced north-south divide in the distribution of high-performing students. The northern location of the case university appears to enhance its visibility and reputation in the northern regions, especially in the northeastern provinces (marked in red), where student quality metrics are particularly high. Second, an east-west divide is evident, with the eastern coastal regions consistently producing relatively higher quality applicants. This pattern likely reflects the structural advantage of the eastern provinces, which have historically benefited from greater investment in education and a more developed academic infrastructure. Third, despite its relative geographical distance from the case university, the southwestern region (highlighted in blue) shows a promising upward trend in student quality metrics, indicating an emerging recruitment opportunity. The spatial concentration of high-performing students in certain regions underscores how geographical factors, including proximity to the institution, regional educational development, and historical patterns of resource allocation, significantly influence the distribution of academic talent in China's higher education landscape. These findings show how

geographical determinants create uneven patterns in student quality that universities need to consider in their recruitment strategies.

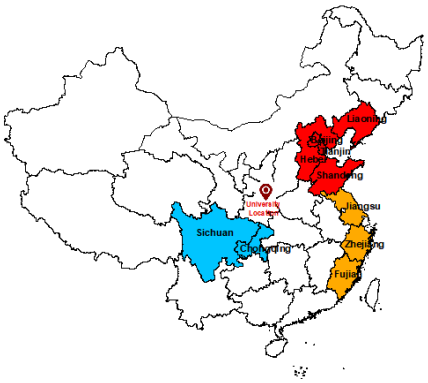
Table 1. Assessment indicators.

Indicators for factor analysis	Indicators for cluster analysis
Standardized minimum score	Current graduate ratio
Standardized average score	Standardized average score
Standardized maximum score	Mean comprehensive score
Mean Chinese score	Mean Chinese score
Mean mathematics score	Mean mathematics score
Mean English score	Mean English score
Average admission raking ratio	Major adjustment rate
Ratio of average score to key university threshold	Program popularity
College preference satisfaction rate	College preference satisfaction rate
League membership rate	League membership rate

Table 2. Provinces with high student quality.

Province	Rank		
	2022	2023	2024
Liaoning	3	1	1
Shandong	7	6	6
Hebei	6	7	10
Tianjin	1	5	20
Beijing	4	4	24
Fujian	2	16	2
Zhejiang	9	3	8
Chongqing	19	8	5
Sichuan	16	10	7
Jiangsu	12	9	15

Figure 2. Geographical Distribution.



3.2. Cluster analysis

Cluster analysis is an important method in the field of data mining and is frequently used in educational research due to its robust ability to classify data (Dutt et al., 2015; Jovanović et al., 2017; Saqr et al., 2023). As one of the most commonly used clustering techniques, the K-means clustering algorithm is used to explore the academic preferences of high-quality students.

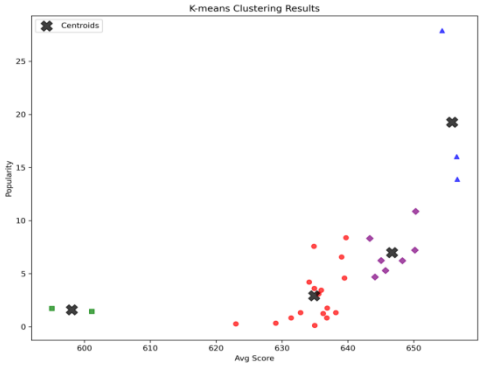
The case university's academic portfolio centers on aerospace disciplines, with complementary strengths in conventional engineering fields such as automation and computer science. Applying K-means clustering to 30 academic programs based on 10 assessment indicators (as shown in the second column of Table 1) reveals four distinct program clusters. Figure 3 shows the result of the 2022 academic year.

Cluster 1 (blue) includes elite programs characterized by exceptional student quality metrics, high applicant numbers, and superior academic performance indicators; Cluster 2 (purple) represents programs with above-average student quality, solid academic metrics, and moderate popularity; Cluster 3 (red), which includes the majority of programs, meets basic institutional standards while showing potential for improvement; and Cluster 4 (green) identifies programs with suboptimal performance in multiple quality dimensions, indicating areas that require strategic intervention. As shown in Table 3, the longitudinal analysis for the period 2022-2024 shows ten-degree programs that consistently maintain their elite status and belong to the top decile of offerings with their three-year average quality metrics. The university's flagship Aerospace Engineering program proves to be the top choice for high-performing students — a position reinforced by its historical prestige, national strategic importance and priority institutional investment. Other programs that have proven particularly successful in attracting highly qualified students include Computer Science and Technology, Automation, Flexible Electronics, Engineering Mechanics and Marine Engineering. This cluster approach provides a data-driven framework for understanding the hierarchical structure of academic program offerings and their differential appeal to high-performing student populations.

Table 3. Clustering results of ten programs (2022–2024).

Program	2022	2023	2024
Aeronautics and Astronautics			
- Advanced Research Track	Excellent	Excellent	Excellent
- Elite Honors Program	Excellent	Excellent	Excellent
- Integrated Track	Excellent	Good	Good
- Civil Aviation Specialization	Good	Good	Good
Computer Science and Technology			
- Top Talent Program	Excellent	Excellent	Excellent
- General Track	Good	Good	Good
Flexible Electronics	Good	Good	Excellent
Engineering Mechanics	Good	Good	Good
Marine Engineering	Good	Good	Good
Automation	Good	Satisfactory	Good

Figure 3. Clustering result (2022).



3.3. Cross-tabulation analysis

To systematically examine the relationship between geographical distribution patterns and academic program preferences, this study employs cross-tabulation analysis — a robust statistical approach for investigating associations between categorical variables. The analysis operationalizes two key categorical dimensions that emerged from the previous analysis steps: geographical regions are classified as either high-quality source regions (provinces ranked in the top 10 by the factor analysis) or other regions (remaining provinces); similarly, academic programs are categorized as either excellent (those consistently ranked in the top 10 by the cluster analysis) or others (remaining programs). This methodological approach allows for a rigorous examination of whether high-performing students from specific geographical regions show particular patterns in their choice of degree programs. Pearson's chi-square tests conducted across all three academic years (2022-2024) yielded statistically significant results ($p < 0.05$ for all years) and provided convincing evidence that geographical origin and program preference are systematically related and not independent variables.

Table 4. Program Admission Rates by Region Quality (2022-2024).

Year	Geographical regions	Academic programs	
		Excellent (Count/%)	Others (Count/%)
2022	High-quality	19.3%	80.7%
	Others	15.9%	84.1%
2023	High-quality	21.4%	78.6%
	Others	17.5%	82.5%
2024	High-quality	23.9%	76.1%
	Others	20.6%	79.4%

Figure 4. Admission Rate of Excellent Programs.

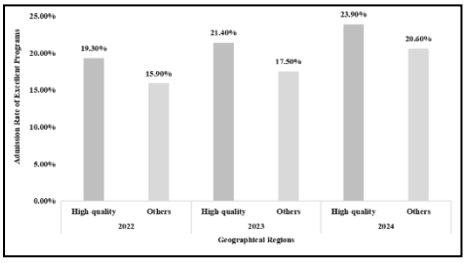


Figure 4 further illustrates this relationship, showing a consistent upward trend in admission rates to excellent programs in both the high-quality geographic regions and the other regions over the study period. This temporal analysis reveals two significant patterns: first, a general increase in the attractiveness of excellent degree programs across all regions, indicating an increasing recognition of the value of these programs, and second, a persistent gap in admission rates, with students from high quality regions consistently being admitted to excellent degree programs at a much higher rate than their peers from other regions. This persistent disparity, despite the general upward trend, shows that geographical advantage translates into differential access to first-class academic opportunities. This empirical evidence supports the statistically significant relationship identified by chi-square tests and highlights the self-reinforcing nature of educational advantage, where students from educationally privileged regions disproportionately secure places in the most prestigious academic programs. These findings highlight the complex interplay between geographical determinants and academic opportunity structures and suggest that targeted interventions may be needed to address persistent regional inequalities in access to world-class educational pathways.

4. Discussions

The results of this study yield actionable implications for recruitment strategies. Universities should pursue a differentiated recruitment approach that makes use of the geographical-academic preference patterns identified. In regions where high-quality students come from, recruitment strategies should enhance the visibility of flagship programs through targeted initiatives that leverage existing advantages, including the strategic use of distinguished alumni as institutional ambassadors, the development of elite partnerships with top secondary schools, and the creation of specialized pre-university enrichment programs aligned with these disciplines. A parallel strategy should address other regions through initiatives that focus on accessibility: implementing virtual engagement platforms that overcome geographical barriers, creating region-specific scholarship incentives that recognize potential rather than prior educational advantage, and developing bridge programs that facilitate successful transition into high-demand technical disciplines. This dual approach recognizes the empirically established relationship between geographical origin and program selection while actively working to expand access pathways. The implementation framework must carefully balance competing institutional needs: Maintaining selective excellence that enhances institutional prestige and expanding equal access that diversifies the talent pipeline. Institutions should adopt quantifiable metrics to monitor how these targeted recruitment strategies impact both the geographical distribution of high-performing students and the quality profile of flagship programs to ensure that efforts to broaden access do not compromise the academic standards that underpin the institution's reputation. This evidence-based approach transforms geographical disparities from passive constraints into strategic opportunities for recruitment management.

5. Conclusions

This study improves the understanding of student recruitment in Chinese universities by analyzing the geographical distribution patterns and preferences for academic programs. Through multivariate analysis, it provides a framework for examining factors that influence student quality of students in different regions. Practical recruitment strategies can be derived from the results. As competition for talent intensifies, universities need to strike a balance between selective excellence and broader access. This study demonstrates the value of data-driven approaches to strategic recruitment management and offers insights that are applicable beyond the immediate context to different higher education systems facing similar recruitment challenges. For future research, the samples can be expanded to a wider range of Chinese higher education institutions in different regions and institutional classifications to improve the generalizability of the findings. The proposed analytical framework can be applied to international contexts to shed light on cross-cultural patterns in the determinants of student quality. Longitudinal studies tracking recruitment metrics would provide hard evidence of the sustained impact of recruitment strategies derived from this research.

Acknowledgment

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CONTEMPORARY VOCATIONAL EDUCATION: THE KEY TO EQUAL ACCESS AND A SUSTAINABLE FUTURE

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Abstract

The report examines the importance of modern vocational education as a key factor for the socio-economic development of society, providing equal access to opportunities and creating sustainable future realization in a working environment. The study presents the concept of equal access to vocational education, emphasizing the key role of innovations and their influence on the creation of modern pedagogical approaches to overcome social and economic barriers for learners. The relationship between vocational education and sustainable development is examined. Methods for integrating soft skills and sustainable practices in training programs are discussed, as well as ways to prepare learners in specific professions for the transition to responsible economies. The study presents a concept for adapting training materials for professional qualification in the profession of "Librarian", using modern methods and tools. This report was developed within the framework of a scientific research project “A model for evaluating the effectiveness and quality of inclusive education, training and lifelong learning” with contract № КП-06-Н80/1, funded by National science fund of Bulgaria.

Keywords: *Inclusive education, vocational training, equality, accessibility, adaptation*.

1. Introduction

Today, in a dynamically changing world influenced by technological progress, vocational education is a key factor in building a competitive environment and an adaptable workforce. In this way, not only are the knowledge and skills necessary for society to meet the modern demands of the labor market provided, but also opportunities for social mobility and economic development are created. In this context, equal access to high-quality vocational education and training is essential for building an inclusive society and a sustainable future. This report examines the contemporary challenges and prospects facing contemporary vocational education and training, emphasizing its importance in reducing socio-economic inequalities and promoting innovation.

As an element of the introduction of a new paradigm for humans, reconsideration at all levels is required. One of them is education, the quality of education and the opportunities it provides for all. (Eftimova, 2018) The problem that concerns with large groups of the population is the lack of qualification. We have a shortage of qualified workforce and at the same time – high percentage of unemployment. This paradox requires some innovative solutions. One of them is the hybrid professional training that can integrate the practice of formal and informal learning, as well as the distance education and dual training. (Yankova, 2017).

According to Article 1 of the Convention on the rights of persons with disabilities (2012), "Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which, in interaction with their environment, may hinder their full and effective participation in society on an equal basis with others."

In the 21st century, technology provides unlimited opportunities for personalizing learning content to support individuals with special needs. Thanks to a variety of tools – both free and paid – educational institutions no longer have an excuse not to offer more flexible and accessible education. In this process, soft skills play an extremely important role, which are of key importance for both educators and learners, ensuring more successful adaptation and integration into the learning and work environment.

Within vocational education and training (VET), the implementation of inclusive practices is essential to ensure equal access and learning opportunities for all learners, including persons with disabilities, marginalized groups and representatives of vulnerable communities (Nusheva, 2024).

Today, the system of vocational education and training is distinguished by its flexibility, which makes it increasingly attractive and in demand. Due to its short-term and practice-oriented nature, it is becoming extremely preferred. Trends indicate that in the future it will be even more attractive to the public, thanks to innovative teaching methods tailored to the requirements of the modern labor market. Through the integration of modern and so-called technologies such as virtual reality (VR), augmented reality (AR) and artificial intelligence (AI), training programs are increasingly starting to offer interactive and practice-oriented solutions that make the learning process more engaging and effective.

2. Soft skills and adaptability

Vocational education and training is not limited to acquiring technical knowledge and skills. In order to be effective and accessible to all, it must include the acquisition and development of the so-called "soft skills", which play a key role in our professional and personal development.

Soft skills include social, communication and emotional competencies that support successful professional realization. Among them are skills for effective communication, teamwork, critical thinking, adaptability, time management and conflict resolution. They complement technical knowledge and increase the ability of individuals to integrate and develop in the work environment.

The application of soft skills in vocational education and training is important for several main reasons:

- Improving communication – good communication between learners and trainers facilitates understanding and learning;
- Developing critical thinking and problem solving – learners learn to analyze situations and find effective solutions.
- Adaptability to change – soft skills prepare professionals for the dynamics of the labor market and technological innovations.
- Stimulating collaboration and teamwork – successful professionals often work in teams, where interaction is key to success.
- Improving leadership qualities – soft skills support the development of leadership potential, which is important for career advancement.
- Applying soft skills for effective and accessible training.

Integrating soft skills into professional training can be achieved through:

- Interactive learning methods, such as role-playing, simulations and case studies, which stimulate the practical application of skills.
- Group projects and discussions that develop cooperation and communication skills.
- Feedback and coaching that support the personal development of learners.
- Digital platforms that make learning more accessible and interactive.

Developing soft skills within vocational education and training is key to creating competent, adaptable and successful professionals. These skills, which include communication, teamwork, emotional intelligence, critical thinking and problem-solving, play an important role in improving workplace performance and career growth. By integrating these skills, learning becomes more effective, engaging and accessible to everyone, regardless of their professional or social background.

Soft skills enable individuals to navigate complex work environments, collaborate effectively with diverse teams and manage challenges with resilience and confidence. Employers are increasingly prioritizing these skills as they contribute to better leadership, improved decision-making and higher overall productivity. Furthermore, promoting soft skills within vocational training not only improves an individual's ability to adapt to technological advances and industry changes, but also fosters a culture of continuous learning and innovation.

Additionally, integrating soft skills into professional development programs fosters a more inclusive and supportive work environment. It empowers employees to build stronger professional relationships, improve customer interactions, and create a positive organizational culture. By implementing these competencies into training and education, employers can rest assured that their workforce remains competitive and prepared for the changing demands of today's labor market.

3. Concept for adapting training materials for professional qualification in the profession of "Librarian"

Adapting the curriculum for the profession of Librarian for individuals with special needs requires different methods and tools depending on the type of needs - sensory, cognitive, motor or other. The contemporary ICT and Artificial Intelligence (AI) are revolutionizing education, especially for individuals

with special needs. AI-based technologies provide personalized solutions that facilitate access to learning content, improve communication, and support the development of individual abilities (Dimitrova, 2024).

The ICT and AI can be used in several key aspects of the educational process for individuals with special needs:

Basic Adaptation Approaches

- **Differentiated teaching**, using different formats such as text, audio, video to present content to meet different learning styles. This approach also includes the element of gamification, as well as the use of infographics and interactive exercises to aid understanding and retention of information.
- **Accessible materials** – creating alternative formats for people with different disabilities, such as audio versions of texts, subtitles for videos, Braille books and text-to-speech software. This ensures equal access to educational content for people with disabilities or special needs.
- **Supportive technology** – using adaptive technologies and software such as screen readers, speech synthesizers, voice recognition applications and online learning platforms with the ability to customize. The integration of artificial intelligence and algorithms for individual progress tracking facilitates adaptation to the needs of each learner.
- **Practical learning** – implementing more demonstrations and working in a real environment, tailored to the needs of learners. This can include simulations, internships, project work and role-playing games that encourage the acquisition of knowledge through practical experience.
- **Personalized learning plans** – flexible learning according to the learning capabilities of each learner. It includes individualized strategies, mentoring and adapting the pace of teaching according to the level and needs of learners. This allows for a more effective and motivating learning experience for learners with special needs.

The adaptation of the educational content for the profession of Librarian must be flexible, digitally accessible and tailored to the individual needs of the learners. The use of specialized software, visual and tactile materials, as well as alternative teaching methods will ensure efficiency and accessibility.

Examples of adaptation that can be applied in the adaptation of the educational content of the qualification courses for the profession of "Librarian"

- Video lessons with sign language or subtitles;
- Visual instructions and infographics to explain library processes;
- Providing written communication training for interaction with readers;
- Using simple language and structured text (short paragraphs, clear definitions);
- Interactive lessons with graphic symbols and colored markers for better understanding;
- Digital resources with audio guidance and the ability to customize settings;
- Interactive games for learning in library activities.

Examples of adapted learning activities

Book cataloging and sorting training

- For visual impairments – tactile sorting markers.
- For hearing impairments – video lessons with sign language.
- For cognitive impairments – visual instructions with steps.

Working with library software

- For motor impairments – using an on-screen keyboard.
- For dyslexia – fonts such as OpenDyslexic for better readability.

Reader service

- For hearing impairments – written communication training.
- For cognitive impairments – role-playing games to learn communication skills.

Tools for effective adaptation of learning content

Text-to-Speech & Speech-to-Text Software

- **NaturalReader** – Converts text into speech for students with dyslexia or visual impairments.
- **Google Read&Write** – Provides reading, writing, and literacy support for learners with learning disabilities.
- **Dragon NaturallySpeaking** – Speech recognition software that helps students with mobility impairments or dysgraphia.

Screen Readers & *Magnifiers*

- **JAWS (Job Access With Speech)** – A popular screen reader for visually impaired students.
- **ZoomText** – Magnification and screen-reading software for learners with low vision.

Augmentative and Alternative Communication (AAC) Tools

- **Proloquo2Go** – A speech-generating app for non-verbal students.
- **CoughDrop** – A cloud-based AAC app that helps learners with communication challenges.

Learning Management Systems (LMS) with Accessibility Features

- **Google Classroom** – Offers voice typing, screen reader compatibility, and captions for videos.
- **Microsoft Teams & OneNote** – Supports Immersive Reader for dyslexic students and note-taking accommodations.
- **Moodle & Blackboard** – Customizable accessibility features, including captions, transcripts, and alternative content formats.

Universal Design for Learning (UDL) Strategies

- **Multiple Means of Representation** – Use videos, infographics, interactive simulations, and audiobooks.
- **Multiple Means of Action & Expression** – Allow students to demonstrate knowledge via oral presentations, art, or hands-on projects.
- **Multiple Means of Engagement** – Gamification, project-based learning, and real-world applications.

Specialized Educational Apps

- Bookshare – Provides accessible ebooks for students with visual impairments or dyslexia.
- ModMath – An app that helps students with dysgraphia do math without handwriting.
- Seeing AI – An AI-powered app that describes surroundings, objects, and texts for visually impaired learners.

Captioning & Sign Language Support

- **Otter.ai** – Real-time transcription for hearing-impaired students.
- **Google Live Caption** – Automatically generates captions for spoken content.
- **Sign Language Apps (The ASL App, Signily)** – Helps communicate with learners who use sign language.

Language learning apps:

- Duolingo: AI analyzes learners' progress and adapts lessons according to their needs.
- Busuu: Combines AI with native speaker feedback.
- Rosetta Stone: Uses AI for interactive pronunciation exercises through speech recognition.

Practice chatbots: AI bots like ChatGPT allow learners to practice language through realistic dialogues.

Voice recognition and feedback: Technologies like Speech-to-Text and pronunciation assessment systems help improve speaking skills.

Creating educational videos - AI makes it easier to produce educational video content:

- Animation and visualization generation: Apps like Vyond and
- Animaker use AI to create interactive educational animations.
- Video lesson synthesis: Platforms like Synthesia allow to automatically generate video lessons with virtual avatars.
- Subtitles and Translation: AI tools like Descript and Rev automatically add subtitles and translate video content (Dimitrova, 2024).

4. Conclusions

Today, vocational education and training plays a fundamental role in building a more competitive and adaptable workforce. The application of soft skills in the educational process not only supports successful professional realization, but also creates a more accessible, inclusive and sustainable learning

environment. Critical thinking, effective communication, adaptability and teamwork are among the key competences that facilitate the integration of individuals into the labor market.

Special attention should be paid to the adaptation of training materials for professional qualifications, such as the profession of "Librarian", for people with special needs. The use of differentiated teaching, accessible materials, assistive technologies and personalized curricula ensures equal access to knowledge and opportunities for all learners.

The integration of modern digital resources and accessibility tools, such as text-to-speech software, screen readers and interactive educational platforms, further facilitates learning and enhances its effectiveness.

In conclusion, the successful adaptation of vocational education and training to the needs of modern society requires a combination of technological innovation, inclusive practices and the acquisition and upgrading of various soft skills. In this way, a sustainable and equitable education system is built, which adequately responds to the demands of the modern labor market and promotes the inclusion of all people in economic and social life.

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This report was developed within the framework of a scientific research project “A model for evaluating the effectiveness and quality of inclusive education, training and lifelong learning” with contract № КП-06-Н80/1, funded by National science fund of Bulgaria.

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THE NEW TEACHING PROFILE IN BASIC EDUCATION: CHALLENGES OF SUSTAINABLE DEVELOPMENT OF THE 21ST CENTURY

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Abstract

In Mexico, basic education has gone through different political, social and economic transformations in its history (1920 – 2024), impacting the teaching profile. The most recent educational reforms were those of 2013 and 2022, whose main objective was to improve educational quality and meet the demands of sustainable development of the 21st century. The document presents a comparative analysis of these latest reforms, based mainly on axes such as the educational paradigm, the subject of the teacher's work and curriculum. The study concludes that although the 2022 reform, called the New Mexican School, is an innovative proposal, it faces challenges of solidifying the teaching profile and its success will depend on its tight execution, as well as the commitment of all those involved in the educational system.

Keywords: *Teacher profile, basic education, sustainable development.*

1. Introduction: Historical vision of educational reforms

Throughout the history of Mexico, education has gone through various stages of transformation. At the foundation (1920 – 1934), José Vasconcelos, founder of the Secretariat of Public Education (SEP), in 1921, initiated the great national literacy course (Guevara, 2011, p. 16). Lázaro Cárdenas del Río made education a universal right, the expansion of coverage was accelerated, and "socialist education" was promoted. (Montes de Oca, 2007, p. 113). In 1943, Jaime Torres Bodet maintained and strengthened the growth of coverage, and, starting in the 1950s, a new concern began to take shape when it was noted that "the curriculum, teacher training, and teaching methods were neglected." (Guevara, 2016, p. 22). Those years progressed until concern for educational quality was placed at the center (1970 – 2000), since "it is not only about training a greater number of professionals, but also about providing useful knowledge" (Echeverría, 1973, p. 8 as cited in González, 2018, p. 107). In the government of Carlos Salinas de Gortari, in 1992, the National Agreement for the Modernization of Basic Education (ANMEB) was created, which "…assigned great power to the unions" (Bensusán and Middlebrook, 2013, pp. 65-66). Finally, during the government of Vicente Fox Quesada (2000 – 2006), "the Social Commitment to the Quality of Education" was strengthened (Cherem, 2005, p. 93).

2. Recent educational transformations of the public sector in Mexico: From the 2013 reform to the New Mexican School in 2022

The main objective of the recent reforms (2013 - 2024) has been to consolidate a teaching profile and an educational model that meets the educational demands required by the sustainable development of the 21st century.

We agree that transforming the educational system is not an easy task because "Education has deep roots that do not change by decree, but in a process that is mediated by the training and conviction of educational actors, especially teachers" (Candela, 2023, p. 17). The challenge of raising quality standards remains constant and the question prevails, how to move from theoretical discourse to reality? with the aim of obtaining significant results in learning and that these are reflected. both in the national evaluation system PLANEA (national and standardized), in SisAT (diagnostic and formative), and in PISA at an international level[*].

Educational reforms generally address comprehensive and binding aspects. In this installment we are only going to focus on the proposal of the 2017 educational model, of the government of Enrique Peña Nieto (2013 - 2018;) as well as the 2022 educational model, of the New Mexican School, which was established in the period of Andrés Manuel López Obrador (2019 - 2024) (Table 1). The latter known as

[*] The national evaluation: National Plan for the Evaluation of Learning (PLANEA), Early Warning System (SisAT). International test: Program for International Student Assessment (PISA).

the political moment of rupture, since for the first time recognized center-left parties won the elections in Mexico.

Table 1. Comparison of educational models: what is new?

Ideas Strength	*Educational model, Reform 2013 and its educational model 2017*	*Educational Model: New Mexican School (NEM) 2022*
educational paradigm	*The four pillars of education are taken up and strengthened in the Curriculum: Learning to learn, to know, to do and undertake, to live and to be. This is aligned with the curricula of the normal schools of the Ministry of Public Education.*	*Project-based learning is proposed, built from the experiences and knowledge of those who participate and intervene in community educational processes.* *This is NOT aligned with the curricula of the normal schools of the Ministry of Public Education*
The subject of the teacher's work	*Learning based on thematic objectives: Academic training fields: Language and communication; mathematical thinking and exploration and understanding of the natural and social world.* *Objective: individual education based on competencies.*	*Improve project-based learning in each of the training fields: Languages; Scientific knowledge and thinking, Ethics, nature and society; Of the human and the community.* *Objective: collaborative project-based education*
Construction of academic curriculum	*Curricular Autonomy: Schools are empowered through the School Technical Councils (CTE) - to incorporate the contributions of the School Councils for Social Participation (CEPS) - to make pedagogical and organizational decisions based on the regional, social context and needs of their students.* *Also considering the Areas of Personal and social Development.*	*Curricular Integration: Schools are empowered through the School Technical Councils (CTE) - to incorporate the contributions of the School Councils of Social Participation (CEPS) - to build the analytical program oriented to learning based on projects, ... inquiry (STEAM), ... problems related to the Training Fields.* *Also considering its seven Articulating Axes: Inclusion, critical thinking, critical interculturality, gender equality, reading and writing development, aesthetic education and healthy living.*
Curricular standards	*Key Learnings. What boys and girls should know as a minimum basis at the end of the school year of the Study Program.* *It constitutes a homogeneous objective of the learning necessary to be competitive at an international level.* *It is about acquiring life skills, disciplinary skills, expected learning, development of socio-emotional skills and an inclusive approach.*	*¨Graduation profile. That boys and girls develop critical thinking that allows them to value the knowledge and knowledge of the Training Fields.* *It is about "Reconceptualizing the curriculum as an open proposal, built from the experiences and knowledge of those who participate and intervene in the educational processes." That is, "... a process of school groups so that the components proposed in the 2022 Study Plan (...) acquire meaning and are articulated in favor of making schoolwork relevant and situated."*

Source: Own elaboration with data from Gutiérrez, E. (2019), Education for the New Generation of Mexicans. Plaza y Valdés S.L. Calle Murcia, 2. Colonia de los Ángeles Pozuelo de Alarcón 28223, Madrid, Spain.
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Note: Science, Technology, Engineering and Mathematics (STEAM).
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3. What is new about the proposal of the New Mexican School (NEM), 2021–2022 in Public Education

Although only five years passed between both reforms, a very short time to make such a radical change, the 2013 Reform had left pending issues that were pointed out with opportunity. Gutiérrez, (2019) points this out about the educational model: "Recognizing the innate curiosity of girls and boys, attending to and respecting their need to explore the world in freedom, to have playful experiences, constitute optimal practices for learning. The educational process must form reflective people, capable of asking questions, looking for solutions and reaching results" (p. 47). And he continues: "Within the framework of the 2017 Educational Model proposal, it is necessary to consider the following aspects:

- Recognize memorization as a function of the brain that must be enhanced with learning processes oriented towards the definition of projects.
- Leave behind the isolation of the student in the classroom and move towards collaborative work.
- That part of the learning be online (Wojciki E. and Izumi L. 2016) so that the student faces the commitment of his own education and development of his skills in a world open to information, knowledge and the use of technologies" (p.51).

To analyze the contributions of the NEM educational model, four strong ideas were selected: 1. The educational paradigm, 2. The subject of the teacher's work, 3. Construction of the academic curriculum. 4. Curriculum standards (see table 1). These not only guide the teaching work but also define the structure and objectives of the teaching-learning process at school.

a) The educational paradigm

It is here where the most significant innovative break in the educational model of the New Mexican School is made and constitutes its transversal axis since it proposes that learning be based on projects, in a general way, throughout the scope of the Curriculum. And it is specified, in the contents of each of the Training Fields: "Language; Scientific knowledge and thinking; Ethics, nature and society; Of the human and the community" (SEP, 2022, p. 135), and its Articulating Axes: "Inclusion, critical thinking, critical interculturality, gender equality, reading and writing development, aesthetic education and healthy living" (SEP, 2022, p. 113).

Also, it is established that the processes of contextualization and co-design of curricular content "... will be built from the experiences and knowledge of those who participate and intervene in community educational processes" (MEJOREDU, 2023, p. 4). This constitutes another great shift, from "Learning to Learn", focusing on individual and competency-based learning, of the 2013 reform, towards a collaborative model based on the definition of NEM projects. The latter brings with it another innovation because now the teacher's work does not fall on an individual activity, but on an activity of leadership and conduction of collective community school processes. This proposed educational model constitutes, at the narrative level, an advance of the greatest importance.

In this sense, certainly project-based learning and its implications in school management as a guiding idea of public education is an innovation and very important, however, its implementation presents many difficulties, including:

- The difficulty of going from theory to practice.
- The contradiction: the model promotes the participation of collective community school processes (governing bodies, teachers, workers, parents), but none of them were called to participate in the construction of the new educational model.
- Teacher training schools maintain previous educational programs.
- The training and training of project-based learning has been insufficient.

b) The subject of the teacher's work

In the 2013 reform, the teacher's work subject - based on the four pillars of Learning to Learn - consisted of achieving thematic objectives defined in the Academic Training Fields: Language and Communication, Mathematical Thinking, Exploration of the Natural and Social World, expressed and guided fundamentally by the textbooks published by the Ministry of Public Education.

In the New Mexican School model, the teacher plays a different role; he must now attend to the participation of parents in their proposed involvement in project-based learning, in addition to their contribution of these experiences in the School Technical Councils. A feature of the teacher's new subject of work is to be the actor-director of collaborative education, under the motto: Let's Learn in Community.

Indeed, it is the teacher's responsibility to develop the analytical program considering the "… analysis of the socio-educational context of the school, contextualization and co-design of content" (MEJOREDU, 2023, p. 2). Under this educational model, didactic planning is carried out according to the needs of the school context. With the purpose of exemplifying this substantive change in the teacher's work subject, an activity that appears in "...A book without recipes for the teacher" of third grade (phase 4)[†] is specified. This textbook instructs the teacher to approach project-based education and offers an example that is organized in several stages, as CONALITEG (2024):

For example. The teacher decides to implement the school project "water problem in my community", which will be made up of the following moments:

1. According to the learning phase where the girls and boys are, suggest that they go to the community (their family or group of friends) and ask people the following:
   - Do they live with any water-related problems?
   - What do you think is the reason that causes this problem?
   - How would you solve it?

[†] "Synthetic study program: Phase 1; initial education from 0 to 3 years. Phase 2; preschool 1st, 2nd and 3rd. Phase 3; 1st and 2nd primary. Phase 4; 3rd and 4th primary. Phase 5; 5th and 6th primary. Phase 6; secondary school 1st, 2nd and 3rd" (SEP, 2024).

- Of course, students can create their own questions.

2. Ask the girls and boys to organize the information according to the answers, that is, organize them according to age, gender or location.
3. Support students to present the results of their project to the group, school or community itself. This can be through drawings, writings, posters, images, an artistic staging or a combination of all of them, or those decided by the group with the teachers (p.14).

In this work, A book without recipes for the teacher, topics are addressed at an example level for all Training Fields.

c) Curricular standards

This strong idea integrates what boys and girls should know at the end of the school year. With the 2013 Educational Reform, in the document "Key Learning for comprehensive education. Plan and Study Program for Basic Education", the specific features are presented: "Language and communication, mathematical thinking, exploration and understanding of the natural and social world, critical thinking and problem solving, socio-emotional skills and life project, teamwork collaboration, coexistence and citizenship, artistic appreciation and expression, attention to the body and health, care for the environment and digital skills" (SEP, 2017, p. 23). Each of them describes desirable traits; What students should know at the end of each year in basic education. In addition, the SEP highlighted the importance of promoting the development of transversal values: "resilience, innovation and sustainable development."

For its part, in the model of the New Mexican School, 2022: The Plan and Program is based on Training Fields, which promotes "… the plurality of knowledge and knowledge from different disciplines with which to approach the reality that one wants to study" (SEP, 2024, p. 139). Under this model, "the graduation profile is related to the trajectory of the students, which responds to specific conditions of their development, context, rhythms and learning styles" (p. 97). However, it does not show what specific knowledge, and skills students must have in the graduation profile.

It is evident that both 2013 and 2022 reforms seek to improve education in Mexico, although with different approaches. However, the lack of specification of knowledge and skills of the graduation profile in the NEM could generate uncertainty, where student learning is directed in each of the phases, previously called school cycles, to achieve the knowledge of each stage.

4. Conclusion

In Mexico, defining the primary education teacher profile for public education is a challenge that prevails despite the great efforts that have been made throughout history. A fundamental situation to be resolved are the parameters that support the access, retention and promotion of teachers, considering that they are transformed in each of the government periods, therefore, it is not possible to transition to quality education if a long-term teaching profile is not defined.

In the 2013 Reform, the General Law of the Professional Teaching Service was created, which constituted its fundamental contribution since it took away from the union (and allied politicians) the power to define who entered the educational system and in its place, it was established that both entry and mobility to management positions would be by competition with strict and transparent protocols. Furthermore, the evaluation and monitoring process of entry, permanence and promotion in the educational system would be through evaluations carried out by the National Institute of Educational Evaluation (public, autonomous and decentralized body). But also, permanence and incentives for performance merit oversaw the National Coordination of the Professional Teaching Service (CNSPD). In fact, the criterion of seniority is abandoned, and the criterion of merit is moved as the guiding axis of mobility in the teaching world. Mentions Arnaut, (2017). "The era of education workers is ending and that of education professionals is beginning" (p. 35).

The center-left government promised to restore dignity to teachers and recognize their work. He proceeded to repeal the Law of the Professional Teaching Service and replaced it with the General Law of the System for the Career of Teachers, which deduces; The Supervision and Monitoring Unit of the System for the Career of Teachers, which oversees the process of entry, permanence and promotion of teachers, however, "is scheduled to be eliminated." (SNTE, 2024).

And the question: is it possible to ensure a quality teaching profile without establishing strict and transparent regulation that establishes the pedagogical requirements and knowledge for admission? Consequently, the lack of solid support prevails for the following moments of learning the educational model of the New Mexican School:

- From entry: there is no articulation of the Study Plans and Programs of the teacher training schools with the basic education teaching profile.
- From permanence: teachers lack timely and continuous training to attend to project-based and collaborative learning with school community agents.

- Since the teacher's promotion in the world of work, the acquisition of new knowledge through postgraduate studies “is not valued”, since we returned to the old scheme where the most senior teacher acquires a higher score.
- The profound contradiction: can there be quality in the learning proposed by the educational model, without ensuring that there are certified educational professionals upon entry?

The sustainable development of the 21st century needs teachers trained and prepared for the continuous acquisition of new knowledge, information technologies, training in investigative thinking, with a vocation as leaders of leaders and an affective and emotional commitment to children, capable of adapting to transformations and converting classrooms into environments to innovate, foster critical thinking and reflect, and train citizens to love their country and democracy.

The success of the New Mexican School will depend on the actions carried out by each of the members of the structure of the educational system and society if they participate and mobilize to defend above all the right of boys and girls to receive a quality education in the public educational system of Mexico. However, it is still too early to know if the purposes of improving educational quality will be achieved with the New Mexican School or if there would have been a better option, for example, the gradualist one. That is, start with the proposal of project-based learning in only one of the training fields, to facilitate the transition, both in the training and training of teachers, and in maturing the exercise of democratic participation in community educational processes, embodied in said model.

Education is everyone's task, with the aim of appropriating the new educational paradigm with a comprehensive and humanistic approach.

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DESIGNING ENTREPRENEURS: STRUCTURING AN EDUCATIONAL FRAMEWORK FOR DESIGN-DRIVEN ENTREPRENEURSHIP

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Abstract

The evolving global economy and an ever-increasing crisis, requires new sources of innovation to respond effectively to the problem. In this panorama, entrepreneurship has a central role: Startups are crucial in fostering innovation, creating jobs, and driving socio-economic growth. Startups, as a key entrepreneurial phenomenon, contribute to the development and dissemination of new solutions but face significant challenges, including market uncertainty and high failure rates mainly due to a lack of needs on the market. Design (Thinking), with its user-centred and iterative approaches, offers unique tools to address these issues, making a compelling case for integrating design-driven methodologies into entrepreneurship education. However, educational pathways concerning entrepreneurship that integrate design principles within their programs remain extremely rare, underscoring the necessity to (re)design curricula that incorporate this approach towards entrepreneurship. This paper explores how design integration can enhance entrepreneurship training in higher education, using the "Design Startup" course developed at the Design School of Politecnico di Milano as a case study – which embed a mix of Design and Management contents. Results indicate that this approach effectively equips aspiring entrepreneurs to address common startup challenges, such as misaligned products and inefficient resource use, by focusing on real user needs and iterative solution testing. The study concludes that embedding design methodologies into entrepreneurship education bridges the gap between creative problem-solving and business strategy, offering a replicable model for teaching entrepreneurial resilience and innovation, preparing new entrepreneurs to contribute in societal economy.

Keywords: *Entrepreneurial education, design education, design-driven methodologies, higher education, design-driven innovation.*

1. Introduction and theoretical background

The implication of the global economic crisis, as escalated by the accelerated development ushered in by the Fourth Industrial Revolution, has made innovation a key instrument for elevating economic competitiveness among both developed and emerging economies (Baumol, 2002). Innovation is becoming more important for its multifaceted socio-economic effects encompassing the rise in living standards, the development of innovative products, and the increase in job opportunities.

Within this innovation paradigm, entrepreneurship, particularly entrepreneurship in the startup context, has emerged as a key driver of technological innovation and economic dynamism (Luger & Koo, 2005). Startups fulfill the role of igniting flexible, experiment-based innovation regimes that differ from the inertias of incumbent firms (Freeman & Engel, 2007). Startups also act as drivers of regional economic development as vectors of job creation, knowledge spillovers, and entrepreneurial ferment. However, for all their potential, the startup journey is fraught with risk; startup failure rates remain high. As Eisenmann (2021) discusses in Why Startups Fail, among the prime culprits is the occurrence of "false starts"–a failure to validate customer needs before launching a solution, resulting in products that ultimately have no market fit.

Of the many innovation models adopted to overcome these challenges, Design Thinking (DT) has attracted a lot of attention owing to its success in managing the uncertainty and complexity associated with entrepreneurship. Its emphasis on empathy, experimentation, and iterative development makes it a suitable complement to entrepreneurial practice. As Barringer and Gresock (2008) point out, entrepreneurship is an integrative process encompassing opportunity identification, idea generation, feasibility analysis, and implementation—each of which is supported by the flexibility and creativity that DT fosters.

This convergence of entrepreneurship and design thinking (DT) has attracted more scholarly and institutional attention in merging design methodologies with business curricula (Garbuio et al., 2018; Glen, Suciu, & Baughn, 2014; Sarooghi et al., 2019). The two fields are aligned in their dedication to opportunity development, specifically by reframing products, services, systems, and business models. This common ground fosters a future-oriented mindset that welcomes uncertainty and iterative learning—a competency essential to dealing with the turbulent dynamics of contemporary business contexts (Garbuio, 2018). In addition, design thinking's value reaches beyond enterprise inception stages, providing insightful approaches and methods in subsequent stages, e.g., evaluation and expansion (Carella et al., 2023).

Education systems must embrace such hybrid models. As Crescente-Romero et al. (2019) assert, Europe's future competitiveness in the world will depend on creating a new generation of entrepreneurs who can fill employment gaps and create employment. Entrepreneurship education remains imbalanced across the continent. Entrepreneurial mindsets are increasingly promoted in primary and secondary education, yet comprehensive and structured experiences are rare in most national contexts. Fixson et al. (2012) point out that to create future innovators, there is a need to merge business education and design education and devise a formula helpful to dispel current challenges.

Design Thinking integration into business education has emerged as a successful pedagogical method of developing adaptable and creative entrepreneurial competencies.

Its user-centered, iterative, and problem-solving nature differs from traditional linear business planning methods (Daniel, 2016; Sarooghi et al., 2019). DT enables experiential learning settings where students can empathize, ideate, and prototype in real-life contexts (Kremel & Wetter Edman, 2019). Empirical studies demonstrate that incorporating Design Thinking (DT) in entrepreneurial curricula maximally enhances the capacity of students to absorb uncertainty, hence increasing their potential for transforming uncertainty into sustainable opportunities (Linton & Klinton, 2019; Huq & Gilbert, 2017). Unlike the rigidly analytical reasoning that will not fully serve to respond to ambiguous and poorly defined challenges, DT equips students with intellectual tools such as abductive reasoning, analogical mapping, and reframing—to adopt more evolved and versatile means of confronting entrepreneurial challenges (Garbuio et al., 2018).

Despite the increasing efforts for developing entrepreneurial skills from an early age, there still exists a large gap in structured support for skills like creativity, problem-solving, and resilience in many education programs (European Commission, 2016).

Although these qualities are generally recognized as essential for entrepreneurial success, they are still not adequately addressed in standard curricula. In such a context, incorporating Design Thinking into entrepreneurship curricula has become pertinent and imperative. The point where technological disruption, changing job markets, and intricate global dilemmas converge demands a reformulation of pedagogical approaches to entrepreneurship education. Hybrid learning frameworks that balance analytical rigor with creative inquiry can empower the future generation of business leaders to tackle these challenges with empathy, innovation, and agility. By incorporating DT into formalized academic curricula, schools can cultivate professionals capable of handling uncertainty, sensing concealed opportunities, and co-creating value in a way that is attuned to the dynamics of the economy today.

Despite several contributions demonstrating the potential of the intersection of entrepreneurship and Design Thinking courses as an effective pedagogical methodology—and that such programs ought to be further developed—there is scarce research that thoroughly describes these experiences. More precisely, there is a shortage of research that deals with the perceived gains derived from the confluence of these methods in teaching curricula.

This paper aims to shed light on the experience accumulated through the "Design Startup" course of the School of Design of Politecnico di Milano. It will outline the suggested model, merging Design Thinking and Entrepreneurship, and the perceived benefits reported by students who have pursued their entrepreneurial ideas in recent years.

2. Storyline and methodology

The Design Startup course is an elective provided to students pursuing the School of Design undergraduate program at the Politecnico di Milano. Available to students pursuing any of the four bachelor's degree programs, the course consists of thirteen four-hour classes. The design orientation of the institution was upheld since the course was explicitly planned to exceed generic business-oriented startup education by providing a solid design-thinking-based approach in the initial phases.

The first part of the course focuses on introducing the students to three core methodologies central to the domain of design: Design Thinking, Design Sprint, and the Lean Startup Methodology. These methodologies are taught in a sequence that provides students with a comprehensive toolset: to first develop empathy for the users; second, to enable quick and creative idea generation; and third, to effectively test

assumptions for ensuring their alignment with users' needs. The teaching curriculum also comprises user interaction techniques and other analytical tools. Students are also provided with a suitably selected set of open-source material, along with specifically tailored material created by the instructors.

The second half of the course turns its attention to management and economics, the basics. Topics include the Business Model Canvas, with particular attention to commonly adopted revenue models in early-stage startups. The students are also introduced to income statement building and analysis to enable them to estimate the point at which a business will break even. Moreover, the course deals with major startup investors' functions and the different legal structures that a startup may follow in its development into a mature business.

From a pedagogical perspective, the course aims to integrate theory with practice to aid in developing entrepreneurial ideas, focusing on a design-based approach, economic viability, and the action steps to establish and develop a business. Each session usually consists of 2.5 hours of course material and a 1.5-hour presentation by founders of startups. These guest entrepreneurs also share their journey—from initial ideation and seed funding through major obstacles they overcame and how they did so. There is also an open Q&A session in each.

Parallel to the lectures, the students have to work on an innovative idea, developing an entrepreneurial pitch. The experiential project challenges the students to use theoretical knowledge in a practical context. All students present their business idea at the conclusion of the course in a three-minute pitch presentation format, thereby simulating an investor presentation.

This study presents an analysis derived from a questionnaire distributed to graduates of the program. It aimed to ascertain their views regarding the course's interdisciplinary nature—combining design and management approaches—and learn about their perceptions of the implemented interdisciplinary education system.

The survey collected 68 responses and employed a mixed-method structure, combining open-ended questions with Likert scale items. Specifically, the questionnaire was divided into three sections: the first aimed to determine how much and why the participants appreciated the course, valuing the educational format; the second explored how they perceived important and integrated the different contents of the course, mainly focusing on the contribution of the Design part into the entrepreneurial one; the last part was related to their evaluation of the course’s relevance to entrepreneurial career development. The responses were collected in an Excel file and analyzed using descriptive statistical methods and visual representations (Hays, 1973). The findings were discussed and interpreted by a research team composed of two faculty members and three academic researchers.

3. Results and discussion

A comprehensive survey was administered to former students of the Design Startup course. The questionnaire combined both quantitative and qualitative items. It was structured using a 5-point Likert scale to evaluate the extent of agreement with a series of statements. In this context, a score of 1 represented strong disagreement and a rating of 5 represented strong agreement with the suggested claims. Besides this, the questionnaire had multiple-choice questions and open-ended questions intended to validate, triangulate, and expand knowledge of the results obtained from the Likert-scale rating.

Starting with the evaluation of the educational format, overall student feedback was highly positive. Students reported overall satisfaction with the course structure and content, with the overall level of satisfaction rating 4.8 out of 5. Open-ended comments also reflected the perceived success of the format, which was described as a well-balanced mix of theoretical instruction, real-world testimonials, and project-based work. The combination of these elements was repeatedly emphasized as a primary strength that enabled students to link theoretical concepts with real-world relevance, thereby equipping them with a sound basis for entrepreneurial engagement. Students commended the equal representation of design-oriented and business-oriented viewpoints, commenting that this mixture was not only academically challenging but also strategically beneficial, as it allowed them to connect innovative ideas with business viability—two indispensable factors in any entrepreneurial endeavor. About the different external guests, students indicated that these testimonials were especially effective, as they offered genuine, context-filled explanations that complemented the theoretical knowledge. Numerous students indicated that hearing about the risks, uncertainties, and perseverance of actual entrepreneurs made them feel more confident, thereby reducing the fear and uncertainty too commonly linked with the process of initiating a business venture.

The second half of the research was about the relevance of incorporating Design Thinking into Entrepreneurship and how they benefit from the combination. Before the course, most of the students did not envision a conceptual or practical connection between the two fields. Survey data corroborated this observation: students rated their original understanding of design-entrepreneurship relationships at 3.09 out of 5. This understanding, however, underwent considerable transformation during the program. After the

course, the same aspect was rated at an average of 4.68 out of 5, indicating a significant change in the learners' conceptualisation of design approaches as a component of entrepreneurial pursuits.

This transition highlights the framework's success in transcending disciplinary boundaries and acclimating learners to a cross-modal cognitive perspective—blending the empathy, inquiring mindset, and iterative process intrinsic to Design Thinking and the strategic planning, viability evaluation, and scalability considerations intrinsic to entrepreneurship. Students reported that they gained a clearer understanding of how the tools and methods of each discipline might be combined to create robust, innovative, and user-centered business ideas.

The questionnaire also investigated students' perceptions of the significance of Design Thinking in facilitating the creation of new entrepreneurial ventures. The mean score for this factor was 4.2 out of 5, reflecting a broad consensus on its significance. To investigate this factor further, the questionnaire contained a multiple-choice question, requesting students to identify what they perceived as the primary advantages of incorporating Design Thinking into the entrepreneurial process.

The most valued benefit, according to 89% of participants, was being able to discover user needs and utilize these insights for entrepreneurial development. This result aligns with existing literature. For instance, Nielsen and Stovang (2015) posit that integrating experiential entrepreneurship education with the open-minded, empathetic Design Thinking mindset enables students to more effectively grasp unmet needs and develop applicable, human-centered innovations. To this end, the course specifically tackled what CBInsights (2021) recognizes as one of the underlying causes of startup failure: the development of products or services that do not meet actual user demands.

The second benefit, by appreciation value, chosen by 81% of the participants, was the facilitation of innovative and creative problem solutions. The format allowed students, in the view of students, to practice what literature refers to as creative reframing—the capacity to reframe problems and view them from various aspects, resulting in the design of new solutions. This capacity, as noted by Carella et al. (2023), is a distinctive trait of many successful startups and is considered a core capability in uncertain and dynamic business environments.

A third key takeaway from the responses, as proposed by 78%, is the positive observation on the course's role in developing an iterative mindset. The iterative mindset developed from the course enabled participants to prototype rapidly, gather and analyze feedback, and refine their ideas through cycles of refinement or strategic pivoting. As posited by Martin (2009), iteration is one of the fundamental principles in effectively managing the uncertainty and complexity that mark the entrepreneurial environment. Students recognized the value of embracing failure as a learning opportunity and found that doing so was liberating and confidence-enhancing.

Another significant value discovered in the course was the convergence of complementary methods such as Design Thinking, Design Sprint, and the Lean Startup approach. This component was particularly well-received, where the usefulness of discovering the three methods received an average rating of 4.83 out of 5. Students appreciated how the course provided not just conceptual knowledge but also actionable frameworks they could use to structure their innovation processes. Relevant academic contributions further underscore the value of combining these methods. Müller and Thoring (2012) compared Design Thinking and Lean Startup, observing that although they have differing natures, they are both dedicated to user-centered development, test, and iteration. While Design Thinking is more likely to tackle ill-defined, exploratory issues in linear stages (Understand, Define, Ideate, Prototype, Test), Lean Startup is concerned with market-based innovation through a Build–Measure–Learn loop (Ries, 2011).

Understanding the distinctions and complementarities between these approaches enabled students to make informed methodological decisions, depending on the stage and nature of their entrepreneurial projects. The exposure to this methodological plurality was cited as an important factor in developing adaptability, a critical skill for navigating the uncertainties and demands of real-world entrepreneurship. Students felt that learning how to shift between methods and integrate their tools enhanced their ability to deal with diverse entrepreneurial scenarios, from ideation and validation to scaling and business model refinement.

In light of the above, the educational framework proposed and tested in the Design Startup course can be considered a promising prototype for integrating Design Thinking into Entrepreneurship education. Its potential to balance theory, practice, emotional learning, and methodological pluralism provides a solid basis for replication or adaptation within other university settings. The model not only enhances entrepreneurial competencies but also enhances key soft skills such as empathy, adaptability, and resilience.

Nevertheless, a number of future research and development directions arose. One of the main dilemmas is achieving a balance between creativity and feasibility. Although the course was effective in encouraging creative thinking, some students required tools that have the potential to close the vision-execution gap. Future educational interventions can be geared towards creating frameworks in which

students can pursue imaginative exploration without compromising the ability to consider pragmatic constraints and business viability.

Another recurring theme in the feedback was related to decision-making under complexity. While students appreciated the exploratory nature of Design Thinking, some struggled to synthesize a number of insights and choose a strategic direction. A student noted that "the extremely exploratory nature of Design Thinking can occasionally go off on a tangent, and it is easy to lose focus." Future versions of the course may be enhanced by incorporating decision-support tools or heuristic frameworks that enable students to prioritize alternatives and assess trade-offs more efficiently.

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THE CONTRIBUTION OF STEM EDUCATION IN CREATING AUTHENTIC LEARNING AND ASSESSMENT ENVIRONMENTS IN K-12 EDUCATION

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Abstract

STEM education can contribute to the creation of authentic learning and assessment environments, as STEM activities foster practical engagement, integrate technology and innovative tools, promote a multidisciplinary approach, link different scientific fields, and enhance critical thinking and creativity among students. The aim of this research was to investigate the extent to which STEM is applied by teachers in primary and secondary education in Greece and how it contributes to authentic learning. It is crucial that teachers are well-prepared and equipped to support students in attaining higher levels of understanding, which can provide them with academic opportunities in science and technology. Through authentic learning, students construct their own knowledge in realistic environments. Furthermore, authentic settings emphasize the social nature of knowledge, which benefits student comprehension and application. Instead of memorizing information, students learn how to learn through hands-on experiments and simulated exercises. By engaging in complex, open-ended problems, students develop skills, search for information, and use critical thinking to solve challenges. They actively participate in practical activities, monitor their progress, and evaluate their final work based on specific criteria that provide a summative assessment of their learning. The aim of this study is to investigate the degree of STEM implementation in primary and secondary education and STEM's contribution to the creation of authentic learning and assessment environments. Fifteen teachers, mostly members of the Hellenic Education Society of STEM, participated in this study. Semi-structured interviews were conducted, and qualitative analysis was used to identify key themes related to how STEM promotes authentic learning and assessment. The initial themes that emerged from the data analysis include the degree of STEM implementation in K-12 education, the contribution of STEM teaching to authentic learning and assessment and barriers to creating authentic learning and assessment environments in STEM teaching. Additionally, the study identified key challenges that teachers face in implementing STEM education, including limited access to STEM resources, a lack of flexibility in developing STEM curricula and the necessity for professional development opportunities that do not infringe on teachers' time. Participants emphasized the importance of securing dedicated time for professional development to prevent teacher burnout and ensure the effective implementation of STEM learning. The shortage of resources, training, and teacher support were highlighted as significant obstacles in creating authentic learning and assessment environments through STEM education. Addressing these challenges can help ensure the broad-scale implementation of STEM education. This research underscores the importance of children receiving adequate STEM education in order to be prepared to thrive in a professional environment seeking executives literate in 21st century skills. Moreover, creating supportive environments for teachers is essential to facilitate the effective integration of STEM into the curriculum.

Keywords: *Authentic environments, authentic learning, authentic assessment, STEM.*

1. Introduction

1.1. Conceptual definition of authentic learning

The core principle of authentic learning is that students engage more effectively when acquiring new knowledge and skills through hands-on experiences rather than traditional theory-based instruction (Chiu et al., 2018). Authentic learning deliberately integrates interdisciplinarity, enhances critical thinking, strengthens argumentation skills, and improves pattern recognition. Research suggests it also fosters the development of strong STEM identities (Singer et al., 2020).

1.1.1. Characteristics of authentic activities. Authentic activities simulate real-world scenarios rather than predefined classroom exercises. These activities present complex problems without straightforward solutions, requiring students to use interpretation, critical thinking, and initiative to find solutions (Herrington et al., 2003; Mims, 2003).

1.2. Conceptual definition of authentic assessment

According to Wiggins (1990), authentic assessment is a "genuine test" of intellectual achievement, requiring deep understanding, higher-order thinking skills (HOTS), and complex problem-solving through the execution of meaningful tasks. As an alternative assessment method, it evaluates 21st-century skills by ensuring active student participation, realistic contexts, and multifaceted evaluation criteria (Khalil & Osman, 2017).

1.3. STEM epistemology

STEM education represents an innovative approach to science learning, emphasizing self-regulated learning and the development of metacognitive skills, critical reasoning, and creative thinking. It aligns with constructivist principles, encouraging students to actively shape their learning process (Kalpana, 2014; Ilman Anwari, 2015; Adom et al., 2016). STEM environments connect schools to the global workforce, enhancing students' competitiveness (Widana et al., 2021).

1.3.1. Skills developed through stem implementation. A comprehensive understanding of STEM principles allows students to analyze, apply, and integrate concepts to address complex challenges, devise innovative solutions, and enhance real-world connections. STEM education fosters digital literacy, communication, data analysis, task management, and cybersecurity awareness (Stehle & Peters-Burton, 2019; Widya & Rahimi, 2019; Lavi et al., 2021).

1.3.2. Prerequisites and advantages of STEM implementation. Designing an interdisciplinary STEM curriculum with authentic assessment requires significant effort, time, and collaboration among stakeholders. Educators increasingly trust STEM's pedagogical approach, reflecting confidence in its educational impact (ElSayary, 2021).

1.3.3. Assessment in STEM environments. Authentic assessment in STEM interdisciplinary curricula targets cognitive, psychomotor, and affective learning domains, ensuring a comprehensive educational approach (ElSayary, 2021). Educators' ability to develop authentic STEM-based assessments is influenced by creativity and proficiency in information technology, which is becoming a mandatory competency in modern education (Widana et al., 2021).

2. Design

This qualitative research was conducted in two stages. Initially, extended literature research took place to highlight epistemology and potential problems. In the second stage of the research semi-structured interviews were conducted with 15 teachers, mostly members of E3STEM which were analyzed using thematic analysis. The aim was to investigate the extent to which STEM education is implemented in K-12 and possible ways that this implementation could contribute to the creation of authentic learning and assessment environments.

3. Objective

There were three equally important objectives in this study. The first two were to examine the extent of implementation of STEM education in primary as well as in secondary education. The final objective was to investigate the ways in which STEM contributes to the creation of authentic learning and assessment environments.

4. Methods

The research utilized Google Scholar and ResearchGate, employing keywords such as authentic learning, authentic assessment, STEM, problem-solving, rubric assessment, (e-) portfolio, and 21st-century skills.

Following the literature review, four research questions were formulated, each aligning with one of three key axes. The first axis examines STEM implementation in primary and secondary education.

The second explores STEM's role in fostering authentic learning and assessment environments. The third investigates the barriers educators face in STEM implementation.

The formulated research questions are the following. Research question 1: Can STEM education contribute to the creation of authentic learning environments in primary and secondary education? Research question 2: Can STEM education contribute to the development of authentic assessment environments in primary and secondary education? Research question 3: In which way can STEM education contribute to the creation of authentic learning and assessment environments? Research question 4: What barriers do educators face in creating authentic learning and assessment environments through STEM education?

Each research question was explored through specific interview questions, tailored to participants. To address these research questions, interviews were conducted with 15 educators, mostly members of the Hellenic STEM Educational Association (E3STEM). Participants reviewed and signed an informed consent form before agreeing to be interviewed. An interview protocol was developed to guide the process and ensure consistency in data collection.

Figure 1. Interview Protocol.

Table 1. Interview Protocol

"Creating Authentic Learning and Assessment Environments through STEM Activities in Primary and Secondary Education"

Question Categories	Question Objectives	Thematic Axes	Interview Questions
General Questions	Introduction to the educator and exploration of their relationship with STEM.	- Academic Background - Teaching Experience - Experience in STEM Education	1.What is your field of expertise? How many years have you been working as an educator? 2.How many years have you been involved with STEM education? 3.Have you received any training or further education in STEM?
The Value of the STEM Perspective in Problem-Solving	Identifying experts' perspectives on the value of STEM in problem-solving.	- STEM Perspective - Problem-Solving Approach	1. What is the value of the STEM perspective in problem-solving?
The Significance of STEM Education at the Curriculum and Teaching Level	- Investigating participants' views on the significance of STEM education at both the curriculum and instructional levels. - Gathering information on what a STEM educator needs to implement at	- Curricula - STEM Teaching Methods - School Textbooks – Multiple Books Approach - Student's Book (Instructional Content) -Teacher's Guide (Methodological Guidelines – Assessment Elements) - Worksheets -Additional Teaching Materials	1. How are curricula and school textbooks connected to STEM teaching? 2. What are the necessary actions for a STEM educator?
The Relationship Between STEM Activities and Authentic Learning	Identifying educators' beliefs regarding the relationship between STEM activities and the achievement of authentic learning.	-Understanding the concept of authentic learning. -Examining educators' attitudes toward	1. What does authentic learning mean to you? How would you define it? 2. Do you believe that authentic learning is effectively implemented within the current education system? 3. Do you think STEM activities contribute to achieving authentic learning?

5. Data analysis

The data collected from the semi-structured interviews were transcribed and analyzed using thematic analysis. Initially, the transcriptions were coded to identify key themes and concepts, while significant statements were also noted within the texts. Through this process, ten codes were developed and subsequently grouped into three broader thematic categories. The analysis focused on identifying recurring patterns and connections between participants' experiences and challenges related to STEM implementation.

6. Findings and discussion

The study revealed that STEM education is more widely implemented in secondary schools, whereas primary education faces greater difficulties due to resource limitations and structural constraints. Teachers expressed enthusiasm for STEM-based learning but reported significant challenges, including the lack of necessary materials, curriculum rigidity, and limited institutional support.

STEM education significantly contributes to authentic learning by linking theoretical knowledge to practical applications, fostering active problem-solving and critical thinking. Authentic assessment methods, such as project-based evaluations, portfolio assessments, and observational analysis, provide a holistic view of student progress, measuring not only comprehension but also collaboration, critical thinking, and innovation skills.

Despite its benefits, the study identified key barriers to successful STEM integration, including resource shortages, restrictive national curricula, and a lack of specialized training for educators. Without adequate professional development, teachers may struggle to design and facilitate engaging STEM activities aligned with authentic learning principles.

Without adequate professional development opportunities, teachers may struggle to design and facilitate engaging STEM activities that align with authentic learning principles.

7. Conclusion

STEM education has the potential to transform traditional learning by fostering authentic engagement and assessment, equipping students with essential skills for future academic and professional success. However, its full implementation is constrained by structural limitations such as inadequate teacher training, resource shortages, and curriculum rigidity. Addressing these challenges through targeted professional development programs, increased resource allocation, and greater flexibility in curriculum design is essential for the successful integration of STEM education in schools. Future research should expand the sample size of educators, examine the long-term impact of STEM-based curriculum reforms, and identify best practices for overcoming existing barriers. By addressing these issues, STEM education can effectively contribute to meaningful, authentic learning experiences that prepare students for the demands of the 21st-century workforce.

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DEVELOPMENT OF A SECOND-TIER RESPONSE TO INTERVENTION (RTI) PROGRAM FOR FINE MOTOR FUNCTION

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Abstract

Motor learning can be understood as the acquisition or modification of movement, which includes learning strategies (or new ones) that will lead to the execution of the movement. Specifically, fine motor skills correspond to the use of intrinsic and extrinsic muscles of the hand and fingers, enabling the performance of activities that require greater manual refinement, such as: daily tasks of eating, hygiene and school tasks. It is emphasized that fine motor coordination is an important indicator of a student's overall level of development, in addition to being able to contribute to social and emotional adjustment in the school environment. The study aimed to develop an intervention program with fine motor functions, based on the RTI model, for students in the 2nd grade of Elementary School. This study was divided into phases, as follows: Phase 1: Corresponds to the development of a program based on the Response to Intervention Model; Phase 2 – Corresponds to the characterization of the performance of fine motor functions of students in the 2nd grade of EFI. Phase 1: To develop the program, a bibliographic survey was carried out regarding the theoretical bases for the development of the Response to Intervention (RTI) program. The focus was on fine motor skills for students in the 1st and 2nd grade of Elementary School I. The Scielo and Pubmed databases were used, with the descriptors "fine motor function" and "intervention". Based on the theoretical models and the fine motor skills surveyed, six sessions with three tasks each were developed, with increasing complexity, and two training sessions per skill. Six sessions were developed, covering the skills of Tactile Perception, Grasping, Dexterity and manipulation of objects with one hand, Bilateral movement, Isolated finger movement and Pincer movement. Phase 2: 25 students were evaluated in fine motor tests (Fine Motor Precision and Visual Motor Integration), and 12 (34.3%) presented fine motor difficulties, which should be referred for intervention in the program developed in phase 1. The study demonstrated that it was possible to develop an intervention program for fine motor skills, based on the Response to Intervention Model (RTI), in the second layer, for students in the 2nd year of Elementary School I and that 12 (34.3%) presented fine motor difficulties, which should be referred for intervention in the program developed in phase 1.

Keywords: *Educational assessment, motor performance, intervention model.*

1. Introduction

Motor development is characterized as a behavior in which this function originates from three main points: the individual, the complex task, and the environment. In other words, an individual produces a movement in order to perform a task while being part of an environment. Thus, the effectiveness of this skill is associated with the ability to perform different tasks efficiently in one or more environments (Shumway-Cook & Woollacott, 2003).

Thus, it is highlighted that motor skills progress is an important indicator for the overall level of development of a student, in addition to being able to contribute to social and emotional adjustment in the school environment (Memisevic & Hadzic, 2013). Such skills are provided for in the National Common Curricular Base of Brazil (Brasil, 2018) – Early Childhood Education, in which motor aspects are encouraged mainly in relation to the promotion of activities that explore fields of experience of the body, gestures and movements and lines, children, nuclei and shapes.

In addition, studies indicate that these skills also become a relevant factor for referring individuals to spatial education or for students to remain in kindergarten. Therefore, investigations regarding motor skills can be beneficial for verifying that individuals who do not perform fine motor skills satisfactorily may possibly harm students who do not present such difficulties. (Cameron, et al., 2012).

Thus, the Response to Intervention model emerges as an alternative for early identification and intervention in the educational context. The Response to Intervention (RTI) Model is a multi-layered system of support for schoolchildren with learning difficulties. Since the RTI Model is an integrated system of assessment and successive interventions, monitoring the performance or progress of each student is one of the strongest points of the RTI Model for early identification, whether for learning, behavioral or motor problems, since the lack of response to these interventions may indicate the presence of these disorders. The model is composed of three layers: universal (layer 1), strategic (layer 2) and intensive (layer 3). Students are placed in one of the intervention layers due to their difficulties (Andrade, Andrade & Capellini, 2014).

Therefore, this study is justified by the lack of such programs. Furthermore, the development of programs using this model will allow for a better characterization of school difficulties with fine motor skills, leading to more precise and early intervention. Furthermore, it is expected to collaborate with the development of an early identification and intervention instrument aimed at stimulating and developing fine motor skills, so that it can promote positive effects in the later stages of writing.

Thus, the study is based on the hypothesis that the development of an intervention program based on the Response to Intervention Model (RTI), with systematic instructions on fine motor skills in students in the 1st and 2nd grades of Elementary School I, in a second layer, can help in the early identification of school risks for motor difficulties.

2. Objectives

The objectives of this study was to develop an intervention program for fine motor skills, based on the Response to Intervention Model (RTI), in a second layer, for students in the 2nd grade of Elementary School I.

3. Methods

This study was submitted to and approved by the university's Research Ethics Committee (protocol no. 6,260,277). All participants signed an informed consent form. For educational purposes, this study will be described in two phases, as follows.

3.1. Phase 1: Corresponds to the development of a program based on the response to intervention model

For the development, a bibliographic survey will be conducted regarding the theoretical bases for the development of the Response to Intervention (RTI) program, which includes screening and intervention proposal for the development of fine motor skills in students in the 2nd year of Elementary School I. The focus was on fine motor skills for students in the 1st and 2nd years of Elementary School I. The Scielo and Pubmed databases were used, with the descriptors “fine motor function” and “intervention”. The proposed theoretical models were considered, such as Feder and Majnemer (2007), Exner (1992), Humphry, Jewell and Rosenberger (1995), Alleoni (2007), Barbosa and Fukusato (2020), Bee and Boyd (2009), Builders (2023), Case-Smith (1993), Greutman (2017), Brasil (2016), Dadkhah et al. (2004), and Yu et al., (2011) contemplating the main skills of: Grasping, pincer movement, bilateral movements, manipulation of objects with one hand, dexterity, isolated finger movement and tactile perception, being developed a specific program for the second layer.

3.2. Phase 2: Corresponds to the characterization of the fine motor function performance of 2nd grade EFI students

After the program was developed, the fine motor profile of 2nd grade students was characterized in order to identify which ones would be eligible for the application of the Program developed in Phase 1. Twenty-five students aged between 7 years and 8 years and 11 months, regularly enrolled in the 2nd grade of EFI, from public schools in the city of Marília-SP, participated in this phase. The students were submitted to the following procedures: motor assessment Bruininks-Oseretsky test of motor proficiency (BOT-2) (Bruininks & Bruininks, 2005), with only the part corresponding to the fine motor tests (Fine Motor Precision and Visual Motor Integration) and age, corresponding to the tasks (Manual Dexterity, Throwing and Catching, and Balance) being selected. The study included students regularly enrolled in the 2nd grade, as indicated by their teachers. As an exclusion criterion, students who did not sign the Free and Informed Consent Form, students with sensory deficits (hearing and/or visual impairment) and cognitive deficits described in school records and/or in neuropsychological assessment findings were excluded from this study. In addition, students who had already undergone some type of Speech Therapy and Pedagogical

remediation will be excluded. The results indicated that 12 (34.3%) of the students performed below average and should be referred for intervention in the program developed in phase 1.

4. Discussion

The findings of this study reinforce the need to implement early intervention programs in the school context. The years corresponding to the beginning of elementary school are a period in which children actively explore and test the capacity of their bodies, leading to changes that result in the refinement of their motor skills, one of which is fine motor skills. Furthermore, the skills listed (Grasping, pincer movement, bilateral movements, manipulation of objects with one hand, dexterity, isolated finger movement and tactile perception) favor the development of fine motor coordination, which is an important indicator of a student's overall level of development and can contribute to social and emotional adjustment in the school environment (Gallahue et al., 2013). Movement intervention programs favor the student's understanding of learning strategies (or new ones) that will lead to the execution of movement (Shumway-Cook & Woollacott, 2003). Specifically, fine motor skills correspond to the use of intrinsic and extrinsic muscles of the hand and fingers, enabling the performance of activities that require greater manual refinement, such as daily feeding, hygiene and school tasks, and are gradually acquired between 18 and 24 months of age (Fonseca, 2008).

In this way, the skills involved in performing this action depend on a set of factors, according to the maturation of an individual, which can be developed in the school context, in Early Childhood Education, such as fine motor, cognitive and visual-perceptive skills, which are directly related to the precise manipulation of the pencil to produce letter shapes with appropriate sizes, order and positions (Almeida, 2013; Tseng & Chow, 2000).

5. Conclusions

The study demonstrated that it was possible to develop an intervention program for fine motor skills, based on the Response to Intervention Model (RTI), in the second layer, for students in the 2nd year of Elementary School I. Six sessions were developed, covering the skills of Tactile Perception, Grasping, Dexterity and manipulation of objects with one hand, Bilateral movement, Isolated finger movement and Pincer movement. The screening (motor assessment) included 25 students aged between 7 years and 8 years and 11 months, regularly enrolled in the 2nd year of Elementary School I, of which 12 (34.3%) presented fine motor difficulties, which should be referred for intervention in the program developed in phase 1.

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BETWEEN A ROCK AND A HARD PLACE – INSIGHTS FROM TEACHING ASSISTANTS IN HIGHER EDUCATION

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Abstract

A teaching assistant (TA) is someone who supports teachers and students in the classroom. In general, the role of a TA can vary widely depending on the school, grade level, and specific needs of the classroom. Some common responsibilities of a teaching assistant may include assisting with instructions, for example with instructional activities, such as working with small groups of students, providing one-on-one assistance, and helping to explain concepts. A TA may also be used to assist classroom management, to help maintain a productive and orderly classroom environment by managing student behavior and reinforcing classroom rules. A TA may also assist in preparing e. g. written materials for hand-outs and other resources for lessons, such as setting up equipment, organizing materials, and ensuring supplies are ready. TA resource may also be used to support the special needs students in inclusive classrooms, TAs often work closely with students who have special needs, providing individualized support and adapting materials as needed thus alleviating the teacher's resource. Teaching assistants play a crucial role in enhancing the learning experience for students and supporting teachers in creating an effective educational environment. How is the situation in higher education institutes? Our university employs senior students for the positions 'to oversee' the younger ones. In addition to the previously mentioned, the duties may, and often do, also include assessment of assignments and communications with the students in premeditated areas, such as the assignment or schedules related questions. The challenging situations may arise when there is a deliverable to be read and evaluated from a peer of the TA. Thus, the work field of the TA is rather versatile and demanding. How do the TA's perceive their position? Seems that personal attitude and integrity play a significant role. An additional interesting question is, how are they chosen for the job and later allocated to the individual courses? In addition to motivation to take part in higher education, one of the most used qualifications in allocating is having accomplished successfully the course for which a TA is sought for. How are all the assignments on courses handled objectively and fairly? Are they? This paper asks such questions and sheds light upon the previously unasked questions how a TA handles such situations and individual sentiments by interviewing a number of TAs from various courses with altering responsibilities. The answers deepen the understanding of this invaluable staff group at our university.

Keywords: *Higher education, teaching assistant role, insights.*

1. Introduction

Higher education is about an educator, like a lecturer or a professor, teaching the subject matter, originally executed by the teacher by reading the material out loud from a book and the students trying to take notes and/or remember the essence and simultaneously already starting to internalize the content. At those times the mere existence of books was scarce. Secretarial staff was there to take care of most of the administrative part. Today the situation is something completely different, development has been, and is, constant (Berggren et al., 2015; Entwistle and Entwistle, 1991; Hellsten and Kallionpää, 2023). Also, with diminishing or rationalized resources, the amount of administrative duties has come to the teaching staff. Similarly, the teaching methods have evolved, during the past years at an ever-increasing pace, into something unprecedented. The universities and teachers therein have had to come up with new ways of executing their task and to keep up with the developments (Kallionpää and Hellsten, 2023). Information is there in abundance. Division of labor has come, actually already a long time ago, into higher education (Feinman, 1991; Sharples et al., 2018). One form of this is the use of teaching assistants (TA). A teaching assistant may mean an undergraduate student or a specifically for this purpose hired person to alleviate the tasks and burdens of the responsible staff member, the teacher (Sharples et al., 2018).

As the use of teaching assistants in our unit at the university is considered, it starts when the permanent teaching staff is required to express their presumed need for teaching assistants to the responsible person in the unit. The person then sums up the combined need and having considered the overall need, formulates the call for assistants and releases it through proper channels to the students to react upon. It is obvious that the persons are not to be chosen light-heartedly for the position but rather a strict process needs to be in place to make sure that the objectivity and fairness are maintained in executing the various tasks that are bestowed upon the teaching assistant, but also in the recruiting phase. However, this aspect is marked out from this study as it merits more attention than is possible on this occasion. Another aspect that is relevant but not included in closer scrutiny is the variety and various ways the permanent teaching staff sees the possible duties and tasks for a teaching assistant in various courses on their responsibility.

Our bachelor's and master's programs at the university have both a number courses, as they do. Quite often the courses have the lectures, rather obvious in higher education, as a teaching method to deliver the message but also additional assignments to deepen the internalizing of the essence. At our university we publish the individual courses on a learning platform. This is quite often also the primary communication channel for the courses. There are also other information systems for the teacher to use and preferably to master; a sort of register system into which the course details and structures are to be typed into, students enroll also via this system onto the various classes. There is also an independent course feedback system with standard questions but also into which a teacher may or may not add his/her own questions, to name but a few. By this short listing the varied field of tools and tasks is demonstrated. The tasks that a TA may or may not have varies quite a bit according to the person in charge. Typically, however, the upkeeping of the learning platform for a certain course more or less independently or reading and assessing the assignments are such tasks, as traditional written examination has long been the primary method of assessing student performance in higher education. Also, a TA may operate as a contact point for the courses running errands, such as answering questions about deadlines and extensions to them and such.

The duties and the role itself of a teacher are studied and reported in journals (Eekelen et al., 2005; Unwin, 2007; Walker and Gleaves, 2016). What about the teacher's vital support? We got interested in teaching assistants and their thoughts of their activities as they play a big, sometimes even a crucial role in whether a course is deemed a success or not. They do alleviate the teachers' pressures and free time for the teachers for perhaps even more subject-related tasks, how do they see themselves in this academic equation, and how could their job be made if not exactly easier but more friction-free?

This paper looks at the opinions and prerequisites the teaching assistants feel for themselves to have. The paper is studying the students' viewpoint. The notions and the mere viewpoint to the issue are versatile. Both sides need to be taken into account. There are additionally some notions from the permanent teachers included, to verify or to offer a counterpoint to statements if need be. TA activities require TA-students to assume authority over their peers even, to verbally articulate their understanding of the subject matter and respond to various questions presented with, offering a dynamic and interactive approach to various situations, whilst the staff member is there in background to offer support when needed. The way of operating may also allow for the assessment of verbal communication of the students on the courses but especially the written assignments handed in. The benefits and challenges associated with the use TA's, this paper aims to illuminate the bigger picture of this approach in higher education setting to better reflect students' true capabilities as a part of university community.

2. Design

Currently we have 17 teaching assistants enrolled. All of them have at least one year more on their record than the students on the course on which they are attached to. The courses cater for a variety of subject matters under knowledge management (KM) umbrella; basics in KM, data administration, CIO's office, knowledge-based management, strategic KM, knowledge-intensive services, to name but a few. The target group for the study was the entire number of current assistants. The enrollment was 17, out of which 13 answers were received. Obviously, the number of respondents could, and perhaps even should have been bigger. Having said that, it is noteworthy that the responses began to saturate already with these numbers.

A questionnaire was designed with 26 questions regarding the views and sentiments of the students about the work as a teaching assistant, which we then sent to the intended respondents. The responding took on average approximately 40 minutes. There were questions with statements with which the respondent could either strongly disagree (1) and strongly agree (5) and open-ended questions to further enlighten the numeric responses. The open-ended questions give the study a touch of qualitative nature. Five involved teachers have taken part in conversations regarding the work TA's do to give additional empirical matter over the area under scrutiny. The questions were planned keeping in mind the position of the TA's in between the 'normal' students, as they possess a sort of position of power over their peers and the permanent academic staff, which TA's are not.

There were questions about the motivation to apply for and to act as a TA. Also, about the possibilities of the individual's TA's to do the work whilst studying. Obviously, the work is supposed not to harm or hinder the progress of one's own studies, but an equilibrium is to be found, preferably independently. An interesting fact may be that as the counterpart at university unit may be a professor, an university lecturer or an university teacher, it seems to play no role whatsoever to the TA's and to their approach. This has had a confirmation in prior observations. The paper scrutinizes the students' viewpoint and gives also some notions on the approach the teaching staff have towards this way of working.

3. Background

The Tampere University community was established through the merger of the former Tampere University of Technology, the University of Tampere, and Tampere University of Applied Sciences. This merger took effect at the beginning of 2019, coinciding with the transfer of ownership of the University of Applied Sciences from the city of Tampere to the newly formed Tampere University. The individual universities were founded in the 1960s, while the origins of the University of Applied Sciences date back even further.

The newly formed university encompasses nearly all internationally recognized fields of study, with a strong focus on research and education in technology, health, and society. Tampere University is one of the most multidisciplinary universities in Finland, boasting a vibrant community of approximately 32,000 students and over 5,000 staff members across seven faculties. The university operates on three main campuses in Tampere, Finland's third-largest city, and has three university centers in Lahti, Pori, and Seinäjoki to address more localized needs.

This paper focuses on the teaching activities at the Hervanta campus, which was primarily the domain of the former University of Technology. It is important to note that the university has made significant efforts to ensure uniformity across all campuses, so the observations in this paper are likely applicable to other parts of the university as well, even if cultural differences between the campuses are occasionally noted. The Hervanta campus is particularly known for its state-of-the-art facilities and its emphasis on engineering and technology disciplines.

The daily routines of the teaching staff often include research work and research-related tasks, with few individuals able to focus solely on one area. The pedagogical and didactic expertise of the staff varies, as many individuals come from research backgrounds. Similarly, the technical proficiency of staff members ranges from those who use basic tools like PowerPoint and PDFs to those who are adept with advanced features of learning platforms. The tasks of the staff can be broadly categorized into teaching (the main focus of this paper), research, and administrative duties. The latter category is somewhat ambiguous, as it may or may not be connected to the other two areas.

In addition to their teaching responsibilities, staff members are often involved in various administrative roles, such as curriculum development, student advising, and participation in university committees. These roles require a diverse skill set and the ability to balance multiple responsibilities. The university supports its staff through professional development programs aimed at enhancing both their teaching and research capabilities.

4. Findings

Among the respondents there are bachelor's degree holders but also students not yet having accomplished that degree. One qualification in choosing a person for a TA position is whether s/he has completed the course a TA is sought for. In their application the applicants are asked onto which courses they would want to be allocated. These wishes are taken into consideration, as they are thought to be an additional motivational factor.

As described above, the TA tasks included communicating with the students almost in all the responses. Similarly, the assignments were there in multiple answers, however what does this exactly mean in every response, remains a little unclear. As the array of the possible tasks is rather dependent on the teachers' willingness and possibilities to instruct and to allocate tasks and responsibilities. They in some cases include instructing exercise sessions, in some cases even planning for these, assessing in some. Administrative tasks were also included in some cases, meaning the maintenance of the learning platform and updating the info's there.

When asked after their motivation for the position the overall grade was 4,54 (out of 1-5). The respondents strongly agreed (7) and agreed (6). As individual motivating factors the possibility to see what working in a university is like gathered many mentions but also the experience to be active in one's chosen field of studies and simultaneously learn more. Also to learn more work life skills, such as presenting and performing, managing groups etc. were mentioned.

The TA's recognized as major skills they need in their line of work to be literary skills, such as scientific writing (also reading), which is easily understood, should instructing and reading the assignments be among the duties allocated to a TA. To be a people person is an advantage, one has a lot to do with people, social, communication, and interpersonal skills are of value. Beneficial features of more general nature such as self- and time management were also mentioned multiple times as was project management type of skills. Self-evidently the subject matter of the course on which the person is working as a TA give the necessary backbone to exercise the mentioned skills.

As to the balancing the studying with the working as a TA, the respondents were very confident in assessing their capabilities in this. The overall grade was again 4,54, which for faculty member makes pleasing reading. Seven respondents agreed strongly and six agreed with the statement. When asked how the TA's accomplish this balancing act, they answer that they need to exercise time management and planning, allocate certain days or time slots to say the least in their calendar. The allocating included among other features the responding to students' emails. This, reportedly, is advisable to be done not immediately by arrival of the mail, but rather in an organized manner in the reserved time frame, for example at a certain hour of the day. Also noting that the most productive hours are beneficial to be allocated for the tasks prioritized higher.

The inquiry regarded also the induction to the duties. This is to be developed. One respondent was of the opinion that this was inadequate. Understandably the instructing is to be taken seriously and planned accordingly. It is not a good start for any new position, should there be unclarities about what and how the related tasks are to be done. Especially for a young person with not much experience. The average grade was 3,92, which is to be interpreted so that there were better performances too. The adequacy was asked, four responses agreed strongly, five agreed, and three answered with grade 3. Conversational approach with the permanent teacher was said to be preferred also due to the nature where one could better express oneself. The conversations covered the overall objectives, the ways to consider the tasks, but also more detailed approaches like how to grade assignments etc. It is to be remembered that also the facts regarding the employment itself need to be included in the induction. Peer support seemed to be invaluable, also that of the more experienced TA's and also from other courses. More support was to be received mainly from the responsible teacher but also from the community. This grading underlines the good relationship between the TA's and the context: 4,69. Ten out of thirteen respondents agreed strongly and two agreed with the statements. Remaining one was indifferent.

When asked about getting along with other students the responses varied a bit more than the prior answers. According to the statement it was supposed to be easy. Five agreed strongly with this, five somewhat, two were indifferent, and one respondent somewhat disagreed. This could be alleviated with good communication and people skills, but also being just, unbiased, and fair and with certain strictness in conduct. Personal resilience grown from and with experience helps to comply the rules and regulation. The previously listed features help also to deal with the possible problematic situations and conflicts. Well founded and fair judgment and understanding on the context pave the way to successful TA task completion.

Some TA's witnessed a grown number of contact requests in various social media channels, thus giving grounds to consider perhaps a ready-planned policy for this. It is not always certain that this is a desired side-effect of working at the university as a TA. Although, the teachers are known to have received equally contact request, so it may be just a sign of the times.

The questionnaire contained also questions about how the TA's regard their own development during and after the employment. The 'academic' skills, reading, writing analytic thinking are considered developed, but also the mentioned performing, public talking, presenting are features that are seen as improved. Self-confidence, assuredness, assertiveness, giving founded feedback are also features that the TA's think as take aways in this work. Students believed that this experience enables a better way to demonstrate their knowledge base than before. The formulation of the answers, binding the details to a bigger picture, explaining the interconnections of the concepts, conversing with the 'other party', but also to compress one's answer into concise sentence, etc., the useful skillsets expected to be required later in working life as well.

The greatest challenges are listed as the challenging situations with students (usually unhappy with their performance), maintaining the fairness in assessing the students' work in all its forms, self-/time management, and punctuated load. The last one is explicable by the fact that for example the assignments are submitted usually on the last day before the deadline, thus piling the burden.

5. Concluding summary

From teachers' point of view, the preparation of TA responsibilities is a good starting point. Omitting the question of the necessity of the TA's. As TA's are an invaluable asset for the faculty staff. It simultaneously relieves the load off the permanent staff while opening communication channel to student

corps, important e.g., for student feedback. The preparations require similar amount work and type of work for the teachers as it does for an independent course execution. It differs in detail. The tasks or duties need to be well pre-thought. More open and two-ways the communication between the teacher and the TA in the relationship during the employment is, the more beneficial it may be. For example, on some learning platforms there are tools to facilitate various features. The teacher may be able to use the old proverb about four eyes seeing more than two. Having said that, it may be argued that many of the take-aways of this mode belong to the metaskills sought after also in the working life after studies, thus it may be argued that this is also something the students are actually well-advised to apply for.

Higher education focuses on teaching the subject matter. However, in the field of information and knowledge management, it's common for questions and their answers to not have a single correct solution. Instead, students should prioritize understanding the essence and context of the content to grasp the bigger picture, the TA's have come to realize that this is also one of the strengthened qualities they have gotten.

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LIMITATIONS OF THE USE OF CHATGPT TECHNOLOGY FOR LEARNING TECHNICAL SUBJECTS IN ARCHITECTURE

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Abstract

The integration of digital technologies into education has long sparked debate among educators, often dividing opinion between those who embrace innovation and those who warn against its unintended consequences. The recent emergence of Artificial Intelligence (AI) marks a significant turning point in this ongoing transformation. Following the foundational principles introduced at the 1956 Dartmouth Conference, AI has developed into a set of powerful tools, among which ChatGPT—released by OpenAI in 2022—stands out for its capacity to generate natural language responses, simulate reasoning, and assist in problem-solving tasks across disciplines. This research evaluates the application of ChatGPT as a pedagogical support tool in the context of a technical subject within the *Bachelor's Degree in Fundamentals of Architecture* at the *University of Seville*. Conducted within the course "*Construcción 5: Rehabilitación*", the study involved 32 students who used ChatGPT to analyze building damage based on photographic evidence and generate construction detail proposals for intervention. The activity was designed to assess AI's performance in three core learning objectives: (1) identifying typical pathologies in existing buildings; (2) formulating a diagnosis based on boundary and material conditions; and (3) proposing technical solutions through graphic and descriptive representation. Methodologically, the study was structured in two phases: first, students submitted building damage images and prompted ChatGPT for a diagnostic explanation; second, they requested the generation of constructive repair details. Student outputs were compared with AI-generated content and evaluated in terms of accuracy, graphical validity, and pedagogical value. The results show that while ChatGPT can support textual analysis and help students frame initial hypotheses, it lacks the precision and graphic reasoning required in construction-based assignments. Most notably, its inability to generate reliable technical drawings underscores its current limitations in architecture education. The findings affirm that, although generative AI offers valuable support for idea generation and autonomous learning, it cannot replace the expertise and judgment of educators in teaching technical subjects related to building rehabilitation.

Keywords: *ChatGPT, architectural education, technical learning limitations, building pathology, AI in construction.*

1. Introduction

Artificial Intelligence (AI) refers to the ability of computational systems—whether mobile devices, personal computers, or robotics platforms—to perform tasks that have traditionally required human intelligence. These tasks include understanding natural language, solving complex problems, learning from data, and making informed decisions. The conceptual foundations of AI were formally established in 1956 by John McCarthy during the Dartmouth Conference, where it was proposed that "every aspect of learning or any other feature of intelligence can, in principle, be so precisely described that a machine can be made to simulate it" (McCarthy et al., 2006). Since then, AI has evolved from theoretical models to real-world applications that are now embedded in everyday life and work. From medical diagnostics to financial forecasting, AI has redefined processes across multiple sectors. The field of education, in particular, has witnessed a dramatic transformation in the past decade, with AI being positioned as a catalyst for personalizing learning, automating feedback, and improving educational efficiency (European Commission, 2019).

Among the most prominent advancements in the field is ChatGPT (Chat Generative Pre-trained Transformer), a conversational AI model developed by OpenAI. First released in its Plus and GPT-4 versions in November 2022, ChatGPT rapidly gained global attention. By mid-2023, it had become a widely used tool in educational environments, thanks to its ability to generate written content, answer queries, summarize texts, and even suggest solutions to complex problems. Its interface, accessible via web browser and increasingly integrated into productivity platforms, has made it an easy point of entry into generative AI for students and educators alike.

However, the growing ubiquity of ChatGPT in education has sparked a range of debates. On the one hand, it promises to democratize access to information, support autonomous learning, and offer real-time assistance to learners. On the other, it raises serious concerns about academic integrity, critical thinking, and intellectual dependency. According to Rosser and Soler (2024), the immediacy with which students can generate any type of text—essays, analyses, summaries—may discourage the development of deeper cognitive skills. Chukwuere (2024) adds that overuse of AI tools risks fostering technological dependence and reducing essential interpersonal interactions in educational contexts. Ethical concerns also surround the integration of AI in education. The Council of Europe's 2023 report on AI and Education stresses the need to evaluate AI systems through the lens of human rights, democracy, and the rule of law (Holmes et al., 2023). Questions of bias, transparency, and algorithmic accountability remain unresolved, especially in high-stakes academic environments. Furthermore, educators have voiced fears that AI could one day replace teaching roles or be used to automate certain educational functions, potentially leading to job displacement (Fowler, 2022). Despite these concerns, some scholars argue for a balanced and strategic use of AI. Girón Jiménez et al. (2024) highlight how tools like ChatGPT can support idea generation and scaffold autonomous learning when used within a well-structured pedagogical framework. They suggest that the key lies not in rejecting AI, but in guiding its application to enhance, rather than replace, traditional learning. In architectural education, these capabilities have both clear benefits and evident constraints. The technical nature of architectural learning involves not only linguistic and theoretical comprehension but also spatial reasoning, material logic, and graphic communication. For example, generating a diagnostic report for a pathological condition in a building might fall within ChatGPT's scope. However, producing a reliable, detailed construction drawing based on that diagnosis remains far beyond its current graphical and contextual capabilities.

This study aims to contribute to that discussion by analyzing the practical results of integrating ChatGPT into a university-level technical assignment in architecture. It focuses on the students' ability to interact with the tool for the diagnosis of building pathologies and the generation of construction repair details, highlighting the strengths, weaknesses, and pedagogical implications of such an approach.

2. Objectives

The primary objective of this study is to critically assess the potential and limitations of using ChatGPT as an educational support tool in the learning of technical content within architectural education. The focus is placed on its role in assisting the understanding of building pathologies and the generation of construction detail drawings.

More specifically, the study seeks to:

1. **Evaluate the reliability of ChatGPT's diagnostic capabilities** when analyzing structural pathologies based on photographic input and descriptive context provided by students.
2. **Assess the effectiveness of ChatGPT in generating construction detail drawings**, either through image-based outputs or detailed textual descriptions that can be interpreted graphically.
3. **Compare AI-generated content with student-developed outputs**, highlighting discrepancies, complementarities, and pedagogical implications.
4. **Document student engagement and interaction with the tool**, including the number of prompts required, the clarity of instructions, and the language used.
5. **Reflect on the broader implications of integrating generative AI tools into architectural education**, particularly in disciplines where visual-spatial literacy is critical.

3. Methodology

3.1. Educational context

The study was conducted during the 2025 spring semester at the *Escuela Técnica Superior de Arquitectura* of the *University of Seville*, within the subject "*Construcción 5: Rehabilitación*", part of the Bachelor's Degree in Fundamentals of Architecture. This is a fifth-semester, compulsory subject, which focuses on structural diagnosis, rehabilitation strategies, and repair techniques in existing buildings. The participants consisted of 32 students, all in their fourth academic year. The subject is heavily technical and

includes both theoretical and practical components, such as the identification of real-world pathologies, analysis of causes, and the design of constructive interventions.

3.2. Activity design

Phase 1: Pathology diagnosis via ChatGPT

Students were asked to identify a building lesion—typically a crack, moisture damage, or material deterioration—either from their own surroundings or from curated examples provided by the instructors. Each student had to: capture and submit a photograph of the lesion; provide contextual information about the building's typology, materials, structure, and environment.; input this visual and contextual data into ChatGPT (via GPT-4 or GPT-4 with Vision); request a diagnostic explanation from the AI, including possible causes and contributing factors; compare the AI's diagnosis with their own analytical conclusions, informed by the course's theoretical framework.

Phase 2: Construction detail proposal

Once the cause of the lesion was determined, students moved on to the repair phase. Here they were instructed to: ask ChatGPT to generate a technical detail drawing or detailed description of the constructive solution; interpret, critique, and/or complete the AI-generated drawing or textual description; draw their own solution using manual or CAD tools, integrating both course knowledge and any useful elements from the AI output.

3.3. Deliverables and evaluation

Each student submitted a single PDF report including:

- A screenshot or transcript of their interaction with ChatGPT.
- The AI-generated diagnosis and the student's own analysis.
- The AI-generated drawing (if available) and the student's detailed repair drawing.
- A reflective section discussing ChatGPT's usefulness, reliability, and educational value.
- A completed survey on their interaction with the tool, covering aspects such as: language used for prompts (Spanish/English), number of iterations to achieve a useful result, time invested in the interaction, most effective phrases or strategies used, perceived difficulty of the task for the AI.

3.4. Data analysis

The collected data were evaluated along four dimensions:

1. **Diagnostic precision** – consistency and plausibility of AI-provided causes relative to technical expectations.
2. **Graphic generation quality** – clarity, usefulness, and constructiveness of the AI-generated detail drawings or descriptions.
3. **Student engagement and feedback** – satisfaction levels, critical reflections, and perceived learning benefits.
4. **Pedagogical coherence** – the alignment of AI use with the learning objectives of the course and the expected professional competencies.

4. Results and discussion

The implementation of ChatGPT in the context of a technical architecture course produced a range of outcomes, some promising and others revealing significant limitations of the tool. The results are organized into three main categories: diagnostic accuracy, quality of graphic output, and student perception and engagement.

4.1. Diagnostic accuracy: Reliable but dependent on context

Most students reported that ChatGPT provided accurate and plausible diagnoses when given a clearly described image and sufficient contextual information. In the example provided by one of the students, a photo was submitted showing a crack above a window lintel on a façade adjacent to a demolished neighboring building. After being fed detailed information about the building's construction system—including load-bearing walls, foundation type, and historical context—ChatGPT correctly hypothesized that the crack was due to a loss of lateral confinement and foundation settlement—precisely the same conclusion reached by the student.

> "*The AI's response matched the analysis taught in class. It even added structural criteria like flexural deformation and lack of reinforced lintels*," a student noted.

These cases highlight the model's ability to simulate critical reasoning, provided that it is guided with sufficiently rich and accurate input. In contrast, vague or minimal prompts led to generic or inconclusive answers, underscoring the importance of prompt engineering and technical vocabulary.

4.2. Graphical output: A major limitation

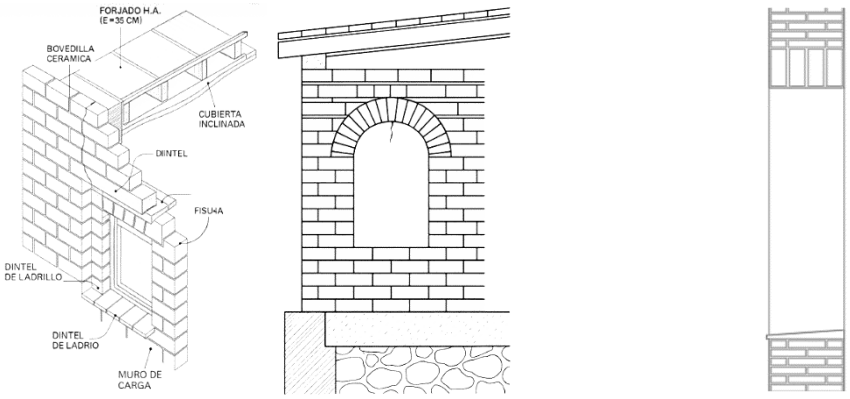
The second phase of the activity, which required ChatGPT to generate construction detail drawings, exposed the tool's most significant limitation. While some versions of GPT-4 can generate basic images (through plugins or external platforms), none of the graphical content produced was technically valid without substantial human intervention.

Students reported various issues:

- Diagrams were not to scale and lacked constructive coherence (e.g., inverted material layers, missing elements such as damp-proof courses or anchors).
- ChatGPT failed to correctly interpret requests for sections or axonometries.
- Labels were often incomplete, misplaced, or inconsistent with architectural conventions.
- In some cases, the tool returned decorative or conceptual illustrations rather than technical details.

In total, 91% of students indicated that ChatGPT was unsatisfactory or unusable for technical drawing, despite successfully generating textual descriptions of repair processes. These limitations are attributable to the model's current lack of spatial reasoning and graphic syntax.

Figure 1. Comparison between AI-generated (left) and student-generated (right) detail drawing for a façade crack repair.



4.3. Student interaction and critical reflections

The structured survey revealed the following quantitative trends:

- 85% of students agreed that ChatGPT was helpful for diagnosing pathologies, especially when fed detailed background data.
- 70% required more than 15 interactions (prompts) to refine ChatGPT's response to a usable form.
- Only 9% found the AI-generated drawings immediately usable.
- 100% used the tool in Spanish, with some experimenting in English to see if it improved results.
- 100% of students affirmed that ChatGPT is only useful as a complement, not as a substitute for their technical skills.

One of the most recurrent themes in student reflections was the importance of context building in their interactions with ChatGPT. Those who approached the AI with specific, layered, and sequenced prompts reported better results than those who used general instructions. This supports the idea that students using AI must first master the content themselves to know how to "instruct" the tool effectively. These findings align with previous academic literature. Girón Jiménez et al. (2024) advocated for the integration of AI within ethical and critical frameworks. Similarly, Chukwuere (2024) pointed to the dangers of over-reliance on AI and reduced peer interaction. In our study, we observed that those students who used ChatGPT as a partner, not a solution gained the most educationally from the experience. In conclusion, the results emphasize that the role of ChatGPT in architectural education must be complementary, scaffolded, and critically monitored. As the technology evolves, its capacity to integrate with architectural representation software (e.g., BIM, CAD) could potentially transform its usefulness. For now, however, human oversight remains essential, especially in visual and constructive aspects of the discipline.

5. Conclusions

The use of ChatGPT in the course "*Construcción 5: Rehabilitación*" allowed for a pedagogically rich experiment in integrating generative AI into technical education. The experience revealed a complex and nuanced picture of its potential and limitations.

On the one hand, ChatGPT proved to be an effective support tool for diagnosing construction pathologies, especially when used with structured, detailed input. The model's textual capabilities enabled students to reflect critically on the causes of structural damage and compare their own hypotheses with automated reasoning. In this way, the tool fostered metacognitive engagement, supported early-stage decision-making, and even introduced alternative interpretations not initially considered by students. However, the most evident limitation was its incapacity to generate reliable construction detail drawings. Despite multiple iterations and clarifications, ChatGPT failed to meet the standards required in a technical architecture context. The lack of graphic precision, structural logic, and representational standards indicates that AI is not yet capable of replacing the graphical competencies that students must develop. This finding is consistent with broader critiques found in the literature (Chukwuere, 2024; Zapata-Ros, 2023).

This study confirms that ChatGPT can play a valuable, yet limited role in architectural education. Its incorporation into the classroom should be deliberate, guided, and critically mediated by educators. Used wisely, it can promote reflection, comparison, and idea generation—but always as a supplementary tool, never as a substitute for analytical or graphical rigor. Looking ahead, the continued evolution of AI—especially in its integration with BIM, CAD, or image-based reasoning—may enhance its utility in technical subjects. Until such developments occur, human oversight, architectural judgment, and representational skills remain irreplaceable pillars of architectural training.

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BRIDGING THE GAP BETWEEN INDUSTRY AND EDUCATION: DESIGNING COURSES FOR ECONOMIC IMPACT

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Abstract

This study analyzes the relationship between gross fixed capital formation (by CAE) and the number of companies in the Cávado and Ave regions, and the supply of Professional Higher Technical Courses (CTeSP) offered by the Polytechnic of Cávado and Ave (IPCA), in Portugal. Using data from national statistical sources and institutional records, the research aims to assess whether the supply of CTeSPs is aligned with trends in regional investment and the needs of local businesses. Through statistical correlation techniques, the study examines how variations in gross fixed capital formation and the number of companies influence the demand for and expansion of CTeSP courses. The results reveal a strong relationship between investment in key economic sectors and the adaptation of the educational offer, suggesting that aligning training programs with regional business dynamics can enhance employability and foster economic growth. The study underscores the importance of strategic planning in higher education to meet local labor market demands, emphasizing the need for continuous monitoring and adjustment of the CTeSP offering in line with regional economic development.

Keywords: *Higher professional technical courses, investment rate, regional development, higher education.*

1. Introduction

Developing human resources and aligning job profiles are essential tasks for promoting both economic and social growth (Goulart et al., 2021). This alignment is especially critical in the context of Cávado and Ave, regions characterized by industrial dynamism. The offering of Higher Professional Technical Courses (CTeSP) by the Polytechnic Institute of Cávado and Ave (IPCA) serves as a direct response to the local market's qualification needs. The continuous transformation of labor market demands, coupled with the need for higher education institutions to adapt to these demands, necessitates a constant review of educational offerings, particularly in economically dynamic regions.

Gross Fixed Capital Formation (GFCF) is a vital indicator for measuring the levels of investment in fixed assets, such as equipment, infrastructure, and construction (Eurostat, 2023). GFCF plays a key role in fostering economic growth by increasing an economy's productive capacity (OECD, 2021). Research indicates that a rise in GFCF is often associated with improved labor market conditions and a growing demand for professionals with specialized technical qualifications (World Bank, 2022). In the Cávado and Ave regions, GFCF has shown an upward trend in recent years, except during the pandemic period (CCDR-N, 2023). This suggests that the regions are seeing increased investment, which further drives the demand for a skilled workforce. The Higher Professional Technical Courses (CTeSP), introduced by Decree-Law No. 43/2014, aim to provide short-term higher technical training closely linked to the specific needs of the labor market (DGES, 2024). The literature emphasizes that higher technical education significantly impacts the employability of graduates and contributes to local economic development, particularly in sectors such as Information and Communication Technologies (ICT) and Industry (Heitor, 2022). The expansion of these courses has been primarily advocated for as a means of diversifying higher education offerings to new audiences and updating the qualifications of the Portuguese workforce, thereby meeting the growing employability requirements of a more technologically advanced and environmentally sustainable economy (CEDEFOP, 2021). Higher education institutions are increasingly adapting their programs to better respond to the emerging needs of the labor market (Hou et al., 2022). In particular, the integration between higher education and a region's investment sectors can foster sustainable economic growth and drive technological innovation, as observed in several European Union countries (OECD, 2021). In this context, the present study examines the Gross Fixed Capital (FBC) by CAE (Economic Activity Code), grouping it into 17 CAE categories, and explores its relationship with the offering of CTeSPs by the IPCA. This approach aims to highlight the alignment between the economic sectors driving investment and the educational offerings tailored to meet those sectors' needs, emphasizing the importance of technical training in fostering regional development.

2. Design

This study adopted a quantitative approach, using secondary data provided by the National Institute of Statistics (INE), the Directorate-General for Higher Education (DGES), and internal IPCA databases. The analysis of the relationship between investments by sector and the supply of CTeSP was carried out through the application of statistical correlation techniques, to identify patterns between the variables.

3. Objectives

The main objective of this study is to evaluate the alignment between the CTeSP offerings at IPCA and the predominant investment sectors in the Cávado and Ave region in 2023, based on the Classification of Economic Activities (CAE), utilizing the Gross Fixed Capital Formation (GFCF) and the number of companies. The specific objectives are**: a)** To observe the values of GFCF, by CAE, in the Cávado and Ave region; **b)** To observe the values of the number of companies, by CAE, in the Cávado and Ave region; **c)** To assess the correlation between the CTeSP offerings and the GFCF in the region; **d)** To assess the correlation between the CTeSP offerings and the number of companies in the region; **e)** To contribute to the debate on the role of higher education in regional development.

4. Methods

The analysis of the relationship between regional investment and training offerings in the Cávado and Ave regions in 2023 was conducted using data on gross fixed capital formation (GFCF) and the number of companies, based on 0the classification of economic activities (CAE) provided by the National Institute of Statistics (INE). For this study, the data on regional investment were cross-referenced with data on the availability of CTeSP (Higher Technical Professional Courses) offered by the Polytechnic Institute of Cávado and Ave (IPCA). The main objective of the analysis was to identify possible significant relationships between regional investment and the availability of technical training, through statistical analysis. The methodology employed for this analysis involved Pearson correlation tests, which were applied after verifying the normality of the data. Pearson correlation was used for variables that followed a normal distribution. The data on the number of companies were organized according to the classification of economic activities, which is divided into 17 categories according to the INE classification, namely: agriculture, animal production, hunting, forestry, and fishing (CAE 01 to 03), covering activities related to agriculture, livestock, forestry, fishing, and aquaculture; extractive industries (CAE 05 to 09), including the extraction of coal, oil, minerals, and quarries; manufacturing industries (CAE 10 to 33), which include food, textiles, metalworking, automotive industries, among others; electricity, gas, steam, hot and cold water, and cold air (CAE 35), related to the production and distribution of electricity and gas; water collection, treatment, and distribution, sanitation, waste management, and pollution control (CAE 36 to 39), covering water supply, sewage, waste management, and pollution control activities; construction (CAE 41 to 43), which includes building construction, civil engineering, and specialized activities; wholesale and retail trade and repair of motor vehicles and motorcycles (CAE 45 to 47), encompassing trade and repair of vehicles, wholesale and retail trade; transportation and storage (CAE 49 to 53), including land, sea, and air transportation, postal services, and logistics; accommodation, food services, and similar (CAE 55 to 56), including hotels, guesthouses, restaurants, cafes, and catering services; information and communication activities (CAE 58 to 63), which include publishing, radio, television, telecommunications, and IT; real estate activities (CAE 68), related to buying, selling, renting, and managing properties; consulting, scientific, technical, and similar activities (CAE 69 to 75), which include legal services, accounting, engineering, advertising, and veterinary services; administrative and support services (CAE 77 to 82), involving the rental of goods, employment services, security, call centers, cleaning, and business support; education (CAE 85), ranging from preschool to higher education, including vocational training; human health and social care activities (CAE 86 to 88), covering hospitals, clinics, nursing homes, and social care services; artistic, entertainment, sports, and recreational activities (CAE 90 to 93), encompassing arts, entertainment, sports, gambling, and betting; and finally, other service activities (CAE 94 to 96), such as associations, household repairs, hairdressers, and laundries.

5. Results and discussion

The main objective of this study is to evaluate the alignment between the CTeSP offerings at IPCA and the predominant investment sectors in the Cávado and Ave regions in 2023, based on the Classification of Economic Activities (CAE), utilizing data on Gross Fixed Capital Formation (GFCF) and the number of companies. To this end, it is first essential to observe the values of GFCF by CAE in both regions. In 2023, the Cávado region registered a total GFCF of approximately 897 million euros, while the Ave region recorded about 861 million euros. In both territories, investment was heavily concentrated in specific sectors. The Manufacturing Industries stood out, representing the largest share of GFCF, with around 296 million euros in Cávado and approximately 462 million euros in Ave. Wholesale and Retail Trade, along

with the Repair of Motor Vehicles and Motorcycles, also revealed significant investment volumes, amounting to about 96 million euros in Cávado and 113 million euros in Ave. Additionally, Real Estate Activities contributed notably to the regional investment landscape, with 89 million euros invested in Cávado and 60 million euros in Ave (***Table 1***). These figures highlight the strong industrial and commercial dynamics of the Cávado and Ave regions, suggesting that the sectors with the highest levels of investment are also those likely to demand more qualified human resources. Consequently, analyzing these investment patterns is critical to assessing how well the CTeSP programs at IPCA are aligned with the real needs and economic opportunities of the surrounding territory.

Table 1. Gross Fixed Capital Formation (€) of companies by geographical location (NUTS - 2024).

Geographical location	Total (€)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Cávado	897,041,119	21,585,959	2,102,623	295,988,415	8,542,500	12,225,440	86,930,400	95,629,547	40,909,794	37,447,399	72,047,532	89,512,705	37,315,022	34,612,261	2,518,591	22,396,272	31,786,658	5,490,001
Ave	860,753,038	23,355,029	5,717,678	461,818,858	3,085,202	5,975,325	44,433,517	112,545,931	26,578,386	26,581,631	7,265,871	60,489,198	20,162,830	10,249,631	1,814,608	14,235,974	33,091,774	3,351,595

Source: INE (2023a); *1- Agriculture, animal production, hunting, forestry, and fishing; 2- Extractive industries; 3- Manufacturing industries; 4- Electricity, gas, steam, hot and cold water, and cold air; 5- Water collection, treatment, and distribution; sanitation, waste management, and pollution control; 6- Construction; 7- Wholesale and retail trade; repair of motor vehicles and motorcycles; 8- Transportation and storage; 9- Accommodation, food services, and similar activities; 10- Information and communication activities; 11- Real estate activities; 12- Professional, scientific, and technical activities; 13- Administrative and support service activities; 14- Education; 15- Human health and social care activities; 16- Arts, entertainment, sports, and recreation activities; 17- Other service activities.*

In 2023, the regions of Cávado and Ave displayed diverse company distributions according to the Classification of Economic Activities (***Table 2***). In Cávado, the total number of companies was 57.634, with the Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles sector having the highest concentration at 10.101 companies. This was followed by Administrative and Support Services (7.068 companies) and Professional, Scientific, and Technical Activities (6.125 companies). The Construction sector had 5.670 companies, while Manufacturing recorded 4.811. Health and Social Work Activities accounted for 4.921 companies. On the other hand, Mining and Water Supply sectors had a much smaller presence, with only 29 and 55 companies, respectively. In Ave, there were 48.561 companies, with Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles leading at 9.552 companies. Administrative and Support Services (5.346 companies) and Professional, Scientific, and Technical Activities (4.353 companies) followed. The Manufacturing sector had 5.151 companies, and Construction had 4.033. Health and Social Work Activities amounted to 4.303 companies. The Mining and Water Supply sectors also had limited representation, with only 29 and 44 companies, respectively.

Table 2. Number of companies by CAE - Cávado and Ave (2023).

CAE	Cávado	Ave
Total	57,634	48,561
1. Agriculture, animal production, hunting, forestry, and fishing	3,066	2,230
2. Extractive industries	29	29
3. Manufacturing industries	4,811	5,151
4. Electricity, gas, steam, hot and cold water, and cold air	241	219
5. Water collection, treatment, and distribution; sanitation, waste management, and pollution control	55	44
6. Construction	5,670	4,033
7. Wholesale and retail trade; repair of motor vehicles and motorcycles	10,101	9,552
8. Transportation and storage	1,281	883
9. Accommodation, food services, and similar activities	3,460	3,318
10. Information and communication activities	1,150	584
11. Real estate activities	2,429	1,932
12. Professional, scientific, and technical activities	6,125	4,353
13. Administrative and support service activities	7,068	5,346
14. Education	2,708	2,327
15. Human health and social care activities	4,921	4,303
16. Arts, entertainment, sports, and recreation activities	1,337	1,341
17. Other service activities	3,182	2,916

Source: INE (2023b)

The analysis of correlations between the offerings of Higher Professional Technical Courses (CTeSP) and regional economic indicators clearly highlights the substantial positive impact of the Instituto Politécnico do Cávado e do Ave (IPCA) on local economic growth and development. The results are not only promising but also reinforce the pivotal role that the IPCA plays in fostering the region's economic prosperity through its educational offerings (***Table 3***). The correlation between the number of internships (representing CTeSP offerings) and Gross Value Added (GVA), which serves as a proxy for Gross Fixed Capital Formation (GFCF), reveals a remarkable coefficient of 0.963 with a significance value of p<0,001. This strong, statistically significant correlation underscores the profound impact of the IPCA's CTeSP offerings on the region's economic growth. As the number of internships increases, there is a substantial corresponding increase in GVA, indicating that IPCA's CTeSP offerings are directly contributing to the generation of economic value. This positive association demonstrates the IPCA's vital role in fostering local economic development, particularly in terms of strengthening fixed capital formation and enhancing the overall economic infrastructure of the region. The correlation between the number of internships and the number of companies in the region also shows a statistically significant correlation, with a coefficient of 0.571 and a proof value of 0.033, revealing a positive relationship. The positive correlation implies that, in the long term, the highly qualified professionals trained by the IPCA can contribute to entrepreneurship and business growth in the region. The positive influence of the IPCA on the qualification and specialization of the workforce is undoubtedly a driving factor for innovation and future business development. In conclusion, the results confirm the IPCA's significant and positive impact on the region's economic activity, especially in terms of generating added value and developing fixed capital. While the immediate effect on the number of companies is not as strong, it does show that the IPCA's educational contributions undoubtedly create fertile ground for future company growth and innovation. These results highlight IPCA's critical importance in driving regional economic development through its CTeSP offerings, and the institution remains a key pillar in advancing the region's economic and industrial infrastructure. This study provides strong evidence that investment in IPCA and its programs is a strategic measure to promote long-term sustainable economic growth in the Cávado and Ave region.

Table 3. Correlation Analysis Between CTeSP Offerings (Internships), Number of Companies, and Gross Value Added (GVA).

Gross Fixed Capital Formation (GFCF) by GVA	$R_P = 0,963$ $p < 0,001$
Number of companies	$R_P = 0,571$ $p = 0,033$

Source: own elaboration*; Note that gross fixed capital formation was constructed based on the year 2023; while the number of companies was constructed based on the years 2021, 2022, 2023; the comparison refers to the number of internships in 2023, when observing gross fixed capital formation and the number of internships in 2021, 2022, 2023 for the number of companies-* ***Table 4 and Table 5.***

Table 4. Distribution of Internships and GVA by CAE (Economic Activity Code).

CAE	Nº Internships	%e Internships	GVA €	%GVA	GVA (million €)
3	184	28,4	757807273	44,8%	757,8073
5	5	,8	18200765	1,1%	18,20077
6	44	6,8	131363917	7,8%	131,3639
7	137	21,1	208175478	12,3%	208,1755
8	12	1,8	67488180	4,0%	67,48818
9	12	1,8	64029030	3,8%	64,02903
10	79	12,2	79313403	4,7%	79,3134
11	2	,3	150001903	8,9%	150,0019
12	117	18,0	57477852	3,4%	57,47785
13	17	2,6	44861892	2,6%	44,86189
14	7	1,1	4333199	0,3%	4,333199
15	8	1,2	36632246	2,2%	36,63225
16	8	1,2	64878432	3,8%	64,87843
17	17	2,6	8841596	0,5%	8,841596

Source: IPCA (2023) & INE (2023a)

Table 5. Distribution of Internships and Companies by CAE (Economic Activity Code).

CAE	Nº Internships	%e Internships	Nº Companies
3	365	30%	29821
5	12	1%	295
6	72	6%	27593
7	276	23%	58398
8	18	1%	5483
9	18	1%	19756
10	160	13%	4531
11	2	0%	12211
12	175	14%	29932
13	31	3%	33163
14	15	1%	14292
15	18	1%	26496
16	27	2%	7187
17	29	2%	16989

Source: IPCA (2021; 2022; 2023) & INE (2023b)

6. Conclusions

This study analyzed the relationship between gross fixed capital formation (GFCF), the number of companies, and the supply of Professional Higher Technical Courses (CTeSP) at the Polytechnic Institute of Cávado and Ave (IPCA) in the Cávado and Ave regions of Portugal in 2023. It found that sectors with the highest investment, such as Manufacturing and Wholesale/Retail Trade, align closely with IPCA's educational offerings, indicating a match between market needs and education. A strong, statistically significant correlation was found between GFCF and the number of internships, suggesting that investment in key sectors drives demand for skilled professionals and supports regional economic growth. While the correlation between internships and the number of companies was not statistically significant, a positive trend indicates that IPCA's specialized training may foster innovation and business growth over time. The findings highlight the importance of aligning educational programs with regional investment and economic dynamics. IPCA's higher technical education contributes directly to value creation, infrastructure development, and sustainable regional growth. In conclusion, the strategic alignment of CTeSP courses with labor market demands is crucial for regional development and graduate employability. The study underscores the need for continuous, market-informed planning of educational offerings to promote innovation, entrepreneurship, and long-term economic prosperity.

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THE APPLICATION OF MIXED REALITY IN AUTISTIC STUDENTS FOR EDUCATIONAL SETTINGS THROUGH BIBLIOMETRIC INDICATORS

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Abstract

In today's societies, technology plays a fundamental role in the development of everyday tasks. This tool is increasingly being used in a wide variety of fields of knowledge. In recent years, the use of mixed reality is spreading in educational environments. This is because mixed reality offers the possibility to create learning situations where communication and social interaction skills can be practiced. Therefore, this tool is adjusted to a type of student that is increasingly present in the classrooms of schools, namely autistic students. As a consequence, the aim of the research is to carry out an analysis on the use of mixed reality in students with autism using all the databases of the Web of Science, in the period 2019-2024. Search words were chosen from the ERIC Thesuarus. These words were autism, autism spectrum disorder, autism spectrum disorders, high-functioning autism, low-functioning autism and Asperger. After applying the inclusion and exclusion criteria, the final sample was 58 documents. The most important results show that the United States is the largest producer of publications with 16 of the papers. Likewise, the most prolific period was the year 2024 with 13 publications, with computer science and engineering being the areas most present in the Web of Science. Finally, the most published document types are conferences and articles. As future lines, the possibility of extending the period of analysis and using other databases is proposed.

Keywords: *Mixed reality, technology, autism spectrum disorders, education.*

1. Introduction

In the educational world there are more and more students with special educational needs who require specific and individualized attention. One type of student whose prevalence has increased significantly in recent years is the autistic student, from 1 in 54 to 1 in 26 (Maenner et al., 2023). ASD comprises a range of neurodevelopmental disorders characterised by social impairments, communication difficulties and repetitive and restrictive behaviour patterns (American Psychiatric Association, 2013). Despite the difficulties presented by autistic learners, they also present great strengths such as strong memory, attention to detail and visual learning facilities (Russell et al., 2019). Taking the strengths of autistic learners as a reference, the technology that can best address the needs of autistic learners is MR. MR combines aspects of VR and AR. In addition, it allows the manipulation of virtual objects in real environments (Maas and Hughes 2020). The use of MR with autistic learners is justified for several reasons. First, MR can be used to create learning environments in which students can safely experiment (Chóez Chiliquinga and Larreal Bracho, 2023). Secondly, RM adapts to the learning needs of each student favouring inclusion from different approaches according to Marín-Díaz et al. (2024). Finally, learning environments that use MR lead to greater interest in the learning of autistic students and the acquisition of educational skills (Khasawneh, 2023).

Based on the justification of the importance of the use of MR with autistic people, the general objective of this paper is to analyse the scientific production of the application of MR in autistic students during the period 2019-2024 based on a series of bibliometric indicators, and the following research questions are posed in order to fulfil this objective:

- Which country is the largest producer on this subject?
- What has been the most prolific period of publication on this subject?
- What is the most widely used type of document in the field of study?
- What are the areas of research most frequently considered by the Web of Science in the topic of study?

2. Method

A descriptive-retrospective bibliometric design has been used in this study. The descriptive-retrospective bibliometric design allows the selection and organisation of the documents analysed (Montero & León, 2007). This method is implemented through the following phases. Firstly, the search and selection of information is carried out. Secondly, the documents are classified according to the descriptors and, finally, the extracted data are analysed (Rosa et al., 1996).

2.1. Sample

The sample consists of 58 articles published during the period 2019-2024 and indexed in all Web of Science databases: Web of Science Core Collection, BIOSIS Citation Index, Current Content Connect, Data Citation Index, Derwent Innovations Index, FSTA, Grants Index, Inspec, KCI-Korean Journal Database, MEDLINE, ProQuest, SciELO, Zoological Record.

The search and selection process took place in January 2025, while the individual reading and analysis phase took place in the period February-March 2025.

2.2. Design and procedure

The following keywords were entered into the associated text box of the Web Of Science in order to search for the documents in the sample, taking into account the terminology of DSM-IV and DSM-V:

('Autism' or 'autism spectrum disorder' or 'autism spectrum disorders' or "asperger" or 'autistic students' or 'high-functioning autism' or 'low-functioning autism') AND ('mixed reality').

After applying the lines of code, 72 documents were obtained, and after applying the inclusion criteria, these were reduced to 58 documents. The documents were filtered following the PRISMA methodology (Page and Moher, 2017). The following criteria were applied as inclusion criteria: year 2019-2024, documents related to mixed reality and autism. While the exclusion criteria used were: repeated documents, documents without access, documents working on other technologies, documents not related to autism and categories other than: Education Educational Research, Social Science Discipline, Computer Science, Automation Control Systems Engineering, Social Science Other Topics and Information Science Library Science. The final sample analysed consisted of 58 documents.

3. Results

The results extracted using the variables explained in the previous section are detailed below.

3.1. Top producing countries

The following results were found with regard to the top producing countries. The United States is the largest producer with 27.58% (16 articles). In second and third place are Spain and China with a total of 8 articles each (13.79%). In fourth place is Taiwan with 6.89% (4 articles).

3.2. Number of articles published by year of publication

The results indicate that the year with the highest number of publications is 2024 with 13 papers, representing 22.41% of the total. The second most productive year is 2020 with 11 papers, representing 18.96% of the total number of publications. The third and fourth most productive years are 2022 and 2023 with a total of 9 papers each, representing 15.51% of the total.

3.3. Type of document most published

With regard to the type of document most frequently published, we find the following. The most published type of article is conferences with 41.37% (24 documents). The second most frequently published type of document is articles with a total of 20 documents (34.48%). In third place we find congresses with 17.24% of the total number of documents (10 documents).

3.4. Categories of the Web of Science

The Computer Science category includes 47 articles. Likewise, the Engineering category contains 33 articles. Finally, the third category with the highest number of papers is Education Educational Research with 22 papers.

4. Discussion

Throughout the development of this research, the aim has been to analyse the scientific production on mixed reality and autistic students according to a series of indicators.

4.1. Top producing countries

In reference to the results obtained on the top producing countries, they reveal a clear predominance of the United States as the country that produces the most papers in this field, with 27.58% of the articles (16 in total). These results reflect the dominant role of the United States in the research and development of innovative educational approaches, given that US institutions have been pioneers in the implementation of RM, which has generated an abundance of research from this country. This is consistent with the country's extensive investment in education and technology, as well as its leadership in promoting interdisciplinary pedagogical approaches (Beers, 2019). In second and third place, Spain and China share an output of 8 articles each, representing 13.79% of the total. Spain's significant presence in this field may reflect a growing interest on the part of researchers in the application of emerging technologies for better and more innovative education (Prendes-Espinosa et al., 2021).

In recent years, there has been an increased awareness of the importance of educational inclusion in Spain, which may be motivating academics to explore new methodologies, such as mixed reality, to support learners with special educational needs as shown in the article by Mera-Macías (2022).

4.2. Number of articles published by year of publication

The results obtained in this analysis reveal a growing trend in the production of articles over the years, with a notable increase in 2024, where 13 publications were recorded, representing 22.41% of the total. Thisincrease may be a consequence of new plans for the development of digital competence and the need for teacher training (Recio Muñoz et al., 2020). The second most productive year is 2020, with 11 articles (18.96%). This year coincides with the beginning of the COVID-19 pandemic, which could have influenced the direction of research and the urgency to publish relevant findings in a context in which ICT played a very important role in education as teachers had to use a multitude of digital resources, techniques and educational platforms, thus arising the need for research on all types of technologies (Jiménez 2020).

4.3. Most published document type

Regarding the most published document type, the results reveal that conferences are the most prevalent document type, representing 41.37% of the total number of publications. This trend suggests a clear need for rapid dissemination of findings in a rapidly evolving field.The high proportion of conferences reflects the culture of collaboration and the desire to receive immediate feedback from the scientific community (Huanca, 2024). In contrast, research articles, which constitute 34.48% of publications, indicate a significant interest in the production of original knowledge, albeit to a lesser extent. This is because academic conferences are considered important vehicles for generating scientific and social impact (Hauss, 2021).

4.4. Web of Science categories

Regarding Web of Science categories. The results reveal that the category containing the largest number of papers is Computer Science, which comprises 47 papers out of the total. This finding suggests that research in the field of computer science is experiencing significant growth, which can be attributed to the rapid evolution of technology and its impact on various areas of society such as education (Segovia-García, 2024). Computer science has not only established itself as a fundamental field in academic research, but has also permeated other disciplines, such as education (Abdullah, 2024). In this sense, the potential of RM in education has been widely studied from two approaches: as a teaching support to renew methods and as a didactic resource to improve students' learning processes (Moreno-Guerrero et al., 2022).

5. Conclusions

This study has shown that scientific production on the use of mixed reality in working with autistic students during the period 2019-2024 has grown steadily in recent years. Based on this study and the results obtained, the following conclusions are presented:

- The United States is the country that produces the most documents on this subject.
- 2024 was the year with the highest number of documents published in relation to working with autistic students and MR.
- The most published document type is conferences.
- The Web of Science category that hosts the most papers on RM and autistic learners is Computer science.

In conclusion, the implementation of RM for working with autistic learners represents a valuable opportunity to innovate and improve the learning experience. This study highlights the need to continue to explore new methodologies that effectively integrate technology into the classroom, promoting a more inclusive and accessible environment. It is suggested that future research should extend the date range studied and augment the information gathered with that extracted from other databases such as Scopus.

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EXAMINING TEACHER PERSPECTIVES ON INCLUSIVE EDUCATION: INSIGHTS FROM SOUTH AFRICAN EDUCATORS

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Abstract

The study examines the perspectives of South African educators on inclusive education, focusing on their experiences and challenges in implementing inclusive practices in primary schools. Employing a qualitative research methodology within an interpretive paradigm, the research involved six teachers from two mainstream primary schools selected through purposive sampling to provide rich insights into their experiences. Meaning that the study interpreted what the SBSTs were saying. Data were collected using semi-structured interviews, allowing for an in-depth exploration of teachers' views on inclusive education. The theoretical framework for the abstract examining teacher perspectives on inclusive education is Vygotsky's Sociocultural Theory. Thematic analysis was applied to identify key themes from the data, revealing that while teachers generally support inclusive education, they face significant challenges such as inadequate training, limited resources, and large class sizes. Many educators expressed a need for more professional development opportunities such as training sessions, teacher workshops on effective teaching methods for inclusive education like differentiation, accommodation and adaptation to address diverse learning needs effectively. The findings highlight the critical role of teacher empowerment in fostering an inclusive classroom environment. Recommendations include enhancing in-service training focused on inclusive practices, promoting educator collaboration, and improving communication with parents and communities. Additionally, the study emphasizes the importance of School- Based Support Teams (SBST) and District-Based Support Teams (DBST) in providing necessary support for both teachers and learners. The research contributes valuable insights into the complexities of implementing inclusive education in South Africa, underscoring the need for systemic changes that support educators in their roles. Ultimately, it aims to inform policy and practice to enhance educational experiences for all learners in inclusive settings.

Keywords: *Inclusive education, educator perspectives, professional development, support team.*

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1. Introduction

In the contemporary educational discipline, the concept of inclusive education has emerged as a beacon of hope and progress, particularly within the Foundation Phase (González-Pérez & Ramírez-Montoya, 2022). The paradigm asserts that education is a universal right, transcending barriers of difference, and mandates that every child, irrespective of their unique backgrounds or abilities, is entitled to receive an education that is not only accessible but also free and equitable. Inclusive education faces challenges such as inadequate teacher training, lack of resources, and insufficient parental involvement, all needing to be addressed to reach its full potential (Materechera, 2020). Effective implementation of inclusive education necessitates well-prepared teachers, as highlighted by various scholars. (Vaughn et al., 2024) Parental involvement is another crucial aspect of inclusive education. Parents often possess unique insights into their children's needs, making active participation in the educational process essential (Sijuola & Davidova, 2022). Despite these frameworks, challenges persist due to overcrowded classrooms and insufficient teacher training (Segooa & Molise, 2023). This study deals with the importance of support systems that should be employed for effective implementation of inclusive education. It explores various support systems and aims to inform policy and practice to enhance educational experiences for all learners in inclusive settings.

2. Literature review

Educational policies highlight the role of School-Based Support Teams (SBST) in fostering inclusivity, with ongoing teacher training and community involvement being vital for its success (Morgado

et al., 2024). Despite their critical role, SBSTs encounter significant challenges, including inadequate training, lack of resources, and insufficient collaboration with parents (Tsotetsi & Omodan, 2020).

Parental engagement is also critical to the success of SBST initiatives, as strong home-school relationships improve educational outcomes for learners with barriers to learning (Mpanza & Govender, 2022). Literature emphasises the vital role of parents in their children's education. It shows that lack of parental involvement negatively affects academic performance, student behaviour, and teacher morale. Teachers are enthusiastic about Inclusive Education (IE), but research shows a significant gap in addressing the needs of Learners with barriers to Learning (LEBL) (Banoo, 2021). This shortfall is attributed to insufficient training, as highlighted in a study by Carballo et al., 2021.

3. Theoretical framework

Vygotsky's Sociocultural theory takes the view that for professional development to get realized, the teacher should participate in social activities and groups (Johnson & Golombek, 2020). The teacher's Zone of Proximal Development (ZPD) as a learning space between his/her present level of teaching knowledge consists of his/her content (theoretical) and pedagogical knowledge and skills and his next (potential) level of knowledge to be attained with the support of others as in the case of inclusive education whereby some teachers only have theory but are grappling with the practical part on how to support learners with barriers to learning(Vaughn et al., 2024) The teacher trainer, as a more knowledgeable partner, may provide the scaffolding, and they engage in mutual professional change. The program designer of professional development should identify the needs and goals of the teacher trainees so that the less knowledgeable trainees could move up through higher stages of ZPD functioning under the supervision of more knowledgeable trainers, which in this case are the effective teaching methods in an inclusive setting (Margolis, 2020). Mentoring and peer coaching are the examples of procedures through which the novice teachers could experience professional development under a more significant other's supervision and collegiality (Walters et al., 2020). The school principals and authorities in the ministry of education could have second thoughts on designing specific professional development programs during which novice teachers are given opportunities to benefit from one another's contributions, knowledge, and experiences (Sancar et al., 2021). Such specific professional development programs may include some specific learning barriers like linguistic or dyscalculia (Kunwar, 2024).

4. Methodology

The study utilised a qualitative approach within an interpretive paradigm using a case study research design to describe and explain the experiences of SBSTs from their perspectives, focusing on their beliefs and meaning systems. This method emphasises how participants interpret their experiences and construct their worldviews, making it relevant for understanding SBSTs' challenges in supporting Foundation Phase teachers (May & Perry, 2022). The emphasis was on their viewpoints, as insiders, in understanding the social realities.

4.1. Research design

The research design used was a case study, since the study was exploring two cases in two different natural settings, using a variety of data collection procedures during a sustained period of time (Hancock et al., 2021). The study attempted to understand the SBST`s experiences and challenges in providing support to FP teachers.

4.2. Data collection

The research was descriptive, exploratory and inductive with data collected in natural settings i.e., at schools through interviews, observations and document analysis (Morgan, 2022). Focus groups of six SBST were used for interviews. The interviews were voice- recorded with the SBST permission.

4.3. Data analysis

This research design enabled thematic analysis of the collected data. To make sense of the information gathered on learners` experiences in inclusive education from the learners' perspective, data was categorized and coded into themes for interpretation (Lochmiller, 2021).

4.4. Population and sampling

The chosen strategy for this research was purposeful sampling of two mainstream primary schools, with the sample composed of participants who have the most characteristic and typical attributes for the topic under study. These schools were chosen through identification from prior information to enhance data quality (Campbell et al., 2020).

4.5. Data presentation and treatment

The information was then taken back to the participants to verify if their written responses reflected what they said (Motulsky, 2021). The final results were the general description of the phenomenon as experienced by the participants (Maxwell, 2021). After the verification of the data by the participants, theory was generated.

4.6. Ethical consideration

Letters requesting access to conduct the study at the sampled schools were forwarded to the school principals and the Department of Education (DoE). The principals and DoE responded to the letter in writing giving permission for research to be conducted. Participants were given consent letters requesting permission to participate in the study. The SBST participated freely and gave the information needed. They were informed of their rights to quit participation anytime they wished. They were also informed that they might refuse to be tape recorded. Participation was done voluntary with no coercion, force, threat or intimidation to give information to the researchers (Aragonés Calleja & Sánchez Martínez, 2023).

5. Findings and discussions

Findings revealed the insight into the teachers' perspectives on inclusive education. The following themes emerged from the collected data: insufficient training, lack of parental involvement and the importance of SBST and DBST in implementing IE.

5.1. Insufficient training

One challenge the SBST raised, was the inadequate training they received. The findings indicated that SBST believed that not all teachers understood the concept of IE because they were not trained enough to specialise in LEBL. They further mentioned that even those who were trained often lack sufficient specialisation. To make things worse, they believe that teachers struggle even to understand the inclusive education policy (SIAS) despite their training, lacking the necessary knowledge and skills to effectively address learners' challenges with learning barriers (LEBL). They further stated that because of this deficiency in knowledge and skills, they received assistance from the social workers when they had to refer learners. While they were willing to support all students, they lacked confidence in implementing the IE policy, leading to frustration. They took the view that the current situation would improve if all teachers could be trained and capacitated in IE, especially in dealing with LEBL.

The philosophy of inclusion in the South African education system is rooted in the Constitution and emphasises human dignity, equality, and human rights. SBST faces several challenges, including inadequate training that limits its ability to support learners with barriers (Dlamini, 2022). Despite their limited knowledge, SBST is willing to help learners through trial and error. Teachers feel the DBST's training for SBST could have been more effective, as the lack of skills and knowledge has hindered the implementation of Inclusive Education (IE) (Nong, 2020).

5.2. Lack of parental involvement

SBST indicated that there was no collaboration among teachers to enhance communication between parents and the community as the result parents do not want to attend school or cooperate with SBST. They further showed that some parents were even ashamed of their children's disabilities, and this posed a challenge to parental involvement. SBST indicated that learners must be helped by their parents with reading at home, assist them in writing words and doing mathematical calculations at an early stage.

The lack of involvement of parents and the community in school activities and the general support of children's education hurts the implementation of IE, as a lack of understanding, communication, and support hinders its practical implementation (Jardinez & Natividad, 2024). The parents or caregivers of learners are the source of information about the child. Studies reveal that (Wilder, 2023) learners who perform well at school are those whose parents showed interest in their education at the early stages of their education and who engaged in supporting learning activities such as rhyming and shared book reading.

5.3. Importance of SBST and DBST

SBST believed that they should play a vital role in IE as they are responsible for screening, identifying, and supporting teachers, learners, curriculum, and institution as a whole. After identifying LEBL, they should provide individual attention and guide FP to complete support needs assessment forms (SNA 1) with inputs from parents or caregivers. This is done so that the DBST can complete SNA 2 in case some learners need intervention. Despite that, SBST noted that teachers had not grasped the concept of inclusive education (IE).

The primary role of the School-Based Support Team (SBST) is to identify and address barriers to learning (Agulhas, 2021). They also interact with the District-Based Support Team (DBST) to provide specialised services for teachers facing these challenges. To enhance its effectiveness, it is essential to adopt best practices from schools that excel in inclusive education and to hire experts who can demonstrate support strategies in classrooms (Gahutu, 2024). Pre-service training in inclusive education for future teachers is also recommended (Makhalemele & Tlale, 2020).

6. Conclusion

From the research findings, it is apparent that SBST had inadequate knowledge and skills for helping LEBL and, as a result, did not adequately support LEBL. There is no collaboration among educators and no communication with the parents and communities. Lastly, the SBST and DBST are not providing the necessary support to the teachers and learners.

7. Recommendations

To ensure effective implementation of inclusive education, the following recommendations were made:

- All schools and districts should establish the School Based Support Teams (SBST) and District Based Support Teams (DBST), ensure their functionality to drive the programme of implementing inclusive education (IE) and ensure that the necessary support is provided for both teachers and learners. Without these structures, IE will remain a dream. This structure should be made of dedicated members as envisaged by the department of education.
- All SBST and DBST should undergo in-service training on inclusive practices so that they know how to support teachers and learners to deal with the learners experiencing barriers to learning. Attending in-service workshops, language teaching education (LTE) course rooms, and conferences could serve as a crucible for the novice teachers to continually test and change their emerging pedagogical concepts and practices and in this way, sustain their professional development.
- Inclusive education needs collaborative efforts, therefore, collaboration among educators must be promoted, coupled with improved communication with parents and communities. Additional to that, parents should be urged to start giving the information about the children so that the SBST and DBST could know exactly which areas need support.

8. Limitations of the study

One of the limitations of the study was that it could not be generalized because it was dealing with cases in the two schools. To overcome this limitation, the focus was on gaining an in-depth understanding of the phenomenon under study. Another limitation was time because, during the data collection, schools were busy with music and exams, so there was not enough time to gather more data. To overcome this limitation, teachers were interviewed during break time. Money was also another challenge, especially during the data collection, because everything was done using money, including internet costs, photocopying, transport costs, etc. To overcome this challenge, personal budget had to be sacrificed.

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DEVELOPMENT OF INTERVENTION CASE CARDS TO HELP PBL INSTRUCTORS IN REFRAMING THEIR ROLE PERCEPTIONS

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Abstract

Recently Project-Based Learning (PBL) style concentrated on real-world issues has been employed in many educational institutions as a learner-centered approach. In the approach the role of an instructor is not to provide knowledge, but to assist learners' progress. Many instructors involved in the practice of PBL, unfortunately, still do not clearly understand their own role, despite the significance that has been presented over the years of encouraging instructors to change their mindset. This study aims to develop a collection of "Intervention Case" Cards to help instructors in reframing their role perceptions within the PBL context, and to design a training program with the cards for evaluating their effectiveness in encouraging the mindset shifts. We collected real intervention examples with experienced PBL practitioners, then developed a set of 30 Intervention Case Cards, throughout iterative prototyping for refinement. The cards have three features: (1) each card presents a concrete example of instructional intervention and (2) corresponds to one or more of the key instructor roles in the learner-centered approach, and (3) the description of instructor's role is adjusted with the PBL context of the institution implementation. The features allow instructors to imagine specific intervention situations and to intuitively judge whether a case should be intervened in supporting learners of actual PBL practice.

Keywords: *Project-based learning, learner-centered approach, faculty development, reframing.*

1. Introduction

For surviving in the VUCA society, it is essential to have the skills to communicate with different people, gather information from different media, make decisions and solve problems in a flexible and resourceful manner. Here, VUCA stands for Volatility, Uncertainty, Complexity, Ambiguity. Young people preparing enter society near future will have to continue learning throughout their lives, as AI and other technological innovations will make the knowledge and skills acquired in school education obsolete faster. For continuous learning, they need to develop self-directed skills during their school life. It is indicated that they are acquired to be able to set their own learning goals, formulate plans to achieve them, carry out self-evaluations and set the next goal. To develop these skills, educational institutions are introducing a learner-centered approach in educational programs. Among these, PBL, which focuses on real-world problem-solving, is being increasingly adopted, particularly by higher education institutions.

According to a report of Japan government, the percentage of higher education institutions in Japan that implement Project-Based Learning within the regular curriculum has increased by approximately 20% over the ten years since fiscal year 2012 (MEXT 2012; a white paper of the Ministry of Education, Culture, Sports, Science and Technology in Japan government). Among learner-centered approaches, greater emphasis is placed on students' activities which may introduces more variables such as the need to coordinate with external stakeholders and to link learning outcomes with real-world issues. Instructors, therefore, are required to make a significant shift from own roles in the traditional professor-centred approach to more appropriate roles (e.g., Reigeluth, Beatty, & Myers 2017, Pan, Seow, Shankararaman, & Koh 2021, Pengyue, Nadira, Danli, & Wilfried 2022). There are many excellent training programs for instructors, like Buck Institute for Education, that link theories and concepts with leaders' educational practices (Suzie & John, 2018). However, despite the growing number of PBL courses, only a limited number of institutions are even supporting instructors in promoting role transformation. It is unfortunate, therefore, that the number of faculty members who can properly engage in PBL programs has not increased.

We have been involved in educational improvement activities at an engineering college, hereafter KOSEN. Then we distributed a guideline for instructors in charge of a PBL course to reconstruct their own roles as a support person in learner-centered approach including specific actions, and have conducted training sessions for attempting to provide opportunities the instructors to reflect on their practice (Ishida et al., 2017, Ishida, Takeoka, & Matsuba, 2018). For our regret, the training was limited to a mere exchange of information, or his/her perspectives on reflection were often self-serving. Some participants resisted the idea of reflection, and gradually fewer people attended the training sessions. In some cases, the role perceptions and behaviors of them changed in a different direction from our will. It is not easily lead to changes in the roles and behaviors for PBL instructors. We reflected our practices from the perspective of whether the training programs intended to change participants' attitudes have not been progressing. Then we found many instructors were unable to envisage specific actions in supporting students, and to link training content to their practice, and so (Ishida, Mizushima, Tanaka, Suzuki, & Matsuba, 2024, Kai, Ishida, & Matsuba 2024).

As a new initiative, we have developed Intervention Case Cards and a training program using the cards to help instructors reconstruct their role awareness in the context of the PBL course they teach via the considerations. In the present paper, we show the effectiveness of the training program using the Intervention Case Cards that we obtain from a formative evaluation practice. The research questions set by us are as follows: RQ1: To what extent are the training program with the Intervention Case Cards developed useful for instructor satisfaction and action planning? RQ2: Were the instructors able to reframe their perceptions of PBL and the instructor's role in the six roles that we expected them to play?

2. Methods

2.1. Development of intervention case cards

We developed Intervention Case Cards to be used in a training program with the instructors at KOSEN who conduct PBL courses with the mixed departmental grade teams as described above. The role of the card development is to enable instructors to reflect on own role perceptions and actions in PBL more meaning-oriented and deeper rather than superficial and rational way (Korthagen, 2017) and to encourage interaction between other instructors, i.e., participants of the workshop, to help reframing their ideas about students supports in PBL practice. Therefore, we designed the cards as (a) the cases are to be close to the context he/she was in past PBL practice, and (b) the role of an instructor is notated along with his/her perceptions and actions of the cases. In developing the cards, we reorganized the roles of teachers as described by Reigeluth et al. (2017) to fit the context of PBL practice at KOSEN, resulting in the following six roles; Support for Goal setting (R1), Support for designing and selecting group assignments (R2), Facilitation of learning (R3), Facilitation of task execution (R4), Support for evaluating learning and performance (R5), and Group mentoring including mental care (R6).

We proceeded with the development of the card using the following procedure: 1) Based on the results of observations and interviews with veterans and new faculties in the target institution, we picked up 47 items illustrated conscious or unconscious actions by them. 2) We asked some faculties who had experience teaching classes at the target schools and experts in instructional design to assort the 47 actions into the six role categories and to check the level of agreement each other. Also the instructional design experts were asked to review the 47 actions and identify areas for improvement. 3) The actions with high concordance were retained, while that with low concordance or noted in the expert review were revised. 4) As the role R1 and R5 had fewer action i.e., item cards among the six roles, we added some actions selected from the Buck Institute for Education's PBL instructor's rubric (Suzie & John, 2018). Finally, we completed Intervention Case Cards consisted of a set of five cards per role.

2.2. Practice of the training program using the intervention case cards

Next, we developed a training program using Intervention Case Cards. The program consists of the following four pieces of work: a one-hour pre-assignment and a two-hour workshop. At the end of the workshop, participants are asked to respond to a questionnaire on their satisfaction with the training program and the extent to which they felt each work contributed to the creation of an action plan. We then present an overview of our training program.

“Preliminary assignment” is called Work 1: Review the practices in PBL classes that you have taught in the past three years; write down the roles and actions of teachers in PBL classes; ask the participants to write down their images of successful PBL classes; and ask the participants to write down the roles and actions of teachers in PBL classes. “Share pre-assignment” is the Work 2. All participants present the results of own preliminary assignment. The Work 3 “Confirmation of past experiences” is divided into two small tasks. The section one is participants classify the PBL class into two categories of “doing” and “not doing” while looking at the 30 cards (Work 3-1). Then by attaching stickers to the list

sheet with the results classified by individuals, it is possible to visualize for each role which items many participants answered as “doing” and which items few participants answered as "not doing. The next section is group working. In each group, participants identified and discussed commonalities and differences in the results of each other's responses. For the items that participants answered they were not doing, they received hints from those who answered they were doing them and thought about how they could do them in practice (Work 3-2). The final task is “assignment and reflection”. They write an action plan for the next year's class and an image of a successful PBL Practice as Work4. The training program completed through these developments was approved by the Institutional Review Board (IRB) and was piloted with five instructors in March 2025. One of the participants was a new instructor member who will be teaching the class in question, and was therefore excluded from this analysis.

3. Result and discussion

Table 1 illustrates satisfaction rate in the post-program Questionnaire. All participants responded 7 or higher out of 10. We show how each of the works (Work 1-3) is helpful in the creation of own action plan (Work 4) in Table 2. There is no person marked less than 6 points as both tables show, so that we have confirmed that all tasks designed in the training program are working as intended and helping the participants.

Table 1. Satisfaction with the training program.

	6 and below	7-8	9-10
(1) Would you recommend the training program to other teachers who did not participate this time? (On a 10-point scale)	0	2	2
(2) How satisfied are you with the training program? On a 10-point scale, please rate your satisfaction.	0	3	1

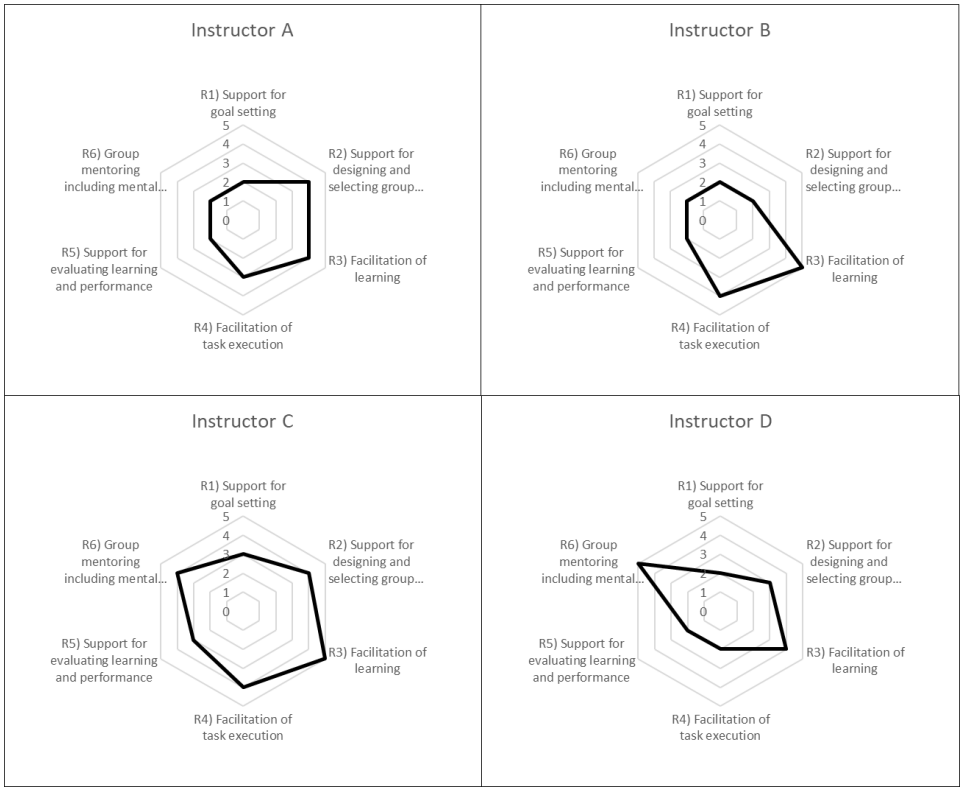
Table 2. Contribution of each task to the creation of the action plan.

	Helpful	Somewhat helpful	Somewhat not helpful	Not helpful
(1) Reflecting on my own actions in PBL classes so far (Work 1)	3	1	0	0
(2) Using cards based on the PBL classes I teach, I confirmed my own actions in classes and the reasons for them (Work 3-1)	1	3	0	0
(3) Using cards based on the PBL classes I teach, I learned about the practices and ideas of other teachers (Work 3-2)	2	2	0	0

We then proceeded to investigate whether a reframing of the participant' perceptions of their role in PBL practice had occurred or not via the workshop. This is main purpose of current project. The following are the results of a comparison of the descriptions in Work 1 and Work 4 for each teacher. Regarding the ideal PBL image, instructor A simply hoped for new experiences and awareness previously, but in the post-work, the image changed to one in which awareness and change occurred as a result of challenging the students in some way. Reflection on action (post-action reflection) was added to the instructor member's role recognition and action. In the pre-survey, instructor B described his ideal PBL image in terms of instructor involvement. In the post-program, it was added to the pre-program content that the theme should be set in a way that both students and instructor could work on it while maintaining their curiosity and motivation. Regarding the role recognition and actions of the instructor members, the program originally emphasized the students' independence and gradually provided support to enable students to work autonomously on their own, but in the post-program, he set his individual goal is support for learners.

The instructor C did not show any change in the description about ideal PBL image between the pre- and post-project cycles. However, changes were observed in the instructor member's role perceptions and behaviors. He mainly mentioned from the perspective of a project manager in past, but in the post-description, he commented about supports for each student to autonomously implement a cycle of self-regulation by sharing not only the goals of the project but also the goals of each member of his team. Instructor D mentioned 2 points for the image of success as a team project and human relations previously and then added individual goal setting and proactive activities for the students' PBL activities in the post-program. His pre-descriptions focused on the changes of individuals through talking and/or observing his students, while the post-descriptions show about actions not only from the instructor members but also to delegate to a third-party familiar with the interaction and activities among the learners.

Figure 1. Classified as "doing" in PBL (Work 3-1).



The questionnaire shows that all participants were highly satisfied with the training program using the Intervention Case Cards. The participants also indicated that they found it useful to reflect on their own actions in past classes in Work 1, and to learn about other teachers' practices and innovations by using the cards in Work 3.

The comparison of the participants' descriptions of their images of PBL success and perceptions of their own roles and actions before and after the training program shows that all participants reframed their roles as PBL instructors. Since there were five cards for each role, a score of 5 indicates that all of the cards for that role were used. You can find there were differences in the roles focused on by the instructor members in Figure1. On the other hand, what all participants had commonly a low implementation rate of R1 (support for goal setting) and R5 (support for evaluating learning and performance) mentioned in the section 2.1. We consider that this is confirmation of our findings in the previous studies (Ishida, Mizushima, Tanaka, et al. 2024, Kai, Ishida, & Matsuba 2024). Of special note are instructor C and D. We think that they have a significant reframe occurred between the pre- and post-assessments. Although instructor D wrote fewer pages in the "Facilitation of task execution" section than the other participants, he wrote in the "New activities to be incorporated" section that he would connect with someone who was familiar with the content of the activities, which corresponded to the description in section 4. In the post-program image of successful PBL, it was added that the students' independence changes through their interactions with each other. This can be seen as an expansion from a one-on-one relationship between the teacher and individual students to a student-student and student-stakeholder relationship.

Figure 1 illustrates that the instructor D has a higher percentage of cards that are implemented in general compared to the other participants, and there is no change in the image of PBL success between pre and post. However, there was a significant change in his role behavior between pre and post, adding their perspective on project management and the need to set goals and self-evaluate individual students. Thus, it was confirmed that the training program using Intervention Case Cards has the potential to add new role perceptions and behaviors within the framework of the PBL instructor role, while preserving the beliefs that the participants value in their teaching.

4. Conclusions

In this study, we collected actual intervention examples from experienced PBL practitioners and developed a set of 30 intervention case cards through iterative prototyping for improvement. We then carried out a pilot training program utilizing the intervention case cards to validate the effectiveness both

of the cards and the program. In a post-training survey, participants reported high satisfaction with the training program, reflected on their own actions in previous PBL courses, and indicated that using the intervention case cards to learn from other teachers' practices and innovations was helpful in developing action plans. Furthermore, the training program utilizing intervention case cards suggested the possibility that it supported teachers in reconstructing their role recognition through reflection in the context of PBL project. We can confirm that the development of intervention case cards and the training program using these cards was a step toward overcoming the situation we were concerned about, where many teachers were unable to envision specific actions to support students and connect the training content to practice. In the next stage, we will conduct follow-up surveys with the teachers who participated in this program, closely monitoring how the reframed roles and actions of teachers in PBL are integrated into practice, while continuing to improve both the intervention case cards and the training program.

Acknowledgments

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THE ORIGIN AND ACQUISITION OF PCK FOR TEACHING SCIENCE: A CASE OF PRE-SERVICE TEACHERS' PLANNING TO TEACH UNFORESEEN TOPICS IN LIFE AND NATURAL SCIENCES

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Abstract

This study investigated the origin and acquisition of student teachers' PCK for teaching natural and Life sciences. Shulman's PCK, pedagogical action and reasoning; and the theory about students' preferred learning styles were used as theoretical lenses that guided this inquiry. The students were taught how to apply the knowledge bases for teaching (as propounded by Shulman, 1986) during the teaching of Natural and Life Sciences. Five topics from each subject were used to model teaching based on the knowledge bases and the students were expected to extrapolate that learning across how to teach other topics in the South African CAPS syllabus document. The students were then given random other topics not taught how to teach for them to design a lesson plan that entailed the application of the different knowledge bases for teaching. The focus of this research approach was to find out what informs the pedagogical reasoning of the student teachers when planning to teach a topic not prior taught about how to teach it. Collected data included student teachers' lesson plans on topics randomly assigned to them and interview transcripts from three students selected for in-depth investigation. This study established and added a new dimension that whilst the general understanding is that the PCK for teaching science is acquired mainly through formal teacher training and during in-service practising after training, the impactful PCK for teaching science is also acquired and conceptualised during years of students' being taught and learning of science subject content (coined entrenched or engrained PCK for teaching science). The findings from this inquiry help to inform the recommendations that educators of science subject content at any level ought to model good science teaching as this is a powerful way of entrenching PCK for science teaching; so that the vicious cycle of poor teaching is broken and not passed from teacher to student, and then from the 'new teacher who was a student' to 'new student'.

Keywords: *Pedagogical content knowledge, entrenched PCK, teaching, subject matter knowledge, science teaching.*

1. Introduction and background

This study investigated the origin and acquisition of pre-service teachers' PCK for teaching Life sciences (Biology). Whilst the teachers' PCK for teaching science has been hailed as being instilled through processes such as teacher training, continued in-service teaching practice after graduation (Shulman, 1986), attendance of teaching workshops, and engagement in communities of teaching practice (Mavhunga & Rollnick, 2017), other possible avenues that could be crucial in the acquisition of ones' PCK for teaching science has largely not been fully interrogated. As a teacher educator, I noted dilemmatic instances in practice. Whilst the different cohorts of pre-service teachers I taught year in and year out were taught about the educational teaching and learning theory courses, there was very little evidence that they applied such educational theories in their teaching practice. Thus, in my quest to investigate this phenomenon, two research questions guided this inquiry:

a) What informs the pedagogical reasoning of the student teachers when planning to teach a given random topic not prior taught about how to teach?

b) How do pre-service teachers apply taught educational theories to teacher science topics randomly assigned to them?

2. Bodies of literature reviewed and the conceptual framework

Ideas by Shulman (1986) about PCK and pedagogical action and reasoning (Shulman, 1987); and the theory about students' preferred learning styles (Taylor & Hamdy, 2013) were used as theoretical lenses

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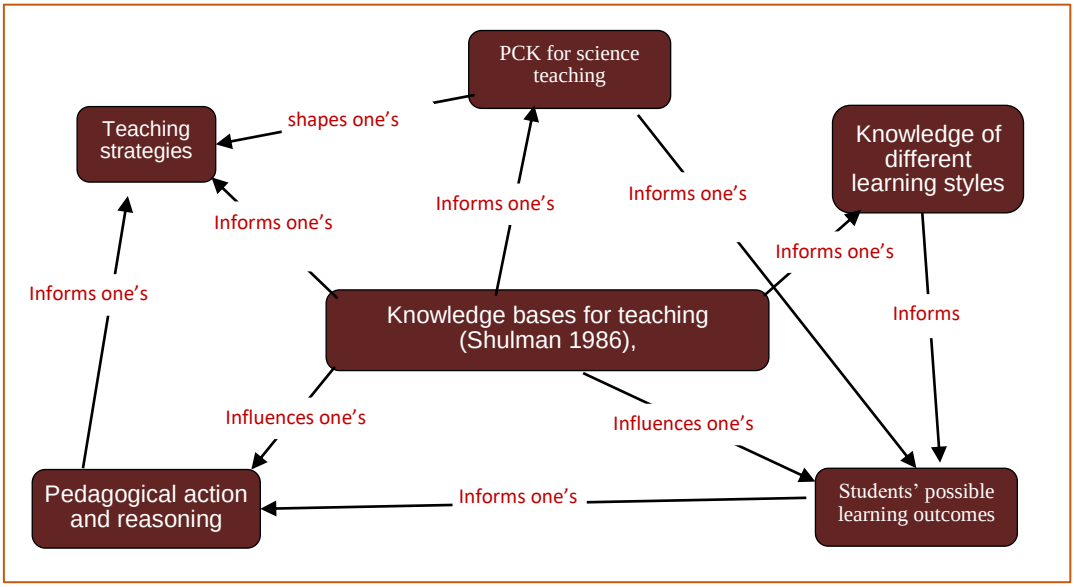
that guided this inquiry. The relationships between the constructs relevant in this study is provided in a single matrix that constituted the conceptual framework for this inquiry.

Figure 1. The conceptual framework used in this study.



In this investigation, I reviewed pedagogical content knowledge model (PCK) by Shulman (1986) so that I was aware of the types of knowledge bases that teachers should have to teach effectively. Shulman (1986) points out that expert teachers should have *subject matter knowledge*, *pedagogical content knowledge*, and *curricular knowledge* for them to teach effectively. Each of these is briefly discussed below in the context of how they were used and applied in this inquiry.

According to Shulman (1986, p. 9), subject matter knowledge, is *'.... the amount and organization of knowledge per se in the mind of the teacher*'. The subject matter knowledge which teachers have determines the quality of learning their students experience (Berry *et al.*, 2008) because as pointed out by Annetta and Dodger (2006, p. 44), '*… the most important component of PCK is science content knowledge'*. In addition to content knowledge, an expert teacher also ought to have knowledge of the curriculum. Curricular knowledge is about three issues. Firstly, it is about the teacher's knowledge of curricular resources for use when teaching a specific topic for maximum student learning. Secondly, it is about the knowledge of the depth and breadth of the subject matter content which ought to be taught to students in a specific level/grade. Lastly, curricular knowledge also entails knowledge of what was taught in the lower levels or grades and linked ideas that would be taught in the upper grades in that specific discipline/subject (Shulman, 1986). In this investigation, my quest was to find out the student teachers' application of curriculum knowledge in their planning to teacher a given topic.

Shulman (1987, p. 8) defines 'pedagogical content knowledge' as a construct that: *... identifies the bodies of knowledge for teaching. It represents the blending of context and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of students, and presented for instruction.* In this inquiry, I considered PCK to be about knowledge of how student teachers were going to plan how to teach given topics because, according to Shulman, for teachers to teach a particular topic effectively, they ought to have appropriate pedagogical strategies, or what he terms: *"... the most useful forms of representation of those ideas, the most powerful analogy, illustrations, examples, explanations, and demonstrations – in other words, the ways of representing and formulating the subject that make it comprehensible to others"* (Shulman, 1986, p. 9). My quest was to find out if the students could represent content in different ways applicable and relevant for enhanced learner understanding.

In this investigation, because my quest was to find out what informs the students' pedagogical reasoning their pedagogical reason, I also reviewed the idea of pedagogical action and reason.

2.1. The idea of pedagogical action and reasoning

Pedagogical reasoning entails teachers' use of their professional knowledge to decide on how to teach given content (Shulman, 1987). Shulman's (1987) model of pedagogical reasoning and actions involves a cycle of six actions that emerged relevant in this inquiry. The cycle includes the student teachers' understanding (*comprehension)* of major concepts of the topic to be taught. In terms of planning for teaching, this is about representing the content for teaching for enhanced particular cohort of students'

understanding (*transformation*). Then the teaching of the given content (*instruction*) follows. After teaching, evaluating the effectiveness of one's teaching and that of students' learning (*evaluation*) occurs. Evaluation is then followed by reflections on the strengths and weaknesses of one's teaching in the light of the students' learning outcomes (*reflection*). Finally, getting a different understanding of pedagogical ideas from feedback from others [*new comprehensions*] completes the cycle (Shulman, 1987; Bishop & Denley, 2007).

2.2. Diversity issues in students that inform teacher planning

When planning to teach, it is crucial for teachers to bear in mind that there is diversity in terms of the students' preferred learning styles (Cassidy, 2010). Some students learn better through seeing what is being taught (visual students), others through hearing what is being taught (auditory musical students), others when content is represented as words, either as speech or writing or both (linguistic students), and yet others through manipulating the environment (Kinaesthetic students). Some students also learn better when engaging in logical reasoning (logical students), others when interacting with significant others (interpersonal students), and lastly, some learn better on their own as individuals (solitary students) (Taylor & Hamdy, 2013).

3. Methodology

A quasi-controlled experiment involving 40 pre-service teachers was used in a bid to answer the research questions for this inquiry. The experimental group (n=20) was exposed to interactive lectures, where they raised questions in class discussions on three teaching and learning educational theories: PCK, Learning styles, Constructivism of knowledge. The lecture sessions involved PCK knowledge bases for teaching [curricular knowledge, pedagogical content knowledge, and subject matter knowledge] (Shulman, 1986). This group was also taught about the issue of what informs the teacher's action and reasoning during teaching, i.e. ideas about Shulman's (1987) pedagogical action and reasoning. Furthermore, these students were also taught about the idea of student diversity in relation to how they prefer to learn. In addition to this, the experimental group was also exposed to lecture discussions on the idea of social constructivism of knowledge as propounded by Vygotsky (1978).

In a bid to eliminate issues of having skills of drafting a lesson plan affecting the outcome of preservice teachers' planning, both the control (n=20) and the experimental group (n=20) were exposed on how to design a lesson through critiquing a typically given good and bad lesson plan. The experimental group were then also given opportunities for peer teaching involving practices on how to apply each of the three educational theories learnt when teaching specific Life and Natural Sciences topics. The peer teaching sessions also involved modelling 'good' teaching that involved the lecturer teaching the student teachers selected content in ways that illustrated how the theories of teaching and learning could be applied in a typical classroom. This modelling of 'good' teaching in the context of educational theories was followed by critical class discussions on the strengths and weaknesses of how the modelling was done by the lecturer.

Some pertinent teaching strategies emerged from modelling and peer teaching discussions e.g. the use and importance of group experiments involving making simple mixtures from sand and water, making simple compounds such as iron sulphide from heating a mixture of iron fillings and sulphur and breaking water into oxygen and hydrogen for kinaesthetic students; group discussions on evolutionary trends in the homo species for verbal and inter-personal students; giving homework and individual classwork on concepts taught for solitary students. In addition to this the issue of taking the students as active participants in their learning to pave way for constructivism of knowledge was key part of the conclusive discussions because students are not empty containers into which knowledge can be poured. The student teachers were then expected to transfer and extrapolate that learning about how to teach involving incorporation taught theories across their teaching of other topics in the Life and Natural Sciences syllabus.

The experimental and control groups were then randomly assigned different topics from the syllabus for them to prepare a lesson plan. Forty topics where randomly assigned letters of the alphabet and each student had to use the second letter of the alphabet in his/her surname to pick a topic next to the letter. The rationale for this was to randomly allocate the topics across the amongst the student teachers. The topics assigned to the control and the experimental group were random topics which were not discussed on how to teach before the designing of the lesson plan task. The focus was for the student teachers to come up with a lesson plan that could enhance student learning. Some student teachers who shared the same letters in their surnames had similar topics to plan for. The collected data included student teachers' lesson plans on topics randomly assigned to them, notes on focus group interviews and six interview transcripts from six students (3 from the control group and 3 from the experimental group) who were randomly selected for in-depth interviews. The lesson plans and interview transcripts from the control and the experimental groups were then analysed for patterns that could have been similar or different though the process of

content analysis. The process of document analysis involved coding from a deductive (based on ideas available in the current research literature) to an inductive approach (themes that emerged from the data).

4. Results and discussions

Because the student teachers were using the second letter of the alphabet in their surnames to pick topics for planning, some topics that were planned for teaching by respondents from both the control and the experimental group were the same. Table 1 below shows coded sections of the lesson plans on topics by both the control and the experimental groups. The respondents were given pseudonyms and numbers from 1 to 20 for both the control and experimental groups e.g. C8 denotes student number 8 from the control group and E4 represent student number 4 from the experimental group (see Table 1 below).

Table 1. The main teacher/student activity components of the lesson plans by student teachers.

Topic	Control Group	Experimental group
Diffusion	**C4**: *Teacher explains what diffusion all is about while students write notes* [**Teacher centred approach**]	**E12**: *Teacher use textbook notes to explain the process of diffusion* [**Teacher dominated activity**]
Osmosis	**C7**: *Teacher tells the students that osmosis is the movement of water* [**Teacher as the think tank**]	**E2**: *Teacher write notes for students on what osmosis is all about* [**Teacher centred approach**]
Water transport	**C12**: *Teacher asks students to copy notes on the topic of water transport and then explains them in class* [**Overreliance on textbook/ Teacher as think tank**]	**E10**: Teacher tells the students what water transport all is about while they copy notes [**Teacher centred approach/ Teacher as think tank**]
Animal cells Plant cells	**C19**: *Teacher ask students to label diagrams of plant and cells using textbook* [**Overreliance on textbook]**	**E6**: *Teacher explains that cells are made of different parts using a textbook* [**Overreliance on textbook/ Teacher as think tank**]
Genetic defects in human	**C15**: *Teacher explains the dangers of genetic conditions* [**Teacher centred approach**]	**E11**: *Teacher* read a textbook on the topic of genetic disease for the students and explain the main ideas [**Overreliance on textbook/ Teacher as think tank**]
Food Digestion	**C17**: *Teacher tells the students that digestion is the breaking down of food* [**Teacher as the think tank**]	**E1**: *Teacher write notes for students on what food digestion is all about* [**Teacher centred approach**]

Table 1 shows no distinct differences in the pedagogical reasoning patterns of the student teachers from the control and the experimental group when planning to teach unforeseen topics. This is because the thematic coding of the components of the lesson plans of both the student teachers from the control and the experimental group underscores the power dynamics revolving around the teacher during teaching and learning. The teacher and the textbook are emerging as the only sources of knowledge and the centre of student activity. For instance, **C15**: *Teacher explains the dangers of genetic conditions;* **E6**: *Teacher explains that cells are made of different parts using a textbook*

This teacher centred and textbook oriented approach is rooted in the basic premise that students are empty containers into which knowledge can be poured from two sources, the textbook and the teacher. Such pedagogical reasoning is problematic because it is rooted in the behaviourist theory of viewing students as empty containers (Kroll, 2004). This is an inaccurate assumption because students come to class with prior ideas relevant to learning new topics (Shulman, 1986).

The experimental and control group planned the same way as there was no evidence of application of the taught educational theories by the experimental group. For instance, in the case of student teachers who had topics where simple experiments could have been done to cater to the kinaesthetic students (e.g. digestion of starch using amylase experiment), the students only included e.g. a section in the lesson plan that says that the teacher will explain to the students how food is digested. Notably, some pertinent teaching strategies were amiss in both groups e.g. the use of group experiments involving simple diffusion of molecules, osmosis and use of potometer for kinaesthetic students; group discussions on evapo-transpiration for verbal and inter-personal students; giving individual classwork on concepts taught for solitary students. Thus, the planning by both student teacher groups excludes opportunities for constructivist understanding of the content being taught as propounded by scholars such as Kroll (2004).

In a bid to get a deeper understanding behind what informed the student teacher's pedagogical reasoning, in-depth interviews were carried out. In-depth and focus group interviews revealed that the students (both the control and experimental group) subconsciously followed how they were taught when then they were students to inform their pedagogical reason during their planning. This was despite having

been recently taught relevant teaching and learning theories and how to apply them during classroom practice for the experimental group. Issues of the students quoting how they were taught then when they were students seemingly had an impact on how they planned, both from the control and the experimental group, e.g.:

C5: *What I know is that when teaching, as a teaching my primary duty is to explain everything to my students.*

E2: *My planning was stemming from my best teacher, I still remember how he taught us and that is why I passed his subject very well*

When **C5** was probed to explain what his phrase: '… *my primary duty is to explain everything to my students'* in relation on whether this included doing experiments and group discussions, his response, '… *this includes everything that is the students' textbook that I need to teach my students'* is indicative of the deep-rooted grasp of the teacher centred-approach as a primary media for content representation and delivery to students by this student teacher, which stemmed from how he was taught science when then a student. This is a point of departure from what other scholars such as Mavhunga and Rollnick (2017) found, e.g. that the teachers' PCK stem mainly from teacher training, attending workshops and engaging in communities of practice.

5. Conclusions and recommendations

This study established and adds a dimension that whilst the general understanding is that the PCK for teaching science is acquired mainly through formal teacher training and during in-service practising after training, the **impactful** PCK (which students turn to subconsciously) for teaching science is **acquired** and **conceptualised** during years of students' being taught and learning of science subject content (coined in this study **entrenched** or **engrained PCK** for teaching science). The findings from this inquiry help to inform the recommendations that educators of science subject content at any level ought to model good science teaching as this is a powerful way of entrenching PCK for science teaching; so that the vicious cycle of poor teaching is broken and not passed from teacher to student, and then from the 'new teacher who was a student' to 'new student'.

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ART EDUCATION IN THE CONSTRUCTION OF A HOPEFUL FUTURE AS EXPERIENCED BY ART EDUCATION AND TEACHER STUDENTS

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Abstract

The study explores how art and art education could support building a hopeful future as experienced by art education and teacher students. The research context is a study module built on art-based learning (5 ECTS), which was carried out in multidisciplinary collaboration. The research material was individual (N=12), and group (N=9) produced during the studies. Data-driven content analysis was used to search for meanings that express the perspective of hope. According to the results, students see with art an opportunity for broad societal influence in building a world tinged with hope. The hope of the social and collective nature of art is integrated into communities and institutions through environmental art and public art. The importance of personality, art accessibility and perception, and skills of interpretation and understanding are also recognized. The reflections of the students provide elements for the implementation of the pedagogy of hope. A hopeful future believes in the transformative power of the intrinsic value of art and the preservation of the thinking of hope in educational work.

Keywords: *Art education, pedagogy of hope, agency, future orientation, resilience.*

1. Introduction

At times we have heard how hope has given strength to overcome difficulties, while losing it has led to despair, fear, and cynicism. Today's global threats and crises such as protracted conflicts and wars, climate, energy and economic crises, pandemics, the oppression of human rights, poverty and refugee flows, and even the confrontations between artificial intelligence and humanity can add to the climate of hopelessness. Such an atmosphere involves a negative emotional charge and evokes value reflection, which the educator must look at both independently and together with children and young people.

The current education system can also add to the cycle of hopelessness. Pulkki (2021) argues that education emphasizes individual performance and competition. These are symptoms of a broader social mindset and ideology. It emphasizes instrumental thinking and the competition for continuous growth Pulkki, 2021). However, a breeder's central task is to create prospects for our living reality, even though our reality is marked by many unpredictable, seemingly create prospects for our living reality, even though our reality is marked by many unpredictable, seemingly uncontrollable events and developments (Foster et al., 2019) and to support sustainability in maintaining hope (Conklin, 2005).

In this context of global insecurity, new approaches and means are needed to add hope-building, rooting and pedagogical ways of dealing with hopelessness and creating faith in the future. For example, there is a need for experiential participation, emotional experiences and thinking skills guidance, where learners actively shape and influence their living world. These skills and approaches are used in art education. Its goal is to support the learner's agency and to emphasize the importance of the senses, emotions and reality in building meanings (Griffith, 2021). In addition, art can be used to train in valuing diversity, critical thinking and questioning oppressive structures that support building a sustainable and peaceful future (Forster & Sutela, 2024). The key task of education is to encourage the search for diversity of problems and to find constructive solutions for the future of hope (Bourn, 2021). From these starting points, the research task of our research took shape - art education as a builder of a hopeful future.

2. Perspectives on hope and the pedagogy of hope

In definitions of hope, several researchers refer to the ideas of hope expressed by Brazilian educator and philosopher Paulo Freire (Hannula, 2019; Suoranta, 2019). Freire (1994; 2016/1970) refers with hope to educational activities that are forward-looking and conducive to the future. In a school context,

this could mean that achieving hope requires learners to practice thought patterns that support hope, in which teaching is seen as a kind of tool in building hope (Freire, 1994; 2016/1970). In this context, there is also talk of a future orientation or belief in the future, in which learners are guided to set forward-looking goals and to act towards them (Snyder, 2000; 2002). The future-oriented model of thinking ultimately leads to a force for change in which, for example, social justice, freedom and equality are realized (Freire, 1994; 2016/ 1970; see also Moisio et al., 2016; Tomperi, 2001). But at the same time as future-oriented questions are asked, the guidance of the learner is also directed to the influence of phenomena and problems in time and to responsibility (Freire, 1994; 2016/1970). This can be experienced as empowering.

In education, the practice of hope takes place between the teacher and the learners in a dialogical interaction (see also hooks, 2003), which gives room for different voices and considers diverse perspectives (Freire, 1994; 2016/ 1970). Being heard and building common meanings strengthens inclusion and the experience of appreciation (hooks, 2003). When learners create an image of their own space and society, they could influence and experience hope. A critical awareness and desire to influence one's own life, vitality and the world around them is born (Freire, 1994; 2016/1970). Thus, hope is also associated with the ability to will and agency thinking (Hämäläinen, 2022). Strong agency thinking motivates action (Vanhalakka-Ruoho et al., 2015; Snyder, 2000) and, despite disappointments, supports the belief in better (Cheavens, 2000). To maintain hope, one needs so-called resilience, i.e., the ability to cope with adversity, such as learning from failure (Snyder et al., 1991; Snyder, 2000; 2002). Therefore, experiences of perseverance, patience, trust, and ability to maintain hope are considered to help individuals maintain an expectation of hope for something good and meaningful (Pihkala, 2017). In addition, other activities that sustain hope are imagination, dreams, and creative thinking (Freire, 1994; 2016/1970).

According to Hämäläinen (2022), education can only be used to awaken the prospect of hope, but each must build it himself. Essentially, it is about self-education, where building awareness of one's own ability to influence change in oneself and those around them increases hope (Hämäläinen, 2022). It is considered that factors based on personally meaningful experiences give educational strength to look at one's own life in a new way (also Suoranta, 2019). Hope also includes recognizing and acknowledging the limitations of life and being human without losing hope. These attributes are called pedagogy of hope. Hämäläinen, 2022.) Hämäläinen (2022) also examines the pedagogy of hope as a pedagogy of will education. According to him, one must recognize the power of reason and will. This is based on the fact, that building awareness of one's own possibility through one's choices to make changes in oneself and in one's surroundings increases hope. In accordance with the principles of hope pedagogy, the task of education is to emphasize the sense of optimism and the possibility of change (Bourn, 2021).

3. Research question, data and methods

In our research, we examine a hopeful future in the context of art and art education, the significance of which has been less studied among students pursuing their university studies. The research question was: 1) how art and art education could support building a hopeful future as experienced by art education and teacher students. Based on the results obtained in the results review, we abstract a theoretical model: themes tinged with the hope of art and art education.

In our research, we examine a hopeful future in the context of art and art education, a perspective that has been less studied among university students. As a research data, we chose a multidisciplinary course of study in Art Education (5 ECTS) during which (four months) students reflect on their observations and experiences. The course also included art project interventions carried out by students at schools. The research material consisted of individual blog entries (Chapter 4.1) (N=12) and group outputs (4.2: Thesis of Art Education; 4.3: Final Reflections on the Electric Wall) (N=9). In art-oriented learning, visual arts, crafts, drama and music were integrated, as well as creative writing and narration.

The scientific philosophy of our research is based on phenomenology, which aims at the openness of the researcher and emphasizes the experiences of individuals. We use data-driven content analysis to analyze the materials so that we look for meanings that express the perspective of hope in the texts. In our analysis, we proceeded inductively from extracting statements of material through grouping to abstracting meanings (Guest et al., 2012). Blog entries and art education theses created in small groups are analyzed in three stages: 1) reading texts and picking statements about hope, 2) grouping statements, and 3) abstracting (Delve & Limpaecher, 2023). The final reflection of the course was prepared on an electronic wall in small groups, and we analysed this material in the same way as the previous ones by classifying and theming statements. At this stage, students reflected on their experiences throughout the course and thus also took advantage of the findings from art projects. In the discussion of the results, we formed the key themes of hope. To increase the reliability of the analyses, classifications were revised by another researcher and unclear classifications were solved together (Guest et al., 2012).

This study was conducted in accordance with the General Data Protection Regulation (GDPR). Prior to the collection of the material, consent was obtained from the students to participate in the study, which was not related to the completion of the course. In addition, students had the opportunity to interrupt their participation at any stage. To ensure anonymity and rights, the data of all parties was anonymized.

4. Results

4.1. Themes of hope in individual blogs

Students emphasized (1) the importance of growing as a person and the value of individual development: “Everyone grows at their own time, at their own pace, into a person.” This refers to the metaphorical expression of the artist, in which growth as a person was combined with the artist's mural of wood. Through the work, the tree symbolizes how different we are and how, despite this, we can grow together. This work communicates that diversity is acceptable and emphasizes the diversity of our community.

Students saw that “art also shapes (2) the society around us, is a big part of culture --- and is about humanity in general.” Art offers an opportunity to influence values, sustainable development and the creation of a positive atmosphere: “---the artist sought to influence society, or at least to take a stand and provoke discussion, by means of art (wars, environmental crises).” --- “Art and artistic activity have a lot of positive effects.” Places of influence include art galleries, which instil individuals and communities in art.

Students emphasized in their writings that (3) “art belongs to everyone” and art must be accessible. These include, for example, environmental art and murals. Public art offers the opportunity to encounter art in different everyday situations. This is called sustainable development. Independent works of art are often left on the walls of galleries or “painting on the wall, not physically recorded. When the exhibition is being built, the next piece will be in its place. (The artist's) art is displayed in places where there are people. Hospitals, maternity clinics, --- shopping centre.” These works will live on. Through environmental art, individuals learn to appreciate art, and it becomes part of their world of life.

The sociability and collectivity of art (4) appeared to students as meaningful dimensions of learning and experience. Art brings the environment and the world closer together. For example, art’s “everyday themes, subjects, and approachable way of making art delight, possibly also create positive feelings that are not often experienced when visiting a hospital, for example.”

In the blog posts, students reflect (5) on the importance of growing up in art: “Is it enough just to notice art? Hardly! First, in the national core curriculum for basic education, art appears not only as something to be observed but also as a set of interpretive skills.” In guiding art education (6), the student has the freedom to learn in his or her own way. Students also found in the artist's mundane paintings that “perhaps the viewer can be more confused by the fact that such a mundane thing (a fruit basket) has been painted in great detail. For the artist himself, painting can be much more important and reflects emotions that are attached to the artist's process or everyday life. For this reason, students would do well to make (7) art for themselves.” “By describing the bodily, emotional, and social process a student has experienced, it helps them to get along better with their own creativity. This would prove to the student that the art he makes doesn't have to be part of some institution to be meaningful to himself.”

The connection between making art (8) to institutions and media “are vital for artists who want to employ themselves”. For an artist, this requires a balance of values.

4.2. Themes of hope in the theses of art education

The first thesis, tinged with hope, emphasizes that “there is no right or wrong in the emotions that art evokes.” This liberating perspective gives room to think creatively and experiment with different approaches, encouraging students to cross boundaries. The second thesis focuses on the balance of individuality and collectivity in art education: “Accepting the individuality and collectivity of making and experiencing art - to whom and from whom.” The third thesis highlights diversity, wide-rangingness and cross-border activities and expression: “Diversity: activities across disciplines and different art disciplines. Art education is so much more than just visual arts and/or music.” The fourth thesis, which expresses hope, focuses on the expression of emotions through art education: “The path of art to the expression of emotions -- how self-expression and communication can be implemented in an artistic way; how art can be used to feel, experience, tell.” The fifth thesis emphasizes giving “a sufficiently open frame - giving room for the student's creativity, but within the framework of instruction, the red thread must be included.” In the sixth theses, “the importance of interpreting and rehearsing the works it is understood that there is meaning and thought behind art and one learns to see them from one's own works as well.” The seventh thesis emphasizes the connection between art and “space --- how art can be represented in space, how a place or space is defined.”

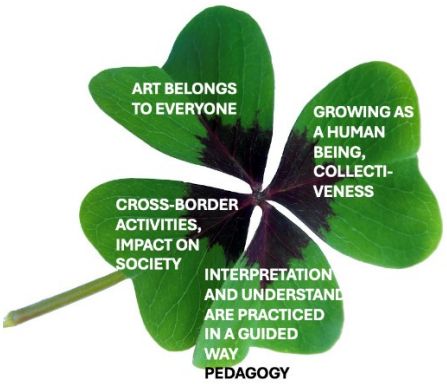
4.3. Themes of Hope in the Final Reflections of Small Groups

In small group discussions, students emphasize the importance of building their own identity. Another meaning in making art is related to self-expression, creativity, developing emotional skills and deepening one's self-awareness. The third aspect emphasizes finding new facets. This includes expanding consciousness, breaking boundaries, creative perception, and the use of alternative forms of expression. In addition, the appropriate level of challenges and applications fuel creativity. The fourth observation focuses on identifying abstract concepts and supporting the understanding of reality. The fifth theme emphasizes the importance of collaboration and interaction skills. All the above factors contribute to a sense of community and synergy in the learning process.

5. Discussion and conclusions

The task of our research was to find out how art and art education could support building a hopeful future. The results abstracted meanings expressing the perspective of the hope of art and art education, from which were built up the four main themes of hope in the four-leaf clover (see Figure 1).

Figure 1. Four-Leaf Clover of Hope: Themes of Hope in Art and Art Education.



According to our research, 1) the starting point for the idea of ‘art belongs to everyone’ is the accessibility and inclusion of art. Social influence and a sense of inclusion hold hope for thinking about a better tomorrow, where justice and equality are realized (Freire, 1994; 2016/1970; Moisio et al., 2016; Tomperi, 2001). According to the students, 2) the significance of cross-border activities in art is reflected in society and back again. The significance of community art is brought close to everyday life, which creates presence and takes a stand and creates prospects for future orientation (Freire, 1994; 2016/1970). Thus, community artworks placed in everyday environments can create collective bonds and dialogues between individuals and communities that uphold the resilience of hope. According to our research results, this can further build, for example, change flexibility, future thinking ability, and problem-solving skills (Southwick et al., 2014).

In this study, students placed the focus 3) on self-importance and relevance. Making art for oneself opens the gate to introspection, to examining one's own growth and thinking. It is necessary to find a personal connection to the creation of meaning, so that the rays of hope open and support the agency (Vanhalakka-Ruoho et al., 2015; Snyder, 2000) to experience inclusion and to maintain and preserve it in the long term even in difficult moments.

It takes 4) educational realization of hope pedagogy to discover the meaning of hope and develop it (Hämäläinen, 2022). In the pedagogy of hope, the teacher directs individuals to perceive and make different interpretations of art. Students emphasized that the teacher must create a path of hope for the learner to practice skills, strengthen commitment, and create a positive atmosphere for working (Snyder et al., 1991; Snyder, 2000; 2002). Collaborative learning enabled students to engage in the comparison of diverse interpretations. Students were also realised that it is the teacher's job to use pedagogical and dialogical means to encourage learners to question their own thinking and to build an atmosphere where it is permitted and safe. (Freire, 2016/ 1970).

This study focused on the activities of one group of students, so a comparison of the other groups could have broadened the perspective. The analysis and cross-checking of the data by two experienced researchers minimized the impact of the individual researcher's personal observations. Despite these limitations, our research deepened students' understanding of the importance of art education and its pedagogical means of building bridges towards a hopeful future.

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PROBLEMS AND SOLUTIONS IN ADULT EDUCATION IN LATVIA: CASE STUDY OF THE ZEMGALE PLANNING REGION

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Abstract

Adult education is vital in a postmodern society; it allows not only to improve the individual's personality, but also to maintain competitiveness in the labour market. Latvia has not fulfilled its task in adult education - there is no umbrella law (Adult Education Law) in place that would allow for the planned organization of education in each Latvian municipality. The coordination of adult educators in each municipality differs, preventing interested individuals from developing and engaging in lifelong learning evenly. There is also a question about the financial aspect, about accessibility in terms of distance to the place of study, about the availability of tools for a quality training process. By learning, a person affects not only his own quality of life; he also affects the quality of life of the entire society. Adult education implies processes, structures, and institutions that are created to promote adult education. Research aim is to explore issues and solutions in adult education within the Zemgale planning region, in order to develop proposals for improving adult education from the perspective of stakeholders. The study, which took place in 2024, used qualitative research methods, focus group interviews with learners and semi-structured interviews with other stakeholders — Latvia's Adult Education Association and the agents from municipalities of the Zemgale planning region. The research concludes that the most widespread problem in adult education is a lack of strategy at all responsible levels, with main issues including coordination deficiencies among providers, difficulties in reaching the target audience due to logistical matters, and insufficient resources allocated to adult education. The results indicate that municipalities in the Zemgale planning region display significantly different models in the planning and organization of adult education processes in the districts, which leads to suboptimal use of local institutions for promoting adult education availability and long-term unbalanced approaches to adult education policy and management by sectors and regions, including the planning and implementation of European Union resource grants by state institutions not delegated to planning regions and municipal NGOs. The proposed solutions include better coordination at the regional level, strategic planning, and investment in adult education resources, as well as innovative approaches to engaging the community in adult education processes.

Keywords: *Adult education, adult education problems and solutions.*

1. Introduction

The time has come when adult learning is a very important social and economic factor in a person's life, as indicated by one of the research topics (Adult Education and Training in Europe, 2018). This factor is also very important for the social and economic development of local communities, municipalities, regions and countries.

Continuous learning can help citizens cope with future challenges, master the opportunities provided by digital challenges, joining the family of European countries, which have provided a place for citizens' education issues and an inclusive society in their planning documents. The situation with citizens' involvement in adult education processes is changing, as indicated by the data of surveys and various surveys in Latvia. Adult education policy planning documents distinguish between different types of education in which adults can participate, choosing it according to the purpose and possibilities. Lifelong education is based on a person's internal need and the necessity caused by external factors to acquire or supplement their knowledge base or develop skills. In the era of high technology and rapid development of science and technology, knowledge once acquired quickly becomes outdated. Purposefully planned education allows an individual to constantly improve their qualifications or even re-qualify, if such an opportunity is offered, and the learner can use a specific offer.

Within the framework of the research, the authors define adult education as follows: "Adult education is a diverse process of educating individuals that ensures personal development and competitiveness in the labour market throughout a person's life" (Nacionala enciklopedija, 2022). Adult education refers to a diverse educational process for individuals aged 25 to 64, which ensures personal development and competitiveness in the labour market (Centrala statistikas parvalde, 2023). This age is marked by active work, when an adult must engage in economic activities, without excluding the possibility of being socially active, getting involved in shaping the life of the community, society and the state, as well as taking care of their emotional, spiritual and mental health. "Adult education is a multidisciplinary process, the aim of which is to promote lifelong learning for all, as well as effective learning throughout life. Its aim is to provide knowledge that increases professional qualifications and to acquire civic, social, moral and cultural attitudes and skills for the performance of duties and progress in all areas of life" (Goñi, 2006).

In Latvia, adult education is organized in the formal and non-formal further education system, also providing for informal learning as an educational process, within which knowledge, competences, skills and values are acquired from everyday and work experience, which improve every individual. Unlike formal and non-formal education, informal learning is not included in the framework of a program or course. According to Articles 36 and 46 of the Education Law, adult education can be implemented in formal and non-formal education programs. The procedure for implementing formal adult education programs is determined by the norms of the Education Law, the Vocational Education Law and the Higher Education Law. Although all these laws stipulate the regulated activities of adult education and lifelong learning, the Adult Education Law is missing, which was being prepared some time ago and which would allow stipulating and regulating the norms of the law in one document (Izglitibas likums, 1998).

Considering the goals set by the European Union for the involvement of many participants in adult education, the authors believe that Latvia has not fulfilled its task - there is no umbrella law (Adult Education Law) in place, which would allow for a systematic organization of the situation in each Latvian municipality. Each municipality differs in terms of the organization of adult education, accessibility and support in this field. Consequently, the coordination of adult educators in each municipality differs, which does not allow everyone interested to develop and engage in lifelong learning evenly. In addition, interest and understanding of the issue of lifelong education on the part of the population prevents improving the involvement of learners in the formal, non-formal or informal learning process. There is also an issue regarding the financial aspect, accessibility in terms of distance to the place of learning, and the availability of tools for a quality learning process. Thus, adult education means processes, structures and institutions that are created to promote and implement adult education.

Research aim is to explore issues and solutions in adult education within the Zemgale planning region, to develop proposals for improving adult education from the perspective of stakeholders.

The research questions raised in the article: what are the main social agents or stakeholders providing adult education? What are the main problems in adult education in Latvia and specifically in the Zemgale region? What are the current and necessary solutions from the perspective of the stakeholders to improve adult education in the Zemgale Planning Region?

2. Social agents involved in adult education

Stakeholder theory refers to a very broad set of groups, institutions, and individuals who are involved or have been involved in some way or are interested in the course of events or a process and want to steer it in their desired direction. The stakeholder approach allows for both conflict resolution and social tension reduction and can promote better cooperation and mutual understanding (Freeman, 2010; Pesqueux, 2005).

In Latvia, a few stakeholders interact in the field of adult education. The Department of Vocational and Adult Education of the Ministry of Education and Science develops policy, organizes and monitors the implementation of policy in the field of vocational education and adult education, as well as, in accordance with the competence of the department, exercises subordination over the institutions subordinate to the ministry: the State Education Content Centre, the State Education Quality Service and the State Education Development Agency. When examining the stakeholders involved in the regulatory framework, adult education implementers and policy implementers should be highlighted, who, by involving a part of society in educational processes, represent residents over the age of 25 and interested parties who want to obtain education for self-improvement to resolve employment issues, driven by the need for community growth or driven by interest. The stakeholders can be divided into three levels according to the scale of their functioning, power and influence: firstly, the state or national level stakeholder; secondly, the regional level stakeholder and the local level stakeholder. These levels indicate the context at which the parties involved operate. As a result of the analysis of empirical data, a typology of parties involved has been created,

consisting of seven types, and they are: policy makers and policy adopters; policy implementers; educational institutions; day centres, libraries, etc.; NGOs and their networks; entrepreneurs; individuals. For each party involved, its main functions have been considered, with the exception of municipalities, which are implementers of both national and local policies. An increasingly broader range of different stakeholders is involved in the teaching and learning process: non-governmental organisations, the private sector, various social groups, etc., to offer diverse learning opportunities, content and approaches, resources and technologies. Thus, new partnerships, networks and forms of cooperation are being formed between educational institutions and other parties involved, between the public and private sectors. An essential factor in this regard is targeted cooperation between general, vocational and higher education institutions, including by developing shared resources

3. Research methodology

The authors have chosen a qualitative research approach as their research approach, using semi-structured interviews and focus group discussion methods.

Semi-structured interviews are effective when the research objectives include exploring diverse perspectives, identifying patterns and themes, and gaining insight into individuals' thoughts and emotions. In addition, this approach is valuable when researchers are seeking to establish connections and build collaborative relationships with participants, as it allows for meaningful and interactive conversations. The use of semi-structured interviews allows researchers to explore the wealth of participants' experiences while maintaining the versatility and adaptability of data collection (Salomao, 2023).

Fieldwork was conducted in March and April 2024, implementing a purposeful selection of available informants. Interviews were conducted both in person and online. Research ethics were observed during the interviews; all mentioned informants were informed about the objectives of the study and agreed to participate in the study. Interviews were conducted with the Chairman of the Board of the Latvian Adult Education Association, a representative of the Zemgale Planning Region, and implementers of Adult Education policy in the municipalities of Zemgale municipalities - Aizkraukle, Bauska, Dobele, Jelgava - and the municipalities and policy implementers of Jekabpils municipalities and the city of Jelgava. During the interviews, it was possible to obtain information from specialists in municipalities responsible for adult education issues. The answers from the informants provided insight into how issues regarding adult education are organized in each municipality, how many employees are employed on this issue, what issues they are entrusted with, what target groups are worked with in the field of adult education, and what resources - municipal, state or EU funds - are attracted to address adult education issues.

On April 2, 2024, 2 focus group interviews (average length 30 minutes) were held at the Dobele Adult Education and Entrepreneurship Support Centre (PIUAC) with learners about adult involvement in educational processes and obstacles that hinder it. The main target groups of learners are employees of local governments and their institutions, entrepreneurs, working and unemployed people or job seekers, and seniors. In the focus group interviews, the informant focused on outlining personal experiences. The participants did not express their views on adult problems in general in the country or region, but expressed a vision based on their personal experience, which also allows the research to understand specific nuances faced by those involved in adult education.

4. Research results

Adult education activities in the municipalities of the Zemgale planning region are implemented in three ways, through Registered Learning Centres (Jelgava City Municipality and Dobele and Aizkraukle municipalities), through Lifelong Learning Centres (Jelgava Municipality) and education specialists in municipalities (Bauska and Jēkabpils Municipality). There are great differences between adult education centres, each of which has its own way and model of organizing adult education in its municipality. Here, we should also mention differences in the territorial sense, where the territory of a Latvia state cities differs from the territory of a municipality, which often combines several cities, villages and parishes (the problem is the accessibility of the population in terms of distance). Adult education centres have been reorganized over time, creating different models, for example, in some municipalities this task is delegated to the Education Board or the Education Department.

The analysis of interviews with stakeholders suggests that the biggest challenge for adult education policy makers and educators in regions and municipalities is to address the issue of greater citizen involvement in adult education, using all available tools and instruments. The advantage for engaging lower-paid and less educated citizens in learning processes lies with the organizers of adult education processes in local municipalities, as personal approach, feelings of security, presence and proximity to educational processes will lead to greater involvement in lifelong learning processes in every municipality

and region. Summarizing what the informants said, a lack of resources has been identified, both in terms of staff fully dedicated to adult education and financial resources specifically allocated to adult education initiatives. However, problems such as long distances in the region and transport problems significantly hinder participation and involvement in adult education.

Those involved in adult education from the local government side face problems in transferring information to their existing and potential clients daily. The closure of printed newspapers, the lack of computer skills and technical support do not contribute to obtaining information for improving one's knowledge. The focus group participants highlighted a similar problem from the client side - the lack of information in the adult education offer. At the Dobele PIUAC, where two focus groups were interviewed about adult education problems, the emphasis was placed directly on the inaccessibility of information. The cooperation of adult educators in the Dobele region as a network has not been established; here the centre's activities are focused on Dobele and Auce, where two training specialists work. As the representative of the Jelgava region municipality mentioned in the interview, the coordinator's duty in each parish is to inform their residents about adult education activities in the region. The head of the lifelong learning centre also emphasized the adult education culture as a problem, as non-existent, on which Latvia still needs to work very hard and diligently.

Informants point out several important aspects in their responses to the problems. For example, coordination between all parties involved in adult education should be improved, possibly with the leadership of the Zemgale Planning Region. This includes the creation of cooperation networks and, possibly, a dedicated position or team responsible for the development and monitoring of adult education throughout the region.

The head of the Lifelong Learning Department of the Jelgava Regional Education Board believes that it would not and is not possible to solve national problems at the municipal level; they should be left at the national level, but what the municipal authorities and the specialists working there can do is to directly address the residents "currently everything is based on personalities; we need a system of coordinators in the country - we need to go to the people. Until there is a culture of lifelong learning in the country, we need to go to the people, otherwise there will be nothing". In turn, representatives of the Dobele PIUAC and the Jelgava City Council believe that it is very important to work on public relations at both the municipal and national levels, talking about adult education, its importance in everyone's life in adulthood, so that a resident in every Latvian parish would think about and consider the need for education even after obtaining formal education (up to the age of 25). Information support is needed at all levels, from the state for popularizing adult education to adult education implementers in municipalities, so that every citizen has access to information about available educational offers, whether it is formal, non-formal or informal education; it is important to know about accessible, supportive, future-oriented education for adults, organized into a system for long-term operation in the future with clearly identified agents - policy makers, funders, education organizers and learners.

Focus group participants emphasize that they are happy to spend time in the evenings guided by their interests; in turn, when asked about training for work needs, they emphasize that they would rather attend such training during working hours. Unfortunately, the interest of employees in attending courses during working hours does not always coincide with the opportunities to attend them, especially if these courses offer to study another field that could be useful to residents in the future, for example, when creating their own economic activity. Focus group participants emphasize that it is very important to attend courses and seminars as close as possible to their place of residence. A very important prerequisite is to receive information about possible training offers, and a very important aspect is the financial aspect, although they point out that if this arena of education is of great interest, the financing aspect is not crucial.

5. Conclusions and proposals

The Education Law and various policy planning documents regulate adult education in Latvia, but they do not ensure a sustainable connection with the parties involved in adult education and the general needs of society.

Participation in adult education is determined by several factors, such as previous education, employment status, profession, age and developed skills. Adults with low or no education, low-skilled workers, the unemployed, seniors are reluctant to participate in lifelong learning. Given that participation in adult education processes is often not possible for adults in this category, the goal remains unfulfilled for those who would need these operations the most.

There is cooperation between the various stakeholders, but coordination could be more effective and with a greater role for the Zemgale planning region in coordinating activities in adult education.

One of the most important problems is reaching and engaging people in educational activities. Information dissemination methods, such as websites and advertisements in newspapers, often have a low

level of effectiveness. Often, a more effective approach is cooperation with libraries, day care centres and direct communication with the target audience.

Projects using European Union funds play a crucial role in providing adult education. However, there is a need for more stable and long-term funding sources to ensure the sustainability of adult education programmes.

There is no law regulating adult education in Latvia; therefore, a sustainable adult education system has not been implemented that would define the division of responsibility and coordination between the ministries involved, the financing procedure from the state and local government budgets for the provision of human resources and teaching aids for the long-term development of adult education.

In the issue of adult education, large differences have been observed between the municipalities of the Zemgale planning region in the understanding of this area and in the provision of adult education to improve the skills necessary for residents close to their place of residence. The absence of a system in Latvia in the development of the adult education area has not led to the planned development and involvement of residents in adult education activities.

The Ministry of Education and Science, as the leading state administrative institution in the fields of education, science, space and sports, as well as in the field of youth and state language policy, must develop an Adult Education Law with a long-term strategy for the formation of adult policy in Latvia, providing for responsibility for the administration of adult education, coordination between the ministries involved, the definition of adult education priorities and the provision of funding in the state and local government budgets, including monitoring of the effective use of resources.

Planning regions and municipalities, for sustainable access to adult education for residents, must establish a coordination and cooperation network, focusing on a balanced sectoral and territorial approach, involving local libraries, educational institutions, day centres and other institutions in the municipality in providing adult education.

To solve the problem, the Ministry of Education and Science, when developing the Adult Education Law, should provide for long-term funding in the state and local government budgets, with a defined delegation of tasks for the provision of adult education in educational institutions at all levels, also providing for monitoring the quality of adult education.

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MUSICAL ABILITY AS AN ALLY IN REDUCING PSYCHOLOGICAL DISTRESS IN SCHOOL-AGE STUDENTS

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Abstract

Student mental health and well-being have gained increasing relevance in the educational field in recent years. In this context, psychological distress—understood as the combination of anxiety, depression, and stress—represents a significant risk factor for student well-being, prompting the search for strategies to mitigate its impact. Various studies suggest that music can positively influence emotional regulation and stress reduction; however, the specific role of musical ability in these processes remains to be further explored. This study examines the relationship between musical ability and psychological distress. The sample included 1,496 students from 6th grade of primary education to the 2nd year of high school across five educational institutions in Spain. The average age was 13.68 years (*SD* = 2.03), with a balanced gender distribution (51.3% female). The study employed a musical ability test and the General Distress Scale (DASS-21). The preliminary results show that students with higher musical ability reported lower levels of depression (r = -0.123), anxiety (r = -0.115), and stress (r = -.077). Statistically significant differences were found between timbre perception and depression (r = -0.124), anxiety (r = -0.121), and stress (r = -0.082). Additionally, a negative relationship was observed between pitch perception and both depression (r = -0.063) and anxiety (r = -0.058); as well as between melody perception and depression (r = -0.053). These findings suggest that musical ability may act as a protective factor against students' psychological distress. This underscores the importance of integrating music education not only as a pedagogical tool, but also as a fundamental resource for facilitating the management of psychological distress in the school environment.

Keywords: *Musical ability, psychological distress, student well-being, mental health.*

1. Introduction

In recent years, the role of music in supporting mental health has attracted growing attention within educational contexts. As psychological well-being becomes an increasingly central concern in schools, researchers and educators alike are exploring how music might serve as a protective factor against emotional distress in students. This interest has been further amplified by the lasting impact of the COVID-19 pandemic, which significantly worsened levels of stress, anxiety, and other psychological difficulties among children and adolescents (Sun, 2022).

Years after the health crisis, concerns about student mental health persist, as reflected in a growing body of research, governmental initiatives, and educational strategies aimed at promoting emotional well-being in schools (Chang, Ji, Li, Pan, & Su, 2021; Muyor-Rodríguez, Caravaca-Sánchez, & Fernández-Prados, 2021). In this context, schools are not only places for academic development but also key environments for fostering emotional regulation and resilience.

One of the most pressing challenges is psychological distress—a combination of symptoms related to anxiety, depression, and stress—which has been consistently linked to negative emotional and academic outcomes (Bhatia & Kaur, 2024; Wuthrich, Belcher, Kilby, Jagiello, & Lowe, 2021). Identifying protective factors that can mitigate psychological distress is therefore essential.

Among the potential protective factors, music stands out due to its unique emotional and cognitive properties. Previous studies suggest that music can aid in stress reduction, emotional processing, and overall mental health. For instance, Perlovsky, Cabanac, Bonniot-Cabanac, & Cabanac (2013) found that listening to pleasant music during academic tasks reduced stress and improved performance. Similarly, Wang,

Huang, Zeb, Liu, & Wang (2022) reported that students engaged in music education experienced notable improvements in anxiety and well-being. However, the specific role of musical ability—beyond music exposure or passive listening—in protecting against psychological distress remains underexplored.

Musical ability is a multidimensional construct that encompasses various perceptual and cognitive skills involved in processing musical information. In this study, we focus on four core components: rhythm, melody, timbre, and pitch. These dimensions are commonly used in research on music cognition and are supported by models such as the one proposed by Law and Zentner (2012), which conceptualize musical ability as the capacity to accurately perceive, discriminate, and mentally represent distinct elements of sound. Rhythm refers to the perception of temporal patterns and beat; melody involves the recognition of sequential pitch relationships; timbre relates to the quality or color of a sound that distinguishes different instruments or voices; and pitch perception involves the ability to detect fine differences in frequency. These components were assessed through a musical ability test specifically designed to reflect these dimensions, and previous studies have shown that each plays a distinct role in emotional and cognitive processing (Janurik & Józsa, 2022; Wang et al., 2022).

In light of this, this study seeks to address that gap by investigating whether musical ability itself may serve as a protective factor against psychological distress in school-age students.

2. Objective

The present study examines the relationship between musical ability and psychological distress in students from 6th grade of primary education to the 2nd year of high school. Musical ability was assessed through core perceptual skills, including rhythm, melody, timbre, and pitch discrimination. Psychological distress was categorized into stress, anxiety, and depression. The primary objective was to determine whether higher levels of musical ability were linked to lower levels of psychological distress. By examining these associations across a wide developmental range, this research seeks to contribute new evidence on the potential role of musical ability as a protective factor. Furthermore, the study aims to strengthen the argument for integrating music education in schools not only for artistic and cognitive enrichment, but also as a valuable resource for fostering students' mental health in educational settings.

3. Methodology

3.1. Design

This study employed a cross-sectional, correlational design to explore the relationship between musical ability and psychological distress (comprising stress, anxiety, and depression) among students in primary and secondary education. Data were collected during the 2023–2024 academic year from students aged 10 to 21 years across five educational institutions in Spain.

3.2. Participants

The study involved a total of 1496 students enrolled in five educational institutions across Spain. Participants ranged from the 6th grade of primary education to the 2nd year of high school, with the distribution as follows: 18.4% in 6th grade of Primary Education, 16.4% in 1st year of Secondary Education, 16.5% in 2nd year of Secondary Education, 14.0% in 3rd year of Secondary Education, 13.5% in 4th year of Secondary Education, 13.0% in 1st year of High School, and 8.3% in 2nd year of High School. The age of the students varied between 10 and 21 years, with a mean age of 13.68 years (SD = 2.03 years). The sample was balanced by gender, comprising 51.3% female students and 48.7% male students.

Participation was voluntary, and informed consent was obtained from all students and their legal guardians prior to data collection. The selection of participants was based on convenience sampling, considering the availability and accessibility of the schools that agreed to collaborate in the study.

No exclusion criteria related to musical background, academic performance, or psychological history were applied, ensuring a diverse representation of the student population. The study was conducted in accordance with ethical standards and was approved by the relevant educational authorities.

3.3. Instruments and measures

The authors designed a music ability test which is currently being validated. The test comprises four modules: a) pitch (ability to detect the direction of small pitch differences), b) timbre (ability to detect subtle changes in instrumentation), c) melody (ability to detect differences in tonal and atonal melodies), and d) rhythm (ability to detect differences in metric and non-metric rhythms). The modules consist of 14 to 20 items, each of which requires participants to compare two musical stimuli which can be different or identical.

To assess levels of stress, anxiety, and depression among participants, we administered the Depression, Anxiety, and Stress Scale – 21 items (DASS-21) (Lovibond & Lovibond, 1995). This instrument comprises three subscales—stress, anxiety, and depression—each containing 7 items. Participants rated each item on a 4-point Likert scale (0 = "Did not apply to me at all" to 3 = "Applied to me very much or most of the time"). Higher scores reflect greater levels of psychological distress within each assessed dimension.

3.4. Data collection and analysis

Data collection took place during regular school hours in collaboration with the participating educational centers. After obtaining the necessary permissions from school authorities and informed consent from parents or legal guardians, students completed the assessments in a supervised group setting. Participation was voluntary, and confidentiality and anonymity were guaranteed throughout the process.

A musical ability test and the DASS-21 scales were applied. The total administration time for all instruments was approximately 45 minutes.

For data analysis, Pearson's correlation coefficients (r) were calculated to explore the relationships between musical ability and psychological distress variables (depression, anxiety, and stress). Statistical significance was established at $p < .05$. All statistical analyses were conducted using SPSS (versión 18).

4. Results

A Pearson correlation analysis was conducted to examine the relationships between musical ability subscales (melody, rhythm, pitch, and timbre), overall musical ability, and psychological distress dimensions (depression, anxiety, and stress). The results are presented in Table 1.

Table 1. Pearson correlations.

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7	8
1. Melody	1496	8.02	2.05	—							
2. Rhythm	1496	9,19	2.22	.315**	—						
3. Pitch	1496	12.67	3.39	.268**	.297**	—					
4. Timbre	1496	13.03	2.80	.270**	.352**	.421**	—				
5. Overall musical ability	1496	42.91	7.42	.595**	.655**	.779**	.750**	—			
6. Depression	1496	11.91	5,29	-.053*	-.111**	-.063*	-.124**	-.123**	—		
7. Anxiety	1496	17.32	7.28	-.040	-.105**	-.058*	-.121**	-.115**	.794**	—	
8. Stress	1496	19.21	7.09	-.030	-.071**	-.035	-.082**	-.077**	.750**	.836**	—

Note. $p < .05$ (*), $p < .01$ (**).

Significant positive correlations were found between all musical ability subscales, as well as among the psychological distress dimensions themselves.

Regarding psychological distress, higher musical ability (both overall and in subscales) was generally associated with lower levels of depression, anxiety, and stress. Specifically, significant negative correlations were observed between rhythm ability and depression ($r = –.111$), anxiety ($r = –.105$), and stress ($r = –.071$). Timbre ability was also negatively correlated with depression ($r = –.124$), anxiety ($r = –.121$), and stress ($r = –.082$).

The analysis revealed a small but statistically significant negative correlation between melody perception and depression ($r = –.053$). Regarding pitch perception, small but significant negative correlations were observed with both depression ($r = –.063$) and anxiety ($r = –.058$).

Overall musical ability was negatively correlated with depression ($r = –.123$), anxiety ($r = –.115$), and stress ($r = –.077$). Although some correlations were small, their statistical significance supports the notion that higher musical ability is associated with lower psychological distress levels.

5. Discussion and conclusions

The findings of this study reveal a modest but consistent relationship between musical ability and psychological distress among primary and secondary school students. Specifically, higher scores in musical ability—particularly in rhythm and timbre perception—were associated with lower levels of depression, anxiety, and stress. These results align with previous research suggesting that music-related skills and engagement with music can play a role in emotional regulation and stress reduction (Perlovsky et al., 2013; Wang et al., 2022).

Of particular interest is the negative correlation observed between melody perception and depression, as well as between pitch perception and both depression and anxiety. Although the effect sizes were small, these findings support the notion that more refined auditory discrimination abilities may contribute to emotional resilience in youth. It is plausible that the cognitive and emotional processes involved in musical perception—such as attention control, memory, and emotional processing—could enhance students' ability to manage negative emotional states (Zhao & Gao, 2025). Future studies should explore these mechanisms in greater depth to better understand the underlying processes.

The overall musical ability score was consistently associated with lower psychological distress, suggesting that a general proficiency in music may serve as a protective factor. These findings reinforce the growing argument that music education should not only be valued for its artistic and cognitive contributions but also for its potential benefits for student well-being, as previous research has shown (Wang et al., 2022; Zhao & Gao, 2025).

Nonetheless, these results should be interpreted with caution. The correlational nature of the study precludes causal conclusions, and although the associations were statistically significant, their magnitude was modest. Additionally, potential confounding variables such as differences in musical exposure, socioeconomic status, and emotional support systems were not controlled, which may have influenced the observed relationships (Perlovsky et al., 2013; Sun, 2022).

Despite these limitations, the findings underscore the potential of music education as a valuable tool for promoting emotional well-being and supporting mental health in the school context. Future research should investigate these relationships longitudinally and assess whether targeted interventions aimed at developing musical skills can contribute to reducing psychological distress among students. Expanding the role of music education within school curricula could therefore offer a promising avenue for fostering emotional resilience and enhancing overall student well-being.

6. Practical applications

Taking our findings into account, a wide range of practical applications could be implemented in the educational setting in order to prevent and reduce psychological distress in students. Participation in music-related initiatives, such as the ones suggested in the following paragraphs, could be monitored and correlated with students' perceived emotional well-being, academic performance and other relevant variables.

First of all, access to music education could be expanded, making group and individual lessons available to all students, offering tuition fee waivers in cases of financial need. Music programmes could be started in the early years in order to build musical and emotional skills over time. In addition to music lessons, participation in music ensembles, clubs and informal spaces for music making could be encouraged in educational institutions. Collaboration with music therapists in the design and implementation of programmes in schools and universities, as occurs in an increasing number of initiatives reflected in academic literature (Chen et al., 2024; Ponce de León & Del Olmo, 2021) could be key in achieving greater reductions in students' psychological distress.

Music could play a greater role in mental health campaigns in the educational setting. Activities involving music could be integrated in events related to health awareness, such as stress-relief days and wellness weeks (Corbin, Kulinna, Dean & Reeves, 2013). Specific workshops focusing explicitly on the potential benefits of music on emotional well-being could be held to increase awareness on the subject.

Short music activities could be integrated in school schedules, acting as brain breaks to support mood and motivation (Vigl, Talamini & Zentner, 2023). To ensure the sustainability and effectiveness of such initiatives, it would be desirable to include these aspects in teacher training and professional development programmes.

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TEAR-FREE MATH ASSESSMENT FOR INFORMAL LEARNING RESEARCH

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Abstract

Assessments are often necessary for justifying making-based education to stakeholders, but traditional assessments rarely align with the values and learning goals of out-of-school time (OST) making-based learning programs. In fact, assessments require that the youth being evaluated genuinely participate in the assessment, something that might be rare or difficult in OST making programs. In this paper, we describe effective, culturally-responsive mathematics assessments designed for youth in OST maker programs and the rationale that led to the assessment development. We then share the design framework that we used to develop these assessments to be camouflaged, appearing to learners to be like other making tasks. We share the results from our pilot with middle schoolers during an afterschool implementation of a math+making program in California, USA. The assessment data relate to measurement, volume, tessellations and transformations, and symmetry. Our research shows that more open forms of hands-on assessments can provide each and every student the opportunity to show what they have learned and leave with something they have made.

Keywords: *Mathematics, assessment, maker education, cultural responsivity, out-of-school learning.*

1. Introduction

Afterschool time offers a tantalizing opportunity to engage youth in rich, meaningful, and fun STEM activities, with unstructured time and few constraints on the type of activities offered. Afterschool is the perfect setting for an ambitious making-mathematics-community program, like Amped 4 Making (A4M). In the four semesters, middle schoolers use mathematics to design, prototype, and build meaningful and useful artifacts. Throughout they learn about and embody principles derived from the life of Cesar Chavez, such as service-orientation, appreciation of their communities, and development of persistence (also a math practice!). The question for such programs as ours is whether youth indeed are learning math or other STEM content knowledge.

2. Background/Lit

In the early 2000s, the National Science Foundation (NSF) made sizeable investments into developing, supporting and researching models of STEM learning in out-of-school-time (OST) learning environments. Practitioners and researchers soon recognized the challenges of assessing learning in these programs. In 2009, NSF sponsored an OST STEM conference with over a hundred participants from the field, and a major finding from the research and evaluation strand was "the need to develop embedded and performance assessments that could document students' development of skills or understanding in ways that did not interfere with students' experience of the OST STEM programs" (Bevan et al., 2013, p. 15). Numerous efforts were undertaken to research and develop invisible or unobtrusive assessments. Pattison, Rubin, and Wright (2016) discussed how the context of the assessment matter. Fu, Kannan, and Shavelson (2019) discuss the goal of assessment while minimizing any disruption to the OST experience. The assessment tasks presented in this paper align with the work of others in the field to fully center participants' learnings while also assessing their development of mathematics content.

3. Design

One of our research questions was "What math content and practices do youth learn through participation in AMPD4Math?" To answer this question, we proposed and piloted an existing instrument to assess mathematical content knowledge, the MARS Tasks (MAP, 2007), presupposing that it was appropriate to the informal education setting because of its participatory nature. The MARS Tasks are commonly used as formative assessments in classrooms and are known to reliably show changes in students' math content knowledge and reasoning skills. Our team of researchers and designers reviewed the publicly available set of MARS Tasks on the MAP website and selected a subset that aligned with the mathematics content in the first semester of A4M. The first semester of A4M culminated in a group project where each participant built a cubby for storing maker supplies and projects. We chose a task assessing volume and surface area, Smoothie Box, because it targeted the lowest of the grades we served and would be possibly accessible to all our youth. We administered the task as pre and post assessments in our pilot year. While 16 students took the pre-assessment across both sites, only 5 students took the post-assessment and only at one site. Facilitators at the site with no post-assessment participants reported that because the students actively disliked taking it, the site staff decided not to administer it again. Of the 5 students who took a post-assessment, only 2 had a taken pre-test. Thus, no statistical analysis on pre-post growth was possible.

Importantly, while there is a socio-institutional contract during school hours between teachers and students regarding how we assess learning through testing, no such agreement would hold in informal learning settings such as our afterschool programs. There was no external incentive in A4M to encourage active participation in testing, such as grades. And, few youths showed the internal motivation to participate in what to them seemed like just another math test after a full day of school and during what is often considered fun and free times.

Without an appropriate existing assessment to address our research question, we took the feedback from youth and facilitators and developed new assessments using a mixture of evidence-centered approach (Mislevy, R. J., & Haertel, G. D., 2006) and a design approach (Goldman & Kabayadondo, 2016). Our design principles were that the assessment needed to:

(1) assess the mathematics relevant to the major work of an A4M semester.
(2) require hands-on making, so that the task doesn't feel like an assessment.
(3) result in a product/artifact that the learner can take with them.
(4) have a feedback mechanism within the task to enable learners to check their own work.
(5) be culturally relevant.
(6) take approximately 20 minutes to complete.

For each semester, we created a bank of ideas for the assessments and evaluated them against our design principles. For finalist items, we refined the language to exclude confusing terminology and provided definitions where needed. We tested the item first with other team members and then with small numbers of readily-accessible youth in the same age-range as the target youth. The result was what we call Maker Tasks.

Table 1. Maker Tasks related to Math Content and Curricular connection.

Maker Task	Math Content	Curriculum Tie-in
1. Box for Dice	Volume (discrete) of objects with linear measurements	Cubbie storage
2. Hojalata Repujada	Symmetry	Symmetrical designs on luminaries
3. Carved eraser stamp	Rigid transformations	Paper circuit designs
4. Bean container	Volume (continuous)	Filling in the raised planter bed with soil

4. Methods

The Maker Tasks were embedded in the semester-long programs. Youth completed a maker task two times each semester: once at the beginning and again at the end. Participants worked independently, but sat at group tables, with access to the necessary materials. Facilitators were given a script to encourage youth to work individually and try as best they could. Then facilitators read the maker task out loud, in English, and if they could, in Spanish. Facilitators were asked not to give hints and to redirect youth to the text of the task. Staff collected the artifacts from the tasks for scoring. In the case of the Dice box and the Bean container, facilitators collected all the boxes/containers. In the case of the Hojalata and Carved Eraser

Stamp, only the paper drafts/sheets were collected and youth were able to keep the aluminum sheet artifact and the eraser stamp.

Staff collected the Maker Task artifacts from the program sites and anonymized each artifact keeping a key list and then sent the artifacts to the research team for scoring. A team of three experienced math education researchers developed and refined the scoring rubrics with un-paired maker tasks. We set used a small set of artifacts to train, ensure inter-rater reliability and sharpen decision points in the rubric. In the end, because we had fewer than expected maker tasks to score, all three researchers scored all tasks. Any conflicts were resolved by consensus in conversations.

5. Maker task results

Figure 1. Example of a student solution to Maker Task 1: Box for Dice.

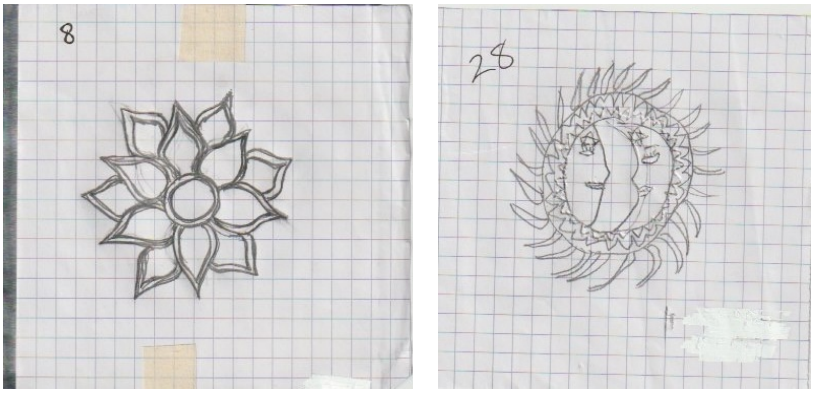
In Fall 2023, the Maker Task involved youth creating a box to contain a set of 12 dice at the beginning and at the end of the program. We scored the pre- and post- for the 19 youth who completed both a pre- and post-Maker Task. The tasks were randomly numbered so they could be scored without researchers knowing if they were a pre- or post-assessment. They were then scored by at least two researchers to ensure consistency in the scoring. Researchers used a rubric that was aligned with the task directions and embedded math and making concepts.

Table 2. Rubric to Score Maker Task 1: Box for Dice.

Is it a container?	(0, 1)
Does it have a top?	(0,1)
Does it hold 12 dice so they do not shake around?	(0, 1)
Does it not have overlapping sides?	0 (it has overlapping sides) 1 (it doesn't)
Does it have the correct height, width, and length of the sides marked on the outside of the box?	0 (no) 1 (yes, correct) 1 for each
Precision of construction	0 (not remotely a box), 1, 2

Math and making are entwined in the task, so math cannot be disambiguated from the making. Overall growth across all rubric items was statistically significant from pre- to post- ($p < .05$). While 79% of youth made a container with a top in the pre-assessment (which was one of the assessment's requirements), 100% of youth made a container with a top by the post. Additionally, the construction improved vastly. In the pre-assessment, 37% of youth created a container where the dice didn't shake around (which was another requirement), while 84% of youth were able to by the post-assessment. Youth also improved in having correct measurements (length, width, and height) marked on their box (another requirement). On the pre-assessment only 26% of youth had at least one correct measurement and only one youth had all three correct. On the post-assessment 73% had at least one correct measurement, and three youth had all three correct.

Figure 2. Examples of student Hojalata prototypes for Maker Task 2: Hojalata Repujada.



In Spring 2024, youth were asked to make an Hojalata Repujada, a metal embossed design, with at least one line of symmetry. Overall, we scored the 21 tasks for youth with both pre- and post-Maker Tasks, using the same protocol as in semester 1. We created a unique scoring rubric for this task. In the pre-, 43% youth had no symmetry in their design. This dropped to 10% in the post. There was also a decrease in average complexity from pre to post (-.38), which may have been because youth were more aware of trying to make designs that they would be able to add symmetry to successfully. We examined partial scores (symmetry and symmetry precision) since this was the math content we were interested in and found the growth from pre to post to be statistically significant ($p < .05$) on a 2-tailed t-test. Changes in overall scores (including complexity) were not statistically significant at a $p < .05$ level.

Table 3. Rubric to Score the Hojalata Repujada Maker Task.

Symmetry	(No=0, Some=1, Very=2)
Symmetry Precision	(Roughly=1, Moderate=2, Very=3, No Symmetry=NA)
Complexity	(Simple=1, Moderate=2, Complex=3)

While we have a small total N across the Fall 2023 and Spring 2024 administrations, we consider that the clear growth from pre to post represents the utility of using the Maker Tasks again in Year 3, since the Maker Task have been found sensitive enough to reflect that growth.

6. Discussion

The team considers the development of Maker Tasks to be a productive direction for our research as our observations and assessment data analysis indicate that they meet our dual needs of assessing what mathematics participants can do while the tasks appear to those participants to be a making task that is in line with the other making that happens in the program. Indeed, in some end of semester interviews some participants mentioned the Maker Tasks to be some of their favorite activities. In program reflections at end of the semester, youth interviewed were able to verbalize the difference in their own making ability and explain how they had improved in their post-maker task. Our small sample sizes show growth in three out of the four tasks. Unfortunately, our project was terminated early by the US government shake up and we could not confirm this trend with our Container for Beans task.

Maker Tasks have proven a much more natural assessment activity for the program's context because it engages youth in making, which is the program's central activity. It is worth noting that this making aspect of the task can also raise challenges to scaled-up implementations. In making tasks, the exact materials can make a difference. Printer paper does not fold the same as cardstock, not all dice are the same size (even when specifications are provided on a seller's website), the gauge of aluminum for an Hojalata can require more or less pressure for embossing, etc. Although scoring the Maker Task artifacts generally requires about the same amount of effort as scoring a MARS task response, they do require more effort than a typical paper-and-pencil math test. Despite these extra challenges, for OST programs like A4M, they are an invaluable research tool to have available.

7. Conclusions

While more research is necessary, Maker Tasks offer a promising opportunity for assessing targeted STEM concepts and skills. However, they take time to develop and refine. Once in use, however, these tasks not only provide insight to researchers and stakeholders interested in knowing whether youth are developing STEM content knowledge but also offer tangible feedback and an enjoyable making experience to the participants themselves.

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We are grateful to the middle schoolers who graciously attempted the first assessment and gave us their feedback as well as the middle schoolers who engaged with the Maker Tasks. With similar gratitude we recognize the work of our facilitators in administering, observing and reporting on youth engagement, and collecting the assessments.

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"I FINALLY FIGURED OUT HOW TO DO IT!" MATH AND MAKER IDENTITY DEVELOPMENT

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Abstract

AMPED 4 Making is a collaboration between TERC and the Cesar Chavez Foundation to develop and pilot a two-year afterschool program that integrates math and making in semester-long units. For each semester, mini-maker projects lead to a larger project focused on making something for youths' own communities and implementing the community-focused values of labor organizer Cesar Chavez. One of the program's goals is to engage youth in a blend of design and making in and for the community—consequential making—to enhance and develop youth's agency and positive identity as makers, mathematical doers and users, and community members. From this goal follows this research question: How do youth's agency and identity as makers, mathematics doers and users, and community members change with participation in the program? To answer this question, we used a combination of methods that included object elicitation interviews, facilitator feedback, and facilitator interviews. Object elicitation interviewing is a data collection method where an object made by the children centers the conversation. Since they are participant-made objects, they embody children's knowledge, skills, and attitudes and make interviews easier by shifting the focus of attention from the interviewer-interviewee dyad to the object. In this paper, we examine the program's findings related to children's math and making identity development. We define math identity as a person's self-understanding as math doers that can flow between being competent and incompetent and that includes interests, aspirations, and engagement. We found that children valued the fact that they were able to express different dimensions of their identities, such as their cultural background, through the projects that they made. Children were proud of what they accomplished in the program, including completing projects, trying new things, and persevering when they encountered adversity. The research identified growth in children's math identity through their increased comfort in using math in the program and their self-perception of their competence as math doers. Youth also increased their awareness of how they are makers. This study shows that integrating math and making into a community-oriented afterschool program supports positive youth math and making identity development.

Keywords: *Math identity, maker identity, object elicitation, afterschool, STEM.*

1. Introduction

A collaboration of the Cesar Chavez Foundation and TERC, and funded by the National Science Foundation, AMPED 4 Making is a middle school afterschool program of mathematics-oriented design and making infused with the core values of civil rights leader Cesar Chavez. Thus, there is a strong focus on caring for community. Among AMPED 4 Making's goals are to engage youth in a blend of design and making in and for the community—consequential making (Barton & Tan, 2018)—to enhance and develop youth's agency and positive identity, as makers, mathematical doers and users, and community members.

AMPED 4 Making is a two-year program composed of four semester-long units. For each semester, mini-maker projects lead up to a larger project focused on making something for youths' own communities—an afterschool program, family, and school levels. For example, youth begin the program's first semester by making a clay figurine that represents something important about themselves. They go on to build skills with 3D modeling and printing and cardboard construction, culminating in making a storage system for program participants to store projects in progress, which they can use in following semesters. Sessions integrate selected Cesar Chavez values by focusing on different aspects of community, such as the case of the storage system that benefits the afterschool program community.

2. Literature review and theoretical framework

We frame the AMPED 4 Making program using Barton and Tan's (2019) concept of *consequential learning*, which they described as learning that "examines what matters to people and how associated values and practices, when coordinated through social activity, can allow for imagining new social futures" (p. 5). This framework seamlessly connects with the Cesar Chavez community values that emphasize individual development in the context of the progress and prosperity of the community (Chavez, 1991). From this perspective, consequential learning provides a context for both individual and community development, which is this program focus on youths' development of positive identities as makers and math does through community-oriented making activities.

Over the past two decades, the mathematics education community has shown particular interest in the development of youth's mathematical identities, as evidenced by Aguirre et. al.'s book (2024) and a multitude of other publications (summarized in Darragh, 2016). Researchers and practitioners see a strong link between mathematical identity and mathematics learning (Boaler & Greeno, 2000). Some out-of-school programming aims at aiding students' positive mathematics identity development (e.g., Gholson & Robinson 2019). This paper describes our recent efforts in this arena.

We define math identity through a quote from Danny Martin (2006): "a person's self-understanding … in the context of doing mathematics (i.e., usually a choice between a competent performer … or an incompetent … but often flowing back and forth)" (pp. 206–207). More recently, Goff et al. (2020) unpacked identity as a cluster of "aspirations, interest, engagement, and perceived competence" (p. 276) and we find these characteristics useful in our analysis of AMPED 4 Making's effect on youth identity.

In the making literature's exploration of identity (e.g., Li, Gao & Yun, 2024; Culpepper & Gauntlett, 2020), maker mindset is commonly discussed. A useful definition is that "the thing being made and its utility becomes a pragmatic goal that sustains motivation, interest and engagement" (Chu et al., 2015). AMPED 4 Making uses maker identity and maker mindset to support students' interest and motivation in mathematics.

3. Design and methods

We used a combination of methods that included object elicitation interviews, facilitator feedback, and facilitator interviews. Object elicitation is a data collection method where an object made by the children centers the conversation (Levin-Güracar et al., 2024). Since they are participant-made objects, they embody children's knowledge, skills, and attitudes and make interviews easier by shifting the focus of attention from the interviewer-interviewee dyad to the object. This type of interview elicits richer information than regular interviews because images and objects facilitate recalling processes and memories in more detail (Harper, 2002). We conducted object elicitation interviews and focus groups with the youth at the end of each semester, so we were able to see how youths' descriptions of the steps they took to make their projects, how they used math, and how they solved problems changed through their participation in the program.

We analyzed facilitators' feedback and the transcripts of object elicitation interviews and facilitator interviews using deductive coding by starting with the main ideas in the research question that we address in this paper as the main codes (Fereday & Muir-Cochrane, 2006). Then, we consolidated the codes into broader themes.

Seven middle school pilot sites were recruited by the Cesar Chavez Foundation to run the AMPED 4 Making afterschool club. The sites were in middle schools in California, where a majority of the over 200 enrolled youth are Latinx (about 80%), ages 10–14 years, multilingual, and receive free or reduced-priced lunch. In some sites, the AMPED 4 Making club was part of the school's existing afterschool offerings, so the youth were already part of an ongoing program and either chose or were voluntold to participate in the club. In other sites, there was no ongoing afterschool program, so CCF recruited youth to participate. The program ran for three years (one pilot year, and two implementation years).

In this paper, we address the project's research question about youths' development in regard to math and making: *How do youth's agency and identity as makers, mathematics doers and users, and community members change with participation in AMPD4Making?*

4. Findings

This paper shows that youths' participation in the AMPED 4 Making program positively contributed to youth's positive development, particularly in their development of their identities as math doers and makers, through consequential making that centered community values. The findings are divided

into three intimately linked main themes: the connection between identity and community, participants' development of their identity as makers, and connection between math learning and math identity.

4.1. Identity and community

In the second semester, youth focused on making for the family level of community. Youth made stuffies that represented their family and luminaries with symbols to represent their family. Luminaries are lanterns that are part of a tradition in the Southwest that dates back to XVI century Mexico. During object elicitation interviews, youth highlighted different dimensions of their identities through the projects they had made. When asked about the Mexican flag stuffie he created, one youth, Carlos, responded that,

> *"Well, because it reminds me of my family heritage and culture and it's a really important thing for me."*

Being able to do projects that reminded Carlos of his family heritage and culture was "very unique" and he reported that it's a "very good thing that we do here." He further explained the importance of being proud of their heritage:

> *"We also did many things that also represent us, which I feel is a very important thing in [AMPED 4 Making] because it lets us understand ourselves, but also in a way, be proud of who we are and getting to know who we are and sharing that with everyone."*

In another project, youth talked about how they used the decorations on their luminaries to represent their families, such as using a square to represent the four members of their family.

In the fourth semester, the focus was on the school community. One of the sites made raised garden beds for their school. When youth were asked in an object elicitation focus group what they would plant, they talked about planting flowers as something nice for the school. Later, they talked about wanting to grow useful plants, such as aloe vera, because as Rose explained, "*it could be used if a student has a burn or something*." The youth were thinking in depth about what they could plant that would benefit the greater school community.

4.2. Identity as makers

In facilitator interviews and focus groups, and in object elicitation interviews with the youth we saw that the youth grew in their identities as makers. Facilitators repeatedly stated that the youth were proud of what they accomplished in the program, such as completing projects like the raised garden beds, trying new things like using a saw to cut the materials for the luminaries, and persevering when they encountered adversity. When talking about a hands-on assessment building a card stock box that fit 12 dice, Walter was proud of what he completed.

> *"I'm proud [of the box I made] and I'm pretty happy that I finally figured out how to do it."*

Later in the semester, Walter showcased two projects that, though they were unfinished, he was happy about. When asked by a researcher if he was proud of his projects, he stated,

> *"Yes, definitely; especially for the measuring and trying and failing to do stuff"*

It is noteworthy that he mentioned the fact that he understood that trying and failing were part of the process, while earlier he was proud of what he accomplished because he was able to make sense of the steps to make the box. Notice also that his mathematical activity was also mentioned as a source of pride, suggesting overlap between these two aspects of identity—mathematics and making.

In the object elicitation interviews, we also observed changes in how youth talked about the making process. Youth became more comfortable explaining the steps involved in making and their decision-making along the process. For example, initially Walter mostly held up his project to show it to the researcher and point out the different elements, without explaining the process or the decisions he made as he built it. In a later interview, the same youth was clearer in his explanation of how he created a carboard photo frame. Instead of pointing at the different elements of his project, he explained the specific steps he took and the difficulties he ran into, clearly taking pride in his increased expertise as a maker.

4.3. Math learning and math identity

We saw the development of math skills, knowledge, and understanding and positive mathematical identities both in youth interviews and in what facilitators reported about youth. Facilitators noted the youth's growth over the course of the program, such as by referencing growth in the youth's use of measurement and overall comfort in math: the perceived competence that Goff identified as a component of math identity. They also clearly showed increased engagement in mathematics, another of Goff's categories. One of the facilitators explained the changes she observed in the following way:

> *"I could tell math wasn't so intimidating to them. At the beginning, I asked them about including measurements, they wouldn't know how, or didn't want to discuss it; by the end, they were open to talking about these things, or the 3D objects."*

The comparison between youths' first and second semester object elicitation showed that, in the earlier interviews, youth tended to have a harder time expressing their ideas in math. However, in later interviews they were able to talk about the application of specific math ideas with more sophistication. They expressed confidence in their abilities and in their control over the mathematics ideas and practices, signs of growing math identities as the competent performers of which Martin wrote. For example, Walter showed awareness about when it was appropriate to use one measurement unit or another, indicating he understood this aspect of competent performance. He stated,

> *"I had to measure a lot of things. And sometimes I'd use things in inches, sometimes centimeters. I mean, for the bigger projects, feet because one was better to use for the thing."*

Walter showed that he understood which units were more appropriate to use in different situations according to the dimensions of the project at hand. Similarly, youth pointed out that millimeters were the most appropriate units for 3D printing because the size of the small size of projects and being off by an inch or a centimeter would radically change the result.

Youth also showed that they were aware of their own growth as math doers and users through their participation in the program. Carlos, for instance, appreciated learning how to be organized in his work. He stated,

> *"I learned [that] it's very important to have things written on paper, actually, because it keeps us organized and it's very good. Honestly."*

Being organized is a math problem solving skill and his recognizing its importance shows that he added this skill to his "toolkit" of a competent performer. He was also keenly aware about the difference between learning in school and learning in the program, and how the hands-on approach of the program could help some youth who may have a harder time with paper and pencil math activities. He shared,

> *"[In school] we would always measure things, but we will never do it hands on, because we just measured things on paper. But here we have it hands on. And I feel like this helps a lot of kids because I'm fine with paper. But I feel like it helps a lot of kids get a grasp of understanding the way measurements work, how math works, but really hands on, which is, I guess the way they learn."*

Carlos expressed an aspect of his mathematics identity as well—"I'm fine with paper" [for learning math]—while recognizing the value of hands-on experiences for others.

In all object elicitation interviews, youth were asked if they used or learned any math while making. The way youth talked about math showed a change in their awareness of the role of math in the making processes. It also showed growth in math identity as, in their minds, the importance of the math they were doing grew as did their perceptions of competence. They initially answered that they did not do math in the program or dismissed measuring as not being math. However, in later interviews, they showed that they understood the importance of measurement as math for making projects and were quite specific in how they talked about the math that they used.

5. Conclusion

This paper shows that youth in the AMPED 4 Making program valued having the opportunity to express different dimensions of their identities, such as their cultural background and being part of a family, through the projects that they made. Youth were proud of what they accomplished in the program, including completing projects, trying new things, and persevering when they encountered adversity. The research identified growth in youths' math identity through their increased comfort in using math in the program and their self-perception of their competence as math doers. They also increased their awareness of how they were makers and that the growth in their identities as makers and as math doers went hand in hand. This study shows that integrating math and making into a community-oriented afterschool program supports positive youth math and making identity development.

We found that by setting a maker task based in the community, opportunities to develop positive community, maker, and math identities naturally arise. This is important because there is an emphasis in literature and in practice on the deep connections between learning mathematics and mathematics identity (e.g., Aguirre, J., Mayfield-Ingram, K., & Martin, D. B. (2024). Based on these findings, we recommend broader adoption of math curriculum in making that integrate youth's identities and cultures.

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MOBILE APPS FOR MENTAL HEALTH: BEST PRACTICES AND ETHICAL CONSIDERATIONS FOR GUIDELINE DEVELOPMENT

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Abstract

The following article outlines comprehensive guidelines and best practices for designing mobile applications that support mental health. The guidelines emphasize a user-centric approach, advocating for inclusive design that caters to individuals with diverse mental health challenges. The guidelines describe the necessary privacy and data security measures for safeguarding sensitive health information. Emotional design principles are explored to foster positive emotional engagement and prevent triggering negative emotions among users. User feedback and customization are encouraged to adapt the app to individual needs, enhancing personalization and efficacy. Ethical considerations are discussed throughout, ensuring the responsible creation of mental health apps that respect user autonomy and dignity. The presentation provides a multidisciplinary framework that combines psychological insight, ethical standards, and best user experience (UX) practices for mobile application development in mental health.

Keywords: *Mental health, mobile apps, guidelines.*

1. Introduction

The growing field of mobile mental health applications signifies a transformative evolution in the provision of mental healthcare services, presenting the potential to overcome conventional obstacles related to access and convenience (Torous et al., 2019). “An average of 2 million apps are available in the Apple and Android stores, and users average more than 80 apps on their phones” (Palmer et al., 2021, p. 137).

The increasing acceptance and utilization of mental health applications stem from a variety of factors, including the escalating prevalence of mental health disorders, a trend significantly amplified by global events such as the COVID-19 pandemic, which has precipitated widespread psychological distress and anxieties (Chandrashekar, 2018). Concurrently, the persistent inadequacies within traditional mental healthcare systems, characterized by long waiting lists, geographical limitations, and a scarcity of qualified professionals, have catalyzed the pursuit of alternative solutions (Powell et al., 2020). Furthermore, a growing inclination among individuals to proactively manage their own well-being and mental health has fueled the demand for self-directed tools and resources, which mobile applications are uniquely positioned to fulfill (Lecomte et al., 2020). The World Health Organization has underscored the critical importance of addressing mental health on a global scale, citing the alarming statistic that individuals with severe mental health conditions experience a significantly reduced life expectancy, which highlights the urgent need for effective and accessible interventions (Zhang et al., 2021). The pervasive nature of depression as a major contributor to disability worldwide further underscores the imperative for innovative approaches to mental healthcare delivery. Mobile applications, with their ubiquitous accessibility and potential for personalized support, have emerged as a promising avenue for bridging the gap between unmet needs and available resources, offering a scalable and cost-effective means of extending mental healthcare services to a broader population (Haque & Rubya, 2022).

In the development of guidelines for mobile mental health applications, a framework encompassing usability, effectiveness, privacy and ethics, and clinical usage is crucial to ensuring responsible and beneficial implementation.

The proposition of leveraging mobile applications to deliver mental health interventions holds substantial promise, yet different ethical considerations and practical challenges should also be considered and addressed to ensure responsible and effective implementation. The availability of smartphones has encouraged the expansion of mental health applications, providing users with tools for mood tracking, stress management, mindfulness exercises, and cognitive behavioral therapy techniques (Lim et al., 2022; Wang et al., 2018). Despite the growing popularity and widespread adoption of these applications, considerable uncertainty persists regarding their efficacy, safety, and ethical implications. It becomes important to address ethical obligations, especially with algorithms providing therapy to consumers in the absence of a therapist-patient relationship (Martinez-Martin & Kreitmair, 2018).

2. Proposed guideline framework

Consequently, the authors have developed the following guidelines based on the literature: Usability, Effectiveness, Privacy and Ethics and Clinical Usage to assess the feasibility and impact of mental health apps. The following table (Table 1) outlines how the guidelines may be used.

Table 1. The considerations of mobile mental health applications development.

Usability	Effectiveness	Privacy and Ethics	Clinical usage
How do you use the app? What features do you like? What makes it easy/challenging to use	Who says the app works? (ie developers) Are there research studies?	How is your data stored? Who has access to it? What personal data is required?	Who created the app? Was there a mental health professional or organization involved in the development?

The ethical dimensions of mobile mental health applications extend beyond data privacy to encompass issues of informed consent, transparency, and accountability, all of which are essential for fostering user trust and ensuring responsible innovation. It is important to be aware of ethical standards in the context of development, research, and integration, balancing benefits, cultural norms, and values (Wykes et al., 2019). Ethical considerations necessitate transparent communication regarding the application's functionalities, data usage policies, and potential risks and benefits, empowering users to make informed decisions about their participation (Fiske et al., 2019). Furthermore, clear mechanisms for addressing user concerns, resolving disputes, and ensuring accountability are crucial for maintaining ethical standards and fostering a culture of responsible development. In the context of clinical usage, guidelines should address the appropriate integration of mobile mental health applications into existing mental healthcare systems, delineating the roles and responsibilities of healthcare professionals in utilizing these tools to augment traditional therapy and support patient care. It is important to integrate digital tools within the context of a therapeutic relationship between a professional and a patient, but this raises ethical concerns about how mental health apps will impact the therapeutic relationship (Alfano et al., 2023). Careful consideration must be given to the potential impact of these applications on the therapeutic relationship, ensuring that they complement rather than replace human interaction and clinical judgment.

The information is showcased in a comprehensive framework for guideline development and includes tenets of usability, effectiveness, privacy, ethics, and clinical integration to ensure that these applications are not only user-friendly and engaging, but also evidence-based, secure, and aligned with established clinical practices. Usability is paramount, encompassing the intuitiveness, accessibility, and overall user experience of the application, as cumbersome or confusing interfaces can deter engagement and hinder therapeutic outcomes. Effectiveness must be rigorously evaluated through empirical studies, demonstrating the application's ability to elicit meaningful improvements in mental health outcomes, such as reducing symptoms of anxiety, depression, or stress. The cornerstone of ethical mobile mental health application development lies in the rigorous protection of user data and privacy, a multifaceted concern that spans data collection, storage, and transmission practices (Wies et al., 2021).

Figure 1. Framework for evaluating the feasibility and impact of mobile mental health applications across four key domains: usability, effectiveness, privacy and ethics, and clinical usage.

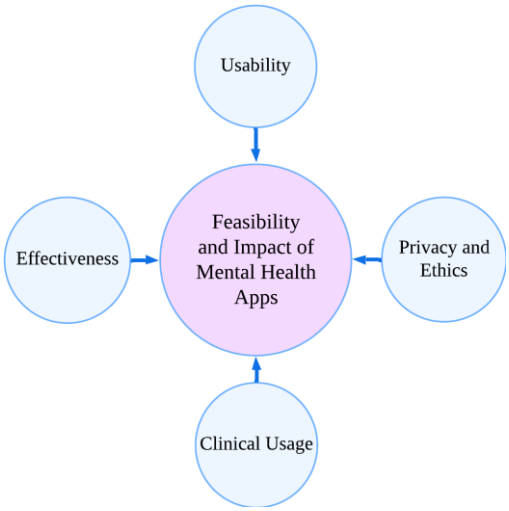

Figure 1 shows how the different domains interact with one another in a visual format.

The rising popularity of mobile mental health applications has spurred debate on the balance between data privacy and service personalization, especially when algorithms offer therapy without a therapist-patient relationship (Zhang et al., 2021). Such advancements necessitate careful consideration of ethical guidelines, encompassing clinical integration strategies, comprehensive training protocols for healthcare professionals, and proactive measures for mitigating potential harm, including robust data ethics frameworks (Fiske et al., 2019).

Stakeholders, including software developers, healthcare providers, and consumers, need to collaborate in setting standards and practices that address ethical challenges (Martinez-Martin & Kreitmair, 2018). The utilization of digital platforms for mental health intervention necessitates a comprehensive examination of ethical considerations to ensure the responsible and effective deployment of these technologies. A proactive approach to addressing these ethical challenges is essential to harness the full potential of digital mental health interventions while safeguarding the well-being of individuals and communities (Burr & Morley, 2020).

3. Next phases

Following the development of the proposed framework, our next phases include practical application development and real-world testing, these steps are:

Step 1: Mobile App Development. In this first step, we will design and develop a prototype mental health mobile application guided by the proposed framework of the four key domains: Usability, Effectiveness, Privacy & Ethics, and Clinical Usage

Step 2: Clinical Testing and Feedback Collection. In this step, we will apply this app in real healthcare settings, such as mental health clinics, other health care agents, or students who study mental health. We will collect both qualitative and quantitative data for assessing the effectiveness, strength, weakness, and feedback of using the app in supporting mental health. The data collected will be used to conduct further research to suggest improvement and revision of the framework.

Step 3: Framework Revision. Based on the data collected from the previous step of data collection. A further study will be conducted to figure out the best areas for improvement in both the app and the framework. With the practical approach, the research result will be used to revise the framework and the app. The revised framework should have the feature of clarity, applicability and impact for addressing or preventing mental health issues.

Step 4: Integration into Teaching. As a long-term goal, the result of this study, the revised framework will be integrated in the mobile app development course curriculum as a guidance of design specially for mental health and wellbeing. With the integration of this guidance into mobile app development curriculum, students will have the awareness of mental health issues, and will learn how to use technology to support mental health wellbeing in the future. In addition, students can have the opportunity to conduct hands-on experiences in designing and developing mobile apps to promote mental health. This experiential learning approach will provide students opportunity in learning ethical design, usability testing, and clinical considerations in app development.

4. Conclusions

The availability and accessibility of mobile apps have increased, particularly in the field of mental health and especially since the COVID-19 pandemic. The authors of this article highlight the development of specific guidelines and subsequent framework for evaluating the feasibility and impact of mobile mental health applications across four key domains: usability, effectiveness, privacy and ethics, and clinical usage. To further develop and test this framework, the authors also articulate their plans for further practical development and real-world testing with integration of feedback. However, at this time, the framework provides a foundation to assess mobile mental health apps and their utility, usability, and privacy along with their overall standards for appropriate usage.

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GRADE 12 LIFE SCIENCES TEACHERS' UNDERSTANDING OF SMARTBOARD AFFORDANCES IN TEACHING GENETICS

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Abstract

Genetics, the study of heredity and inheritance, is a fundamental discipline in modern biology. Its significance extends far beyond the classroom, influencing various aspects of life from medicine, agriculture to biotechnology and forensic sciences. Understanding genetic concepts is crucial for addressing pressing global challenges such as disease diagnosis and treatment, crop production, and conservation of biodiversity, hence it is fundamental for learners to understand genetics. However, genetics concepts are often complex and abstract, posing challenges for both teachers and learners when teaching these concepts. Traditional teaching methods fail to provide dynamic and interactive learner engagement opportunities during the learning process, leading to difficulties in conceptual understanding of genetics concepts. To address these challenges, innovative technologies such as smartboards have been found to enhance the teaching and learning of genetics. Smartboards offer a range of interactive tools and multimedia capabilities that can facilitate immersive and interactive learning experiences. The study herein reported explored grade 12 teachers' understanding of the affordances of smartboards for teaching genetics concepts. The study was framed by the Technological Acceptance Model as the theoretical framework in interpreting findings of the data collected. Through a quantitative research approach, 40 grade 12 life sciences teachers were purposefully selected to participate in the study. These teachers used smartboards and were presumed to possess the requisite content knowledge in genetics as stipulated by the South African Curriculum and Assessment Policy Statement. To collect data a questionnaire designed by researchers was administered to the teachers to determine their understanding of smartboards affordances and their competencies in using the smartboards to teach genetics concepts. Data analysis involved computation of descriptive statistics. The findings revealed that teachers have limited understanding of the usefulness of smartboards to teach genetics concepts due to insufficient technological knowledge and skills. This is despite them holding positive perceptions on smartboard affordances, citing its potential to promote collaborative learning, autonomous learning, and learner-centred approaches. The findings showed that insufficient technological knowledge hinders teachers' ability to effectively utilise and explore the interactive tools that smartboard can provide when teaching genetics. The findings provide implications for the design of focused interventions and teacher professional development and provision of technical support to enable meaningful utilisation of smartboards in teaching abstract science concepts.

Keywords: *Genetics, grade 12 teachers, life Sciences, smartboards, teacher understanding.*

1. Introduction and background

Genetics is a fundamental field of study that occupies a paramount position in contemporary society, permeating various aspect of everyday life, such as agriculture, health, and biotechnology (Thörne, 2018). Consequently, acquiring a robust understanding of genetics concepts is essential for learners to critically engage with the complex socio-scientific issues that arise from advancements in genetics (Ezechi, 2021). The effective teaching and learning of genetics concepts in South African schools, particularly in grade 12 Life Sciences, is hindered by a significant conceptual knowledge gap in biological concepts. This challenge is evident in learners' sub optimal performance on genetics-related examination questions, as highlighted in the Department of Basic Education Diagnostic Report (2023).

Research suggests that both teachers and learners perceive genetics as a challenging topic due to its abstractness, which leads to learners lacking conceptual understanding (Moll & Allen, 2014). Thörne (2018) further suggests that conceptual gap on genetics can be attributed to the pedagogical approaches and resources used by Life Sciences teachers in the classrooms. To address this challenge, the integration of

smartboards in the classroom can be beneficial, enabling teachers to utilise visual aids and illustrations to facilitate deeper understanding of the concepts.

A smartboard is an interactive, touch-sensitive display board that connects to a computer, enabling the projection of digital content through built-in or overhead projector (Mihai, 2020). The Department of Basic Education in South Africa installed smartboards in schools and provided teacher training to harness the potential of smartboards to improve quality of teaching and learning across various subjects (Tefo, 2020). Research has shown that smartboards enhance teacher-learner interactions in the classrooms and conceptual understanding of abstract concepts through multimedia presentations (Aktas & Ayden, 2016). The dual display feature facilitates collaborative learning, enabling learners to work in pairs on activities, (Tefo, 2020) for example when solving Mendelian genetics problems. Domain-specific external representations such as animations on the smartboard improve visual literacy and enable learners to create mental models of abstract genetics concepts, enhancing conceptual knowledge and learners' academic performance (Bayar & Kurt, 2021).

Teachers generally perceive themselves as competent in using smartboards (Mihai, 2020). However, limited teaching experience and inadequate training can lead to lower self-efficacy and limited utilisation of smartboard features (Tefo, 2020). The limited use of smartboard features in Life Sciences highlights the importance of teachers' technological skills and knowledge, which influences their perceptions of smartboard usefulness in teaching genetics (Mahdum, Hadriana, & Safriyanti, 2019). It is against this backdrop that the study sought to explore teachers' understanding of smartboard affordances in making genetics concepts accessible to grade 12 Life Sciences learners. The study sought to answer two research questions: 1. What are teachers' understandings of the affordances of smartboards as digital tools to make genetics concepts more accessible to grade 12 learners? 2. What are teachers' perceptions of their competencies of using smartboards as digital tools to make genetics concepts more accessible to grade 12 learners?

2. Theoretical framework

Technology Acceptance Model (TAM) by Davis (1989) served as the underlying framework for this study, which investigates teachers' willingness to adopt and utilise emerging technologies in the classroom. According to TAM, two key factors influence an individual's intention to use technology: perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which teachers believe that technology will enhance learner performance and understanding of concepts, while perceived ease of use pertains to the simplicity and user-friendliness of the smartboard (Eze, Obi Chukwu & Kesharwani, 2021). In this study TAM provides the basis for interpreting teachers' understanding and willingness to adopt smartboard utilisation in their Life Sciences classrooms.

3. Methodology

This study employed a quantitative research design, enabling computation of descriptive statistics (Creswell & Creswell, 2018). Quantitative data centres on a single belief and understanding of a phenomenon rather than the varying opinions of participants regarding the subject under investigation (Creswell & Creswell, 2018).

3.1. Selection of participants

Using purposive sampling technique (Patton, 2002) forty grade 12 Life Sciences teachers from Gauteng West District in South Africa, were selected. The sampling method allowed for deliberate selection of participants based on their accessibility and experience in using smartboards in their schools. The selected teachers were presumed knowledgeable about genetics concepts as outlined in South African Curriculum and Assessment Policy Statement (CAPS).

3.2. Data collection and analysis

To collect data a closed-ended 4-point Likert scale questionnaire was administered to the 40 selected grade 12 Life Sciences teachers through Google forms. The questionnaire was adopted from Mahdum et al. (2019) and modified to suit the objectives of the study. The questionnaire sought grade 12 Life Sciences teachers' understanding of the affordances (perceived usefulness) of smartboards in teaching genetics; perceived ease of use of smartboards in teaching genetics; and their efficacy in using smartboards to make genetics concepts more accessible to learners. All the 40 teachers responded to the questionnaire items. Collected data was analysed using Statistical Package for Social Sciences (SPSS) and descriptive statistics were computed.

4. Findings

The study findings addressed two research questions which sought teachers' understandings of the affordances of smartboards as digital tools to make genetics concepts more accessible to grade 12 learners; and their perceived competencies of using smartboards as digital tools to make genetics concepts more accessible to grade 12 learners. Grade 12 is the last level in high school in the South African education system. The results are presented under teachers' perceived usefulness of smartboards; teachers' perceived ease of use smartboards; teachers' perceived affordances of smartboards; teachers' perceived self-efficacy in using smartboards to teach genetics concepts; and teachers' trainings needs on smartboard use. The sample comprised 57.5 % females (n=23) and 42.5 % males (n=17).

4.1. Teachers' perceived usefulness of smartboards

Table 1 shows teachers' responses regarding their understanding of the usefulness of smartboards in teaching genetics concepts.

Table 1. Teachers' perceived usefulness of the smartboard to teach genetics concepts.

Items	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
1. The use of smartboard can increase learners' motivation in learning genetics concepts.	0	0	47.5	52.5
2. The use of a smartboard enables learners to become active learners and work in pairs during genetics lesson.	0	0	52.5	47.5
3. The use of smartboard can make genetics concepts more accessible to learners for better understanding of the topic.	0	0	59.0	41.0
4. The use of a smartboard can improve my teaching of genetics concepts.	0	0	46.2	53.8

All the 40 grade 12 Life Sciences teachers in this study perceived smartboards indicated that smartboards were useful in teaching genetics. They perceived smartboards as useful digital tools to motivate and engage learners; in making learners active as they work in pairs; making genetics concepts more accessible to learners; and hence enhancing their teaching practices.

4.2. Teachers' perceived ease of use smartboards when teaching genetics

Table 2 shows the teachers' perceptions on the ease of use of smartboards when teaching concepts in genetics.

Table 2. Teachers' perceived ease of use of smartboards when teaching genetics concepts.

Items	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
1. The use of a smartboard makes it easy for teachers to explain the genetics concepts during a lesson.	0.0	0.0	42.5	57.5
2. Technical problems are experienced when using smartboards to teach genetics concepts.	22.5	35.0	35.0	7.5
3. The use of a smartboard provides convenience in communication when teaching genetics concepts.	0.0	0.0	42.5	57.5
4. The use of a smartboard can make the learners have a better understanding of how genetics affects their lives.	15.0	10.0	42.5	32.5

All teachers view smartboards as user-friendly digital tools for explaining complex genetics concepts (100%). Many teachers perceive smartboard as a digital tool that makes it easy to communicate the content to the learners (57.5%); and enhancing learners' understanding and appreciation of the practical applications of genetics concepts (75%). However, 42.5% of teachers encountered technical problems when using smartboards to teach genetics concepts, meaning that they view smartboards as digital tools that are not easy to use.

4.3. Teachers' perceived affordances of smartboards

Table 3 shows teachers' perceived benefits of using smartboards as digital tools to make genetics concepts more accessible to grade 12 learners.

Table 3. Teachers' perceived affordances of smartboards.

Items	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
1. The use of a smartboard can facilitate learner-centred learning of genetics concepts.	0.0	0.0	41.0	59.0
2. The use of a smartboard provides an opportunity to improve my teaching strategies of genetics concepts (differentiated teaching)	0.0	0.0	48.7	51.3
3. The use of a smartboard can improve learners' understanding of genetics concepts.	0.0	2.5	50.0	47.5
4. The use of a smartboard can make learning of genetics concepts more meaningful to learners.	0.0	0.0	67.5	22.5

Teachers have a positive attitude towards utilising smartboards to teach genetics, citing its potential to facilitate learner-centred approaches. Smartboards also capture learners' interest and enhance understanding by enabling active engagement in knowledge construction of genetics concepts.

4.4. Teachers' perceived competencies of using smartboards to teach genetics concepts

Table 4 shows teachers' perceived competencies of using smartboards as digital tools to make genetics concepts more accessible to grade 12 learners.

Table 4. Teachers' perceived competencies of using smartboards to teach genetics concepts.

Items	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
1.I believe in my knowledge to use smartboard in designing genetics learning activities.	7.5	20.0	50	22.5
2. I like to make use of a smartboard in teaching genetics concepts learning activities because I am certain that I can get benefits**.**	2.5	5.0	62.5	30.50
3.I can search and choose smartboard features that are appropriate to support my teaching and learning activities of genetics concepts.	0.0	27.5	60.0	12.5
4. I have certain strategies to solve problems I face when using a smartboard to teach genetics concepts.	2.5	7.5	67.5	22.5

Most teachers felt proficient in using smartboards to teach genetics. There are however 27.5% who lack technical skills and confidence in using smartboards. There are also a few teachers who are not convinced of the benefits of using smartboards (7.5%) and those that have no knowledge of solving problems they encounter when using smartboards (10.0%). Teachers' proficiency levels impact their perceived benefits and confidence in using smartboards.

4.5. Teachers' developmental needs on smartboard use

In the questionnaire, teachers were also asked about the kind of development they received on the use of smartboards and also its adequacy in equipping them with the necessary skills. Table 5 shows teachers' responses.

Table 5. Teachers' developmental needs on smartboard use.

Items	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
1. The training held by the Department of education motivated me to use a smartboard in teaching genetics concepts.	2.5	10.0	42.5	45.0
2. I use a variety of smartboard features that were shown during the training when I teach genetics concepts.	10.0	42.5	32.5	5.0
3. I need more training on how to use a smartboard in teaching and learning of genetics concepts.	10.0	10.0	40.0	40.0

Most teachers (87.5%) credited the Department of Education for the motivation and equipping them with all the necessary skills they were using in teaching genetics concepts with smartboard. However, despite enthusiasm, many teachers indicated that they still struggled to utilise various smartboard features (52.5%), highlighting a need for additional training to fully leverage its capabilities (80.0%). A small percentage (12.5 %) reported never receiving training, possibly due to joining the profession after smartboard integration in Gauteng province.

5. Discussion

This study reveals that Grade 12 Life Sciences teachers recognise the potential of smartboards to enhance learner engagement and conceptual understanding of genetics concepts. The findings align with Kırbas' (2018) assertion that the multimodal representation feature of smartboards facilitates learner knowledge retention through multisensory experiences. Teachers' responses also demonstrate the perceived usefulness of smartboards in enhancing learning outcomes and learner motivation which was also echoed in previous studies (e.g. Mihai, 2020; Kırbas, 2018). However, challenges with ease of use persist, largely due to inadequate training that result in the grade 12 Life Sciences teachers failing to fully utilise the advanced features of the smartboard to teach genetics. This aligns with Bayar and Kurt's (2021) assertion that effective utilisation of smartboards is contingent upon teachers' self-confidence and belief in their technological abilities. As such some of the affordances of smartboards are not realised particularly in catering for diverse learning styles when teaching abstract genetics concepts.

6. Conclusion

This study explored grade 12 Life Sciences teachers' understanding of smartboards' potential in teaching genetics concepts. Findings revealed that while teachers recognise and appreciate smartboards' affordances in enhancing learner engagement and accessibility, their limited technical training and support hinders the effective utilisation of advanced smartboard features. Despite positive perceptions, a gap exists between teachers' attitudes and actual smartboard use in the Life Sciences classrooms. Developing teachers' technological knowledge and ICT efficacy is crucial to unlock smartboards' full potential in teaching genetics concepts. Targeted training is needed to provide regular, hands-on training sessions for teachers to develop their skills in using smartboard features, addressing specific challenges and subject-specific needs. Furthermore, there is need for provision of ongoing technical support and resources to teachers to ensure proficient utilisation of smartboards.

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INTEGRATING MAKER EDUCATION AND PROJECT-BASED LEARNING IN BUSINESS ENGLISH TEXTBOOK DEVELOPMENT: AN INNOVATIVE APPROACH FOR HIGHER EDUCATION

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Abstract

Maker education prioritizes experiential learning and utilization of tools and materials to foster creativity and socio-emotional development. This study investigates the integration of this pedagogical approach into business English education with a particular focus on the development of textbooks that facilitate real-world business projects. A differentiated framework for textbook development was proposed, encompassing the selection of authentic business projects, formation of both heterogeneous and homogeneous teams based on students' skills and needs, establishment of personalized learning objectives, and application of diverse learning methods and resources. This framework also underscores the importance of varied outcome presentations and formative assessments that offer dynamic feedback and support student growth. The incorporation of Social and Emotional Learning (SEL) into project-based learning processes is a crucial strategy for enhancing students' holistic development. This study reveals that a core problem chain, driven by business project-based learning activities, effectively integrates professional English with creative skills by focusing on knowledge chains. The adaptation of business English textbooks is associated with interdisciplinary core knowledge points, supported by maker instruction, a flexible credit system, and the effective assessment of both practical and classroom-based courses. This approach enhances the creative mechanism for textbook development and strengthens connections between families, schools, enterprises, and communities.

Keywords: *Maker education, business English textbook, Social and Emotional Learning (SEL), undergraduates, strategies.*

1. Introduction

Maker education serves as a mechanism to foster creativity (Conradty & Franz, 2018) and socioemotional skills (Li, 2025) among college students. It plays a pivotal role in the utilization of tools and materials (Juca-Aulestia et al., 2021) through a series of integrated workshops (Lee et al., 2021). These resources enable students to engage in diverse organizational and collaborative practices in technology design, self-directed exploration, and self-learning services (DeFeng, 2021). Concurrently, it empowers educators and learners to cultivate a cooperative learning culture that links schools with communities within an open educational environment. Consequently, in Maker education contexts, learners dynamically construct knowledge through social interaction. Specifically, social interaction within business English classrooms, grounded in authentic business projects, facilitates an organic integration of learning capacity with practical processes, thereby transforming traditional classrooms from a focus on business knowledge to competence-oriented learning via Makerspaces. Nonetheless, the potential for practical operations and production skills within humanities curricula remains insufficiently explored (Xiaomei & Qingmei, 2021). Therefore, this study aimed to integrate maker education and business project-based learning into textbook development. It examines the development framework of maker-style business elective courses and the pathways for teaching materials to achieve learning-by-doing and discovery learning in undergraduate business English.

2. Theoretical background

This study employs a sociocultural perspective to comprehend the sociocultural aspects of learning and the efficacy of designing real-world business projects that can be shared and refined. According to Dewey, Vygotsky, and the Reconceptualist Movement, which emphasizes cognitive psychology and

conceptual reconstruction, The design process serves as a learning mechanism where learners refine their understanding to determine why a design does not function as expected (Kafai, 2006). During maker design, various tools and materials become object-to-think-with, fostering connections between internal and external models for profound business learning. A key component of sociocultural learning environments is enabling learners to create artifacts meaningful to themselves and their communities (Resnick, 2002). This social perspective aligns with theories of socially constructed learning (Case 1996), emphasizing both individual artifact design and community influence. Therefore, it is essential to examine both learner design and community practices, including how they manifest through tools and activities in Business English textbooks.

3. Differentiated textbook developing framework

3.1. Developing framework

3.1.1. Differentiated project selection from real business world. Real-world business project-based learning (RWPBL) is student-centered and personalized through intense interdisciplinary knowledge, moving away from the uniform pace of traditional teaching during business planning. This gives educators more flexibility to adopt textbook content.

- Choice of goals in learning by doing.
- Differentiated Team Structure.
- Personalized assessment methods.

There are six aspects in which differentiated instruction can naturally be a part of the RWPBL:

3.1.2. Differentiated teams in RWPBL. Team formation is key to differentiation during the RWPBL. Specifically, heterogeneous grouping is required to encourage collaboration and cross-empowerment. At other times, homogeneous grouping based on factors such as members' social and emotional skills, knowledge levels, or project task style is better for targeted guidance. When forming groups, we consider:

- What aspects do you differentiate? (Cognitive level, communication style, social and emotional skills, curiosity, etc.) For example, a team may need creative thinking, data analysis skills, and strong communication abilities. Teams might be formed based on members' cognitive levels in different knowledge areas.
- How does this group support specific teaching or collaborative business goals?

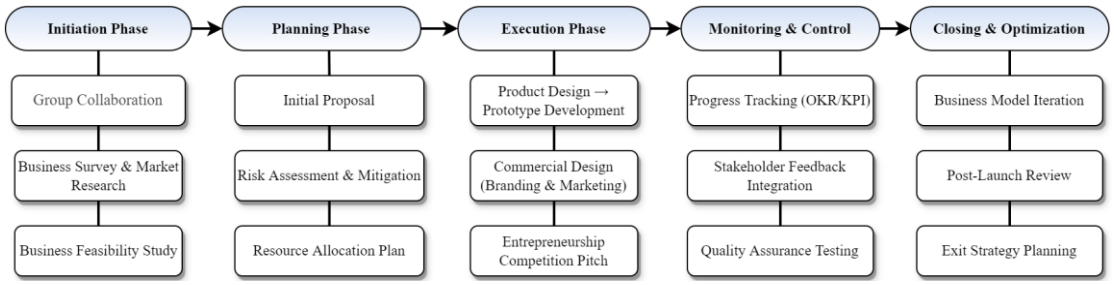
Differentiation is not just about mixing high and low performers; it is also about designing teams based on learning styles and support needs in the same project.

3.1.3. Differentiated goal setting in RWPBL. Encourage students to set personal learning goals through reflection. At key project milestones, ask the students:

- What have I learned thus far in terms of knowledge and skills?
- What do I want to master?
- What is my next goal?

In addition to the above questions, the project-generated reflection journal (PGRJ) was designed for self-assessment and changes in students' attitudes during the study. The instrument was designed to guide students to reflect on their weaknesses while also identifying their strengths, personality, aptitudes, learning outcomes, competencies, attitudes, and traits through positive and negative statements, or both (Li, 2025). In addition, SES assessment scales, such as Mosaic (ACT, 2021), are utilized for assessment. Educators can then provide tiered support based on these goals. Differentiated goal-setting combines personalized growth paths with educator support strategies under basic procedures (see Figure 1).

Figure 1. Business English textbook development via RWPBL (simple).



3.2. Differentiated learning methods in RWPBL

Provide varied learning methods and resources. Offer micro-lessons in this study for students with knowledge gaps; create learning stations with online videos, books, and interactive tasks with real-world businesses and communities; and let students choose tasks or resources to enhance autonomy. For instance, an educator offered five ways to review "business model iterations": analyzing competitor products, studying by micro-lessons, case materials, review model process, conduct a project post-mortem to identify key learning, sprint retrospectively helps teams improve workflows, or explaining to a peer. Differentiated learning means more choices and better resource matching, and not just more lectures.

3.3. Differentiated outcome presentation in RWPBL

Respect diverse expression styles. The outcomes can be successful commercial campaigns and business profits, product iteration design, tools and materials exploration, individual business reports, LOGO, PPTs, papers, art, animations, and interviews. In the RWPBL, different presentation forms are allowed.

- Writing for logical and rigorous expressers.
- Images/posters for visual learners.
- Theater/performance of outgoing and context-sensitive students.
- Videos/Vlogs/podcasts for commercial digital media.

If business plan writing is a standard requirement, it is included as part of the presentation and is not the only outcome. A differentiated outcome design means clear standards and diverse expressions.

3.4. Differentiated formative assessment in RWPBL

This assessment did not require paper-based tests. Designing varied formative assessments, such as group interviews, individual talks, graphic organizers, quick Q&A, pairing exercises, self-reflection journals, or reflection cards. The key is to adjust teaching support based on assessment results, not just to assign grades. Differentiated formative assessments involve dynamic feedback and timely adjustments to teaching.

For new educators struggling to balance knowledge teaching with social and emotional skills development, the RWPBL offers a natural social context. This article provides easy strategies to integrate communication, listening, cooperation, leadership, and empathy goals into RWPBL, helping students develop soft skills through real collaboration and learn to coexist, create, and win-win together.

4. Textbook development objectives and practical example

4.1. "Real-world business project-based social and emotional skills" for educators

Educators are often overwhelmed by knowledge delivery, classroom management and student relationships. In addition to teaching content, they are expected to help students become cooperative and good listeners with emotional control. However, this was not an additional task. The RWPBL is a natural platform for social-emotional learning (SEL) under the OECD framework (2023). Behaviors in the RWPBL, such as collaboration, listening, negotiating, leadership, self-regulation, and reflecting, are key SEL skills (Li 2025). Educators can begin by helping students learn to work together better in their current projects.

4.2. RWPBL naturally fits SEL

RWPBL is not just about grouping students to search for information and create PPTs. It is a complete process, from questioning and task collaboration to presentation and expression. This process includes four key social and emotional learning skills: self-regulation, team collaboration, social interaction, and open innovation (Li 2025). Although business plans are routinely developed with several business intelligences (Lopez-Robles et al., 2019), STEAM projects mainly focus on creativity (Herro et al., 2017). However, corresponding to the five skills in the OECD framework (Steponavicius et al., 2023; OECD, 2021), exploring authentic business scenarios to assess multiple skills, a good learning atmosphere, and a reasonable curriculum have a significant impact on students' learning input, which is attested to by the literature (Wu et al., 2022) that demonstrated the code descriptors. The business plan students made regarding their actions, the plan with whom they interacted, their dialogue options, or the time they decided to spend in certain tasks were the core elements for the assessment of each SES.

- Cooperation: Students need to discuss task divisions and options to avoid disputes and reach a consensus.
- Active Listening: Students should listen carefully to their peers' viewpoints, respect their differences, and respond appropriately.

- Compromise: Conflicts are inevitable, and it's essential to learn strategies like "I take a step back, and you move forward a bit."
- Self-regulation: Students must recognize their roles, emotions, and habits within the whole business projects to adjust themselves.

These skills do not require additional class time. Educators can help students internalize them by pointing out, encouraging, and giving feedback during projects.

4.3. Teaching strategies for RWPBL × SEL

4.3.1. Design "social observation points" in projects. When designing tasks, a social and emotional goal is set along with business project knowledge. For example, set the cooperation observation point as "pay attention to whether you can listen to others in this group work."

- Before the project, provide a collaboration observation point, such as taking turns speaking or information search, not interrupting others, and using "I suggest..., I try to… statements.
- During the project, a self-assessment and peer assessment of social and emotional skills were conducted.

4.3.2. Provide "real-time social and emotional feedback" during projects. When students are discussing, educators can approach and say, "You waited for him to finish before adding your thoughts—that was great listening." These comments offer positive social feedback, which is more effective than after-class lectures.

- Be specific in your language: "Instead of interrupting, you used eye contact to encourage him to continue."
- Consider keeping a "student social behavior observation notebook" as a record of growth.

4.3.3. Design "reflection cards/journals" after projects. After each group project, a social reflection task was included alongside reports or presentations.

- "What I'm most satisfied with in this cooperation..."
- "What new communication method I've learned?"
- "What I want to improve for next time?"

This can be enhanced through personal reflections and peer evaluations (each person writes a card for other members).

4.4. Case discussion: "Global marketing initiative for Uyghur traditional products"

- Subject goals: Learn about cross-cultural literacy, commercial design, business surveys and searches, special learning material selection, and project retrospective.
- Social and emotional goals: Creativity (Big C), such as creative and critical thinking, role assignment, cooperation, active listening, compromise, self-regulation, and consensus building.

Conclusion: One project can achieve a win-win situation for subject knowledge and social and emotional skills.

4.5. Social and emotional skills can be "assessed"

We cannot grade personalities in exams, but we can include social and emotional skills in business project evaluations with low weight and growth focus.

Example assessment criteria (cooperation dimension)

- They actively participate in team discussions.
- Respects different opinions.
- Mediating group conflicts.
- Completes assigns tasks.

Suggested weight: 5%-25% of the total score, combined with self-assessment and reflection journals to prevent students from feeling labeled.

4.6. Teaching the ability to coexist through RWPBL

Social and emotional skills are not just about language educators' "emotional attitudes and values" or moral education classes' "life principles." In every project, every cooperation, and every moment of "I'll listen to you first," we help students grow into expressive, tolerant, and empathetic learners and life participants. For new educators, as you familiarize themselves with courses and manage classrooms, starting with a small social observation point, simple feedback, or a reflection card, you have already planted a seed of social and emotional skills.

5. Summary

A good RWPBL is not about having only one path to developing a business English textbook. Instead, it focuses on the collaborative design of various learning methods that communicate with families, schools, communities, and businesses. Team grouping might be “purposeful, not random.” Task content might be “basic and clear, with layered challenges.” Final-product presentation must be “creativity-based and expressed diversely.” Process feedback ought to be “timely, adjustable, and individual-centered.”

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ARTIFICIAL INTELLIGENCE, THE ULTIMATE OPPORTUNITY OR THREAT TO THE ESSENCE AND INTEGRITY OF EDUCATION

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Abstract

Whilst the advent of the ever-growing technological era has come with multiple benefits that make everyday life comfortable and easy, hidden threats are now emerging in the education arena. Seemingly, the issue of Artificial Intelligence, has posed unlimited threats and opened doors of machine-based learning. Based on this premise, the quest of this study was to find out the extent and how students at institutions of higher learning use Artificial Intelligence to enhance their scores in given assignments, online tests and examinations. Two main research questions guided this inquiry: *a) What are the students' perceptions about Artificial Intelligence in the light of enhancing their tertiary education?*; and *b) How do students at institutions of higher learning use Artificial Intelligence during their learning?* A total of 45 Bachelor of Education final year students drawn from three different universities from three countries: Botswana, South Africa and Zimbabwe participated in this inquiry. Similar semi-structured questionnaires, oral group interviews and in-depth interviews were the data collection instruments used across the different countries. The TPACK theoretical lens was used as the main framework that guided the data collection and analysis. The collected data was analysed thematically for any emerging themes from a deductive to an inductive approach, through the technique of coding. It emerged that the digital age is posing threats and opportunities in educational settings. Opportunities in education include improved content representation and delivery to students, enhanced self-learning from AI scaffolding, immediate assessment of learning and feedback for learning efforts. The threats included academic dishonesty that involved the unethical misuse of AI to write online summative assignments, tests and examinations for inflated false scores that do not measure the academic competences of students. The need for plagiarism software that could effectively detect AI plagiarism emerged. The idea of avoiding online summative assessments and the use of sit in writing options could help in regaining the integrity of education in the context of tests and examination scores. Educators ought to be exposed to multiple training opportunities to improve their technological competences so that they can effectively monitor and manage the unethical use of AI by students.

Keywords: *Artificial Intelligence, education, technology, integrity, digital age.*

1. Intro and background

Whilst the advent of the ever-growing technological era has come with multiple benefits that make everyday life comfortable and easy, the integration of AI in various aspects of our lives has become unavoidable (Chen, Xie, Zou, & Hwang, 2020). Artificial Intelligence, as viewed in this inquiry, entails the applications of machine learning, algorithm productions, and aspects of language processing (Borenstein & Howard, 2023; Akgun & Greenhow, 2022). Seemingly, whilst the use of AI is a welcome development in this modern technological 4IR era, it has also ushered in hidden threats and opportunities that are now emerging in the education arena. The issue of AI has posed unlimited threats and opened doors of machine-based learning (Akgun & Greenhow, 2022). This is because AI encompasses the development of devices that have levels of intelligence, cognitive abilities, ability to learn, and ability to make decisions, like and even better than that of humans (Chen, Chen & Lin, 2020). Thus, one can argue that if AI can lead to all the conveniences in general life, then AI has the potential to also be used or misused in achieving good quality education or even unethical educational achievements respectively.

Whilst the use of Artificial Intelligence in Education [AIEd] (Ouyang & Jiao, 2021), is closely related to computer science, this development is now widespread and fully integrated in the field of education (Talan, 2021). In the education sector, AI is being used to facilitate decision making, teaching and learning (Ouyang & Jiao, 2021). AI has multiple roles in education. These include technological developments in areas such as cloud computing, mobile internet and delivering of learning content that suits the unique learning needs of individual students and assisted student learning by humanoid robots (Kabudi, Pappas, & Olsen, 2021).

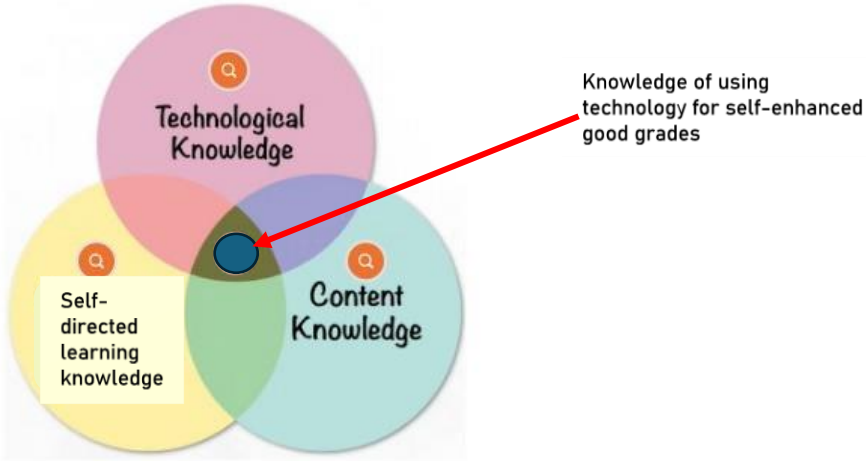
The potential impact of AI on improving or discrediting the quality of education has not yet received special attention from education practitioners and education policy makers (Kabudi, Pappas, & Olsen, 2021). Thus, the purpose of this study was to investigate the opportunities and threats of AI to the integrity of education delivery. Two research questions guided this inquiry:

a) What are the students' perceptions about Artificial Intelligence in the light of enhancing their tertiary education?
b) How do students at institutions of higher learning use Artificial Intelligence during their learning?

2. Reviewed bodies of literature and the theoretical framework

The theoretical framework used in this study was a modified version of Technological Pedagogical Content Knowledge (TPACK) as propounded by Mishra and Koehler (2006). This framework emphasises that a teacher ought to have sound content or subject matter knowledge, pedagogical or knowledge of the best teaching strategies and technological knowledge for enhancing classroom teaching with technology. Whist the TPACK theoretical framework is mainly used to illustrate knowledge bases which a teacher ought to have to teach effectively with technology, in this inquiry, this theory was taken and adapted from the perspective of the students. In other words, the knowledge bases which students ought to have for their effective learning using technology, with particular reference to AI. As adapted from TPACK, three knowledge bases are highlighted. Firstly, knowledge about technology (TK) is crucial for enhanced student learning (Harris, Koehler & Mishra, 2008). Secondly, knowledge about subject content knowledge (CK), or the subject matter for learning, is important for the students to weave with technological use for their enhanced learning. Students' knowledge about technological use and how they can use technology to enhance their attaining of good grades results in knowledge about their self-directed learning (See Figure 1 for this depiction).

Figure 1. A modified version of the TPACK model (Mishra & Koehler, 2006), as used in this inquiry.



3. Literature on studies in use of AI in education

AI has been hailed for its novelty in delivering teaching and learning materials. Different studies have unveiled that AI provides new ways of content presentation and representations that make it easier for teachers to impart the content to their students. The use of AI in educational settings has also been found to empower teachers to teach in more effective ways that make it easier for students to grasp the content, increase student's content retention and understanding, and, also enhancing students' competence levels in the modern digital world (e.g. Kong, Man-Yin Cheung, & Zhang. 2021; Timms, 2016).

The application of AI in education has also been found to opening opportunities for improving the quality of self-directed or personal learning (Akgun & Greenhow, 2022). This is because AI has features such as intelligent tutoring that can provide support, scaffolding and give constructive feedback during personal learning by individual students (Ouyang & Jiao, 2021, Chen at. el, 2020).

AI has also been used to monitor students' emotional and psychological well-being during teaching and learning to maximize those process that enhance student learning. For instance, AI has facial recognition features that has been used by teachers to analyze student attitudes and behavior through analysis of student facial expression during teaching and learning. This has been found to makes it easier for teachers to prevent actions and processes that place student under unnecessary stress during teaching and learning goals (Chen et al., 2020).

The use of AI has also been integrated with widely used learning models. These learning models include problem-based learning, collaborative learning, blended learning, project-based learning, learning robots and even mobile learning. Robots has been found to act as teacher helping agents in routine activities such as learning to pronounce and spell words, and other learning activities that needs demonstrations (Chen et al., 2020). Such integration has been found to enhance student learning outcomes, academic performance, learning motivation, achievement, creativity and problem-solving skills (Chen, Xie, & Hwang, 2020).

4. Methodology

The study involved a sample of 45 students who were drawn from three different universities from three southern African countries: Botswana, South Africa and Zimbabwe. The sample was conveniently selected because the three institutions offered the same four-year Bachelor of Education program. A total of 15 students were drawn from each country to make the sample manageable within a limited time allocated to this study, and in the context of the large Geographical area needed to be travelled by limited field workers. Data was collected using three research instruments: questionnaires, group and in-depth interviews. The same individual questionnaires, oral group interviews were used with all the 45 students. In-depth interviews were carried out involving three of the 15 students from each country. The rationale for this was to have enough time for a one-to-one recorded oral in-depth interview with each of the respondents. Data was analysed thematically from a deductive to an inductive approach through the process of codding. The initial coding system was formulated based on the ideas in the literature (deductive approach). This coding system was modified and updated as new codes emerged from the data (the inductive approach). The modified version of TPACK, as shown in Figure 1 was the theoretical lens that guided the data collection and analysis in this inquiry. Table1 below shows samples of coded responses.

5. Results and discussions

Three main themes that emerged are shown in the Table 1 and these are discussed below.

Table 1. Themes that emerged from the data analysed. Key: e.g., S3B: Student 3 from Botswana, S14 Z: Student 14 from Zimbabwe; S7SA: Student 7 from South Africa.

Research Question	**Emerging theme**	**Supporting statements** from **respondents**
What are the students' perceptions about Artificial Intelligence in the light of enhancing their tertiary education?	Artificial Intelligence perceived as a powerful platform in education	**S7SA**: *AI is one of the best things to have ever happened towards uplifting students' learning.* [**high recognition**]
		S2B: *I think AI is essential for every student learning as it makes learning convenient even the comfort of one's home* [**high recognition**]
		S5Z: *How I wish I had been exposed to the use of AI since my early schooling years, that could have made my schooling less of a hustle in terms of the way content is being delivered to students* [**high recognition**]
How do students at institutions of higher learning use Artificial Intelligence during their learning?	Use of Artificial Intelligence to enhance students' performance/grades	**S4B:** *Since I started using AI, my personal learning has become so convenient. I no longer struggle to learn difficult content alone.* [**Important role of AI**]
		S8B: *I use AI to write my online tests and assignments* [**Important role of AI**]
		S7SA: *I use the intelligent tutoring component of AI to learn difficult concepts I struggle with* [**Important role of AI**]
		S13B: *AI is a tool which is useful for my learning, I like its multi-disciplinary nature as I find it useful for all my modules* [**Important role of AI**]
		S4Z: *I use AI to Scaffold my learning using the performance mapping feature of AI, that also evaluate my learning to give me immediate feedback* [**Important role of AI**]
	Unethical use of Artificial Intelligence to enhance grades	**S10B:** *If writing online exams or doing my assignments, AI is my close companion, I do not see the reason why I should struggle to think out answers when AI could do an equally great job for me at no cost* [**Academic dishonesty/unethical use of AI**]
		S11Z: *I use AI to write my online tests and assignments, my grades have since been good* [**Academic dishonesty/unethical use of AI**]
		S5SA: *I know that cheating in exams and tests is morally not fine but who does not want good grades at the end of the day?* [**Academic dishonesty/unethical use of AI**]

5.1. Artificial intelligence perceived as a powerful platform in education

The respondents from the three countries perceive the use of AI in education as welcome development which offers convenience in student learning. For instance, the response by **S5Z:** *How I wish I had been exposed to the use of AI since my schooling years, that could have made my schooling less of a hustle in terms of the way content is being delivered to students* denotes and underscores the idea that university students perceive the use of AI as playing a crucial role in their learning. The convenience in student accessing content for learning using AI is evident. This corroborates the postulations by Chen et al. (2020) who also unveiled that the use of AI in education has unlimited potential to improve the delivery of learning materials and content for learning to students.

5.2. Use of artificial intelligence to enhance students' performance/grades

Most of the respondents acknowledge the use of AI to enhance their learning and performance in education. For instance, when writing their tests and assignments, personal learning through AI tutoring, and scaffolding when learning difficult concepts through performance mapping features from the use of AI. For example, the following responses are indicative of this: **S4B:** *Since I started using AI, my personal learning has become so convenient. I no longer struggle to learn difficult content alone;* **S7SA:** *I use the intelligent tutoring component of AI to learn difficult concepts I struggle with;* **S4Z:** *I use AI to Scaffold my learning using the performance mapping feature of AI, that also evaluate my learning to give me immediate feedback.* These insights corroborate what has been found elsewhere, especially that the use of AI in education has offered unlimited opportunities to change and improve educational delivery in many countries and disciplines (e.g. Kong, Man-Yin Cheung, & Zhang. 2021; Timms, 2016).

5.3. Unethical use of artificial intelligence to enhance grades

Whilst the students predominantly use AI to increase comfort in and enhance their learning, the issue of academic dishonesty also emerged. For instance, the following comments by some of the respondents are indicative of the unethical use of AI by students to improve their scores: **S10B:** *If writing online exams or doing my assignments, AI is my close companion, I do not see the reason why I should struggle to think out answers when AI could do an equally great job for me at no cost;* **S5SA:** *I know that cheating in exams and tests is morally not fine but who does not want good grades at the end of the day?*

As evident in the above students, the use of AI in education has also ushered in threats of machine learning (Akgun & Greenhow, 2022), brazen plagiarism which led to falsified scores and student performance. Seemingly, this is the ultimate threat to the essence and integrity of education. This is because the graduates from different programs will, be mere shadows of what they were supposed to be in terms of graduate attributes. This has the potential to perpetuate cycles of mediocracy when such graduates go to places of work or even their become educators of the future crop of students.

6. Conclusions and recommendations

The emerging conclusions from this study include opportunities and threats in the use of AI in education. AI opportunities in education include improved content representation and delivery to students, enhanced individual learning from scaffolding, immediate assessment of learning and feedback for learning efforts, and convenience during learning in the comfort of homes. The threats entail the unethical misuse of AI during summative assessments such as assignments, online tests and examinations to get inflated false scores that do not measure the academic competences of students. There is a need for a rethink on the use of AI in education in terms of control mechanisms and type of assessments that could avoid AI plagiarism and unethical practices. There is also a need to come up with more plagiarism software that can effectively detect AI use in the writing of tests, exams and assignments. The option of sit in examinations and tests writing as opposed to online writing could help in regaining the integrity of education in the context of tests and examination scores. Educators ought to be exposed to multiple training opportunities to improve their technological competences so that they can effectively monitor the trends and use of AI by their students.

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UNIVERSITY PROPAEDEUTIC PHYSICS: ENGINEERING DEGREES EXPERIENCE

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Abstract

In this study we describe and analyze the experience that has been carried out for more than a decade. It has been found that after the specific training, the percentage of students with a low initial level who pass the compulsory subject is like that of students with an adequate initial level. Furthermore, the student perception surveys show their high degree of satisfaction with the training received, as well as with the involvement of teachers and mentors and the learning material provided to them. They especially value face-to-face interaction. Regarding the evolution over this decade, it has been noted that: (a) the percentage of students who need this support is increasing, (b) they are increasingly demanding in the audiovisual quality of the learning material provided to them, (c) reading and writing problems are increasing and, (d) the capacity and time of effective concentration is reduced. Consequently, the design of the subjects and the support material must be periodically reviewed considering the own experience of professors and mentors, as well as the comments of the students.

Keywords: *First-year university students, higher education, physics, propaedeutic.*

1. Introduction

One of the main problems detected in the learning process of first-year university students of engineering degrees is the inhomogeneity of prior knowledge of mathematics and physics. This fact entails the need to generate and design complementary activities and learning material to achieve a higher level of performance for the group of students after the first academic year. One of the strategies is the design and implementation of propaedeutic Physics courses for those students with a low initial level in the subjects considered basic in engineering. For engineering studies, it is advisable to have some previous knowledge of Physics and Mathematics. Without this knowledge, first-year university students will easily fail first-year compulsory subjects (Burkholder, 2023) (Tsui & Khan, 2023), which leads to a significant dropout rate (around 30% in our engineering grades). It is shocking because when choosing an engineering degree, secondary school students applying for said degrees are expected to be those with high Physics and Mathematics performance (Tan et al., 2021). Unfortunately, one of the characteristics of the Spanish university system is that a significant number of first year students in engineering degrees have not taken Physics subjects the year (or two years) before reaching university. Thus, it is highly recommended and advisable to design physics courses of a propaedeutic nature. Therefore, these courses should be designed for students who have already enrolled in the university. It is different to those courses designed for pre-university level; such courses are prepared to detect those who can be good engineering students or to make a pre-selection of the most apt and prepared. For example, to discriminate between eligible and ineligible students during the propaedeutic phase of medicine and biomedical science study programmes (Etjsvogels et al., 2013). At present, problems are not only detected in first-year subjects; the problem is spreading to higher grades (Suárez et al., 2024). With respect to these courses success, one of the most important aspects linked to the success of the propaedeutic courses is the engagement of the students. This includes their willingness to work collaboratively in different scenarios, their ability to interact with their peers and teachers in a positive spirit, self-reflection on their learning process, development of a critical spirit and the capacity for analysis and synthesis (Ontiveros et al., 2019). In other words, both soft and hard skills. Evidently, the engagement of the academic staff is also necessary. MOOC courses have been introduced in recent decades (Estela-Carbonell et al., 2016). These courses should be considered complementary. The need for face-to-face interaction (teacher-student) has been noted to improve both engagement and performance.

In our study, propadeutic Physics courses have been implemented. The current courses are the evolution of those carried out over almost two decades. The students who act as mentors have been trained in previous sessions with the support of the academic staff. More broadly, propaedeutic courses should be extended to all subjects related to each specific STEAM domain to achieve this homogenization.

2. Objectives

The objectives of this study are to improve the Physics knowledge of first year students and to achieve an improvement in their academic performance. Consequently, drop-out rate is expected to be reduced and the previous cognitive deficiencies in Physics corrected.

It is expected that the propaedeutic courses help the homogenization of the Physics knowledge and the academic performance.

3. Methodology

The methodology used in this study consists of:

a) Design of two Physics courses intended for first-year undergraduate students of engineering degrees.
b) Generation of teaching material: Including summaries of theory, solved problems, videos and self-evaluation questions and problems.
c) Interaction of faculty and student mentors with students in the classroom and virtually.
d) Activity evaluation surveys with subsequent statistical analysis.
e) Monitoring of students' academic performance in compulsory Physics subjects.

The material is appropriate to the courses generated. One with content mainly on mechanics (kinematics, Newton's laws, work and energy) and the other on electromagnetism and circuits (electric and magnetic fields, direct current circuits). This division is justified by the existence of two compulsory Physics courses (one in each semester of the first academic year).

It should be noted that a decade ago, the number of students participating was in the order of 30 to 40. Over the last few years, the growth has continued up to 250-300 in the last two years. This fact is related to the growing interest of students in the complementary training offered by the university and to an increasingly lower level of Physics at university entrance (at least on average). This low level is also detected in mathematics and in aspects related to reading and writing.

4. Results and discussion

In this section we show some examples of the material generated for learning and analyze the academic success. The continuous interaction between the learners and the academic staff favors the improvement of the design of the subjects and the supporting materials are periodically reviewed to transform them into attractive resources for the students.

Figure 1 shows a problem that students encounter on the on-line platform. These problems are used to self-evaluate their learning. There are problems in which the specific data values are randomly varied and, therefore, each problem has multiple variables. On the other hand, students are provided with the theoretical foundations and solved problems (in pdf and video format). This material is also worked in face-to-face classes. One of the difficulties of this online learning is that the platform evaluates the result, not the resolution procedure. Consequently, face-to-face tests and exams continue to be necessary.

Figure 2 shows an image of a video in which a problem is solved. The interaction with the students has allowed us to improve the teaching material generated. It has been noted, especially after the pandemic, that students are becoming more visual and have more problems with reading and writing. As a result, they are more demanding in terms of the quality of the audiovisual material. Likewise, the statements of the problems and questions, as well as the theory, must be explained in detail.

There is a certain contradiction: on the one hand, there is a desire to have access to all teaching materials on the university's online platform, and on the other, face-to-face sessions with direct interaction with teachers and mentors are highly valued.

With respect to the students acting as mentors, these have been trained in previous sessions with the support of the academic staff. Obviously, there are students of the two last academic years (correct mathematics and physics knowledge). Their activity has been recognized academically through a scholarship (or sometimes as an internship for academic credits). The positive influence of mentors in the learning performance is analyzed in previous students (Daza et al., 2020) (Daza et al., 2023).

Figure 1. Example of problem (Energy section) designed for self-learning and self-assessment.

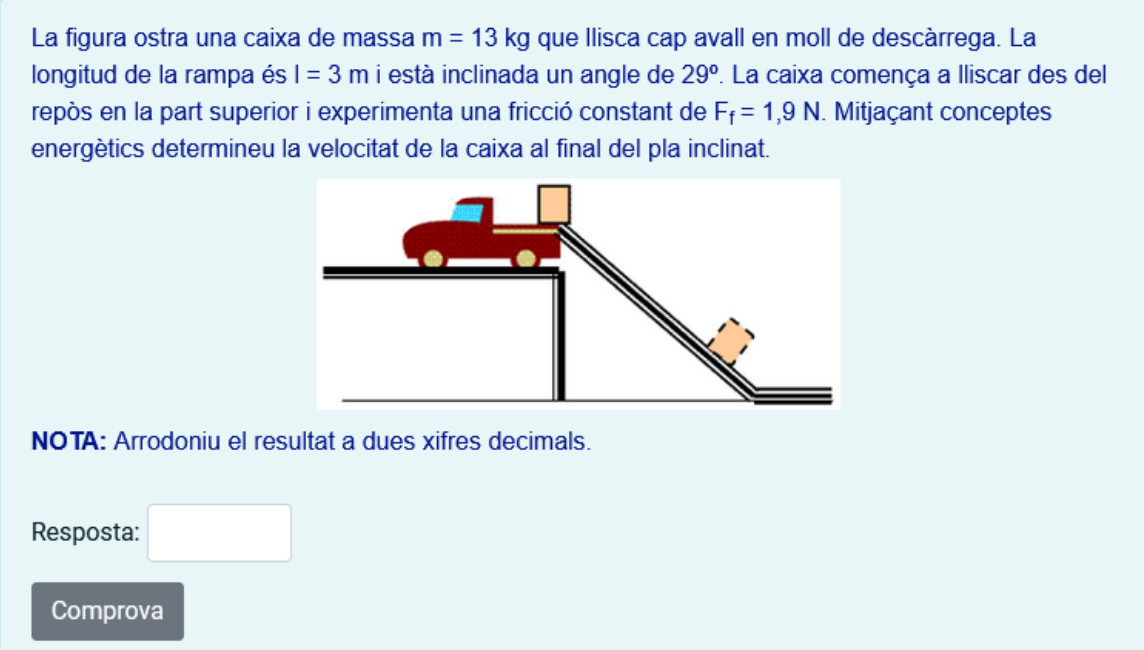
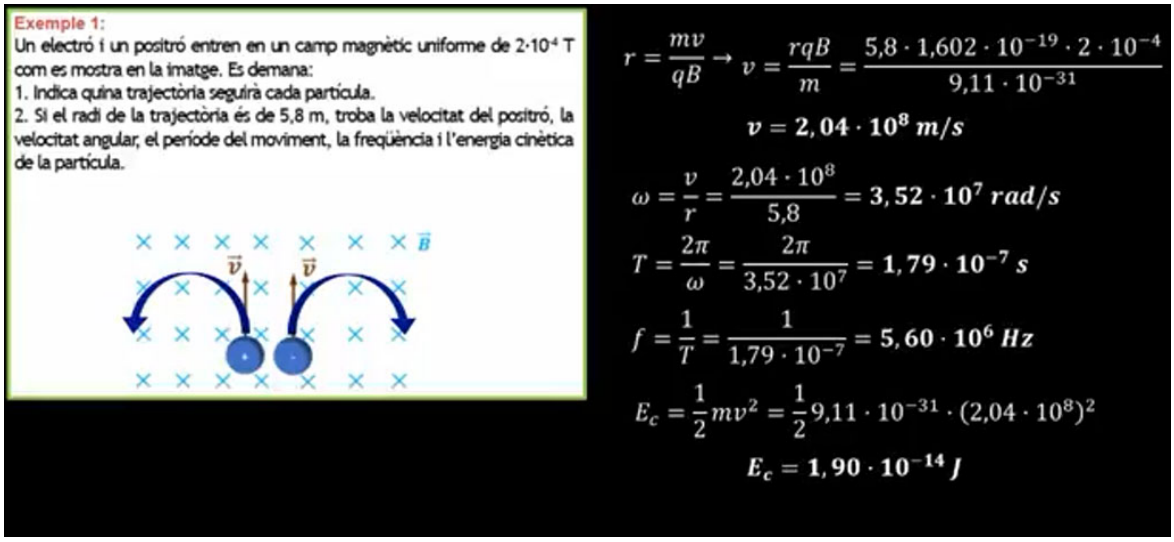


Figure 2. Image of a video (Energy section). Resolution of a problem.



In addition, students are provided with links to external videos made by professors specialising in teaching Physics in an online environment. Those considered most appropriate are selected.

One of the secondary objectives is to make the courses more affordable and structured. Thus, the knowledge pills follow a structured format of timed teaching-learning sequences. Each sequence is made up of resources and different activities (questions, problems). The resources include both theoretical and experimental contents. There are designed to favor the diversification of learning depending on the specific characteristics of each student.

In the last year, two Physics courses have been designed in the OpenUdG platform. The main goal is to favor the access to this learning material to high-school students and professors. It has been detected that these courses have been well received by the pre-university educational community, as shown by the annual registrations for the courses (74 registered during the 2023-24 academic year). 73% of these registrations correspond to students intending to study a degree in engineering and the rest correspond to teaching staff at high school and further education level.

One of the problems detected in the learning of Physics in the pre-university field is that most teachers have not studied Physics. Consequently, their access to teaching material is facilitated to help them in their subjects and allow them to determine what level their students must have when they access engineering degrees.

Another aspect to be analyzed is that of formal evaluation. The following figures show the statistical analysis of the grades obtained in 2023 and 2023 in the evaluation of various topics. Specifically in the Physics course of the first semester.

Figure 3. Marks (mean value and statistical deviation) of the 2023 assessment of several topics. A: Kinematics (one dimension), B: Kinematics (two dimensions), C: Kinematics (general), D: First law of Newton, E: Second law of Newton, F: Dynamics (circular motion), G: Work and Energy, H: Law of Conservation of the Energy, I: Energy variation.

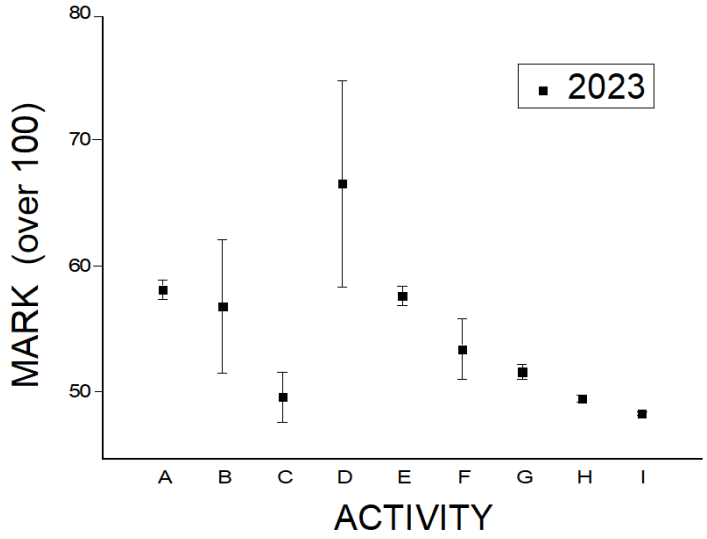
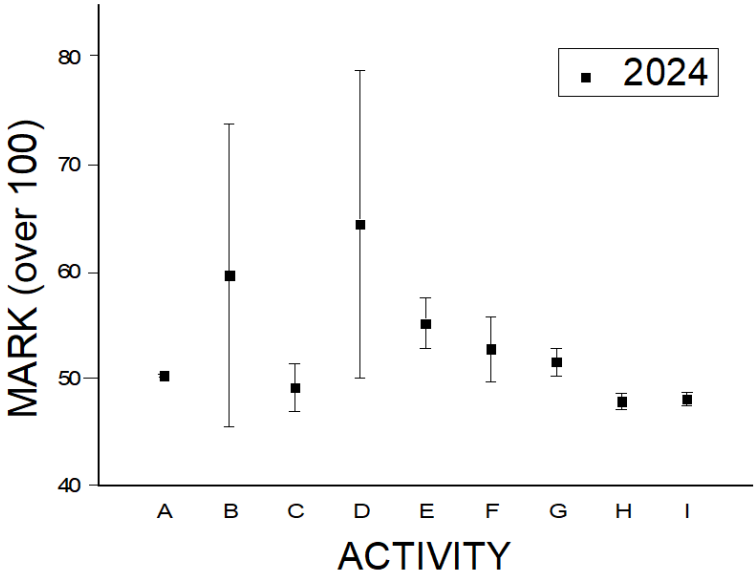


Figure 4. Marks (mean value and statistical deviation) of the 2024 assessment of several topics. A: Kinematics (one dimension), B: Kinematics (two dimensions), C: Kinematics (general), D: First law of Newton, E: Second law of Newton, F: Dynamics (circular motion), G: Work and Energy, H: Law of Conservation of the Energy, I: Energy variation.



Several trends are detected. In both cases, the grades are mostly positive, the best average grade is related to the application of Newton's first law and the worst results are obtained in the topics of conservation of energy or in problems of variation of energy (the last of the first preparatory course). The segmented evaluation causes more work for the teaching staff, but makes it easier to detect in which concepts or applications the students have greater cognitive problems. A detailed analysis allows in subsequent courses to focus more on the concepts that the students show more difficulty.

The majority of students (over 90%) pass these courses. As already pointed out, student engagement is essential to achieve these results. These courses encourage students with a lower initial level to drop out of university studies at a lower rate. Historical data show high dropout rates and a high

percentage of students who complete their studies in 2, 3 or more additional years. In other words, an engineering degree structured in four academic years was completed after 6 years or more.

For these courses to be useful, another of the procedural objectives is that their final level resembles that of the rest of the students. The detailed analysis of the grades of the compulsory Physics subjects shows that this is the case. It has been detected that the percentage of students who end up passing the subject that same academic year is around 50-70% higher than before and the percentage of success is similar to that of the students with an initial correct knowledge of Physics.

5. Conclusions

This study has shown that well-designed and correctly implemented propaedeutic courses in Physics is a clear option to improve the academic performance of first-year undergraduate students of engineering degrees with a low initial level of Physics. On the other hand, an adequate segmentation of the contents, their evaluation and the interaction with the students allow for a continuous improvement of the teaching material generated. The results show that the majority (>90 %) of the students involved pass the basic subject and that the percentage of students passing the compulsory Physics subjects is like the percentage of students with an acceptable initial level of Physics. Moreover, it has been found that the number of students following these courses is increasing (from 30-40 to the current 250-300), being an indicator of the decreasing average level of physics-mathematical knowledge with which new students enter university, even in engineering studies. In addition, online courses have been created for pre-university students and teachers.

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PERCEIVED MEDIA LITERACY OF FIRST YEAR UNDERGRADUATE STUDENTS AT A UNIVERSITY IN LATVIA

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Abstract

In the present digital age where disinformation and manipulation are increasingly bigger problems worldwide, media literacy is widely considered a critical skill for citizens of well-functioning democracies. Following a series of reforms that were gradually introduced beginning with the 2020/2021 school year, media literacy skills are now included in the Latvian secondary education curriculum standards in the fields of language, civics and social studies, technology, and culture. The aim of this research is to determine the perceived media literacy skills of first year undergraduate students in Latvia who studied in secondary school following the implementation of these updated curriculum standards which explicitly include media literacy. 163 first year undergraduate students at a university in Latvia who had graduated from secondary school following the full implementation of the new curriculum standards participated in a survey that asked questions regarding media literacy. Students were asked to rate their abilities regarding four key media literacy skills mentioned in the Latvian secondary education curriculum standards. On average, students rated their ability to discern fake from real news most highly, followed by their ability to recognize whether a media content author is trying to manipulate them, and then their ability to find quality information sources for research. Overall, they rated their ability to recognize logical fallacies as the lowest of the four indicators. However, when asked to give specific examples of the different indicators, although nearly three fourths of students named a correct method to discern fake news, less than half were able to correctly identify a way to recognize manipulation, find quality sources, or recognize logical fallacies. Furthermore, certain students who rated themselves as "very confident" about some of the media literacy indicators either named incorrect methods or were unable to answer. The results show that despite the focus on media literacy in the new Latvian secondary school curriculum and a general level of confidence among the students, university educators should continue developing student media literacy.

Keywords: *Media literacy, secondary education, perception, education reform, higher education.*

1. Introduction

Despite having become a widely-used term since apparently being coined by Louis Forsdale in 1955 (Silverblatt, 2014, as cited in Carlsson, 2019), "media literacy" remains a difficult concept to accurately and definitively define. A study by Potter (2022) that analyzed 258 definitions of media literacy in 134 articles published in the *Journal of Media Literacy Education* found that while there is no single common understanding for exactly what media literacy entails, definitions most often consist of a mixture of skills that include "the ability to read, evaluate, analyze, imagine possibilities, deconstruct messages, recognize patterns, challenge meanings, judge credibility, decipher sender intent, counter-argue, dig for truth, avoid influence, and produce messages" (p. 41).

While Park, Kim and Park (2020) point out increased interest in media literacy and the related topics of information literacy and digital literacy since the beginning of the 21st century, according to Hobbs and Jensen (2009), the modern tradition of media literacy education in the United States of America began with the efforts of groups such as the short-lived Society for Visual Education founded in 1919, which sought to help educators teach students how to analyze the then-new medium of motion pictures. In response to a perceived increase in the use of by then widely-adopted radio to spread propaganda messages, the 1937-founded Institute for Propaganda Analysis brought journalists together with secondary and post-secondary level educators to develop material to help students detect, analyze, and resist such propaganda (Hobbs & McGee, 2014). As new forms of media have developed, media literacy education efforts have adapted to the changing technological and social landscape (Carlsson, 2019).

2. Media literacy in Latvia

In the Republic of Latvia, there has also been increased interest in the field of media literacy throughout the past decade. A "Media Literacy Database" established in 2023 by The National Electronic Mass Media Council, the state media regulator (Ministry of Culture, 2023), contains more than 220 research studies, books, articles, lectures, educational materials, and other works related to media literacy published in the Latvian language and/or related to Latvia. However, in The Media Index 2023, a report by the Open Society Institute – Sofia which rates European countries' level of media literacy on a scale from 0-100 based on weighted aggregate data from relevant reports by various non-government organizations and the United Nations, Latvia scored 55/100 which was 15th out of 27 European Union countries (Lessenski, 2023). Although this was a slight improvement from a score of 54/100 in 2022 (Lessenski, 2022) and 53/100 in 2021 (Lessenski, 2021), there is clearly work to be done.

In 2018, the Latvian government approved new primary and secondary education curriculum standards as part of a sweeping reform known as "Skola2030" (Klūga & Krieviņš, 2018). Instead of curriculum standards for specific subjects, the system was reorganized into seven "fields," including language (Latvian and foreign); social and civics; cultural understanding and self-expression in the arts (culture); science; mathematics; technology; and health and physical activity. In each field, there is a series of "learning outcomes" at different levels of complexity. For the level of secondary education (grades 10-12), the three levels are named "general," "optimal," and "highest." For students to graduate from most secondary education programs, they must at a minimum complete courses that satisfy all of the learning outcomes at the "optimal" level and also take three courses at the "highest" level. The standards gradually came into effect beginning in September 2020, with the graduating class of 2023 being the first to experience all three years of the new standards at the secondary level.

One of the goals of the Skola2030 reform was to integrate media literacy concepts into the obligatory curriculum standards. Because of its interdisciplinary nature, learning outcomes related to media literacy were divided among the fields of language, social and civics, technology, and culture.

Table 1. Reformed Latvian education standards related to media literacy.

Field	**Standard**
Social and civics	S.O.1.3. Discusses and leads a discussion about justice, the rule of law, and contemporary ethical issues.
	S.O.2.3. Analyzes the media as an instrument of power to assess the influence of individuals and society.
	S.O.6.1. Compares a variety of information sources according to certain criteria, determines their reliability. Summarizes this information and draws conclusions. Uses information obtained from reliable sources for their own learning goals.
	•S.O.6.2. Distinguishes forms of scientific knowledge from scientific alternatives, critically evaluates sources, interprets facts, and generalizes theoretical foundations to obtain true information and create new knowledge.
	•S.O.6.3. Uses criteria and methods for checking falsified information, analyzes media content and distinguishes facts, recognizes manipulation and the most common logical fallacies.
	•S.O.6.4. Analyzes the communication of opinion leaders in virtual (digital) space and time to assess the impact of the chosen communication culture on social processes and individual habits.
	•S.O.6.5. Collaborates, acquiring skills to objectively analyze information in communication, forms deductive and inductive judgments, practically explores the importance of perception and evaluation skills in information processing.
Language	VL.O.2.2. Analyzes symbols, images, and verbal means of expression used to reflect events or opinions in various media. Chooses the most appropriate verbal and non-verbal means to create and enrich their texts, justifying this choice with rational and emotional arguments.
	VL.O.2.3. Analyzes language devices (words and their forms, metaphors, comparisons, grammatical constructions, punctuation) in media texts to identify the methods of influence and manipulation tools used in the text. Recognizes misleading perceptions and opinions in the text to determine the authenticity and reliability of information.
	VL.O.2.4. Responsibly, observing ethical norms, engages in communication situations, especially in social media, skillfully using language tools: words, phraseologisms, symbols, punctuation marks. Treats the views and beliefs of the communication partner favorably. Regulates his/her linguistic behavior in order to implement communication goals or change the course of communication if cultural norms of communication are violated.
	VL.O.3.3. Creates scientific style texts of certain genres, for example, oral reports, reports, summaries, reviews, observing the conditions for text creation and the choice of language means.
	•VL.O.3.3. Respects copyright and intellectual property rights by accurately citing authors and carefully citing sources.

Technology	T.A.2.2.4. Develops audio files (e.g. jingles, animation or video soundtracks, podcasts, etc.), digital graphic design solutions and videos (e.g. user manuals, advertisements, etc.) necessary for a design solution in an appropriate format and connects them, taking into account the planned communication strategy.
Culture	K.O.3.5. Studies the structure of the cultural field and creative organizations. Gets acquainted with specific professions in this field (exhibition curator, agent of a musical performer or writer, translator, cultural project manager, sound and lighting operator, video operator, director, producer, etc.), studying those working in the profession in person. Plans and organizes the course of their own creative project, cooperates in team building in accordance with the specifics of the chosen and familiarized art form.
	K.O.3.7. Evaluates the implementation of the goals of the creative project and the implementation process, including the impact of the chosen artistic means on the viewer or receiver of the creative work, the work process and the contribution of oneself or each group member to achieving the goal. Analyzes or models how this product will be perceived by others (for example, another generation, community, members of the regional culture).

(Cabinet of Ministers Regulation No. 416 of 3 September 2019 "Regulations on State General Secondary Education Standards and Sample General Secondary Education Programs")

3. Research design

This aim of this study was to determine the perceived media literacy skills of first year undergraduate students in Latvia who completed secondary school following the implementation of the updated curriculum standards. Since these students were able to achieve sufficient marks in all subjects in order to get accepted into university, they should theoretically have achieved each of the required learning outcomes of the curriculum standards.

The sample for this survey was 163 first year undergraduate students at Latvia University of Life Sciences and Technologies who had graduated from secondary school following the full implementation of the new curriculum standards: either in the year 2023 or 2024. An online questionnaire was designed that asked students to rate their abilities from “very confident” to “not at all confident” regarding four key media literacy skills outlined in the secondary education optimal-level curriculum standards: distinguishing fake from real news, recognizing manipulation techniques, identifying logical fallacies, and evaluating the quality of information sources. Students were then asked to write a concrete example of each skill in order to compare their overall perceived level of media literacy with their actual media literacy abilities. The student responses for each of the open-ended questions were evaluated as “correct,” “partially correct” or “incorrect/empty” based on the accuracy of the responses.

The survey was conducted in October of 2024, with a small portion of class time being devoted by lecturers for students answering the questions in person. Questions and answers were written in the Latvian language, as that is both the sole state language of Latvia and the language of instruction that all classes are conducted in aside from “Professional English.”

4. Results

The results from the questions asking students to rate their confidence in four different media literacy skills are displayed in Table 2. Students were given a scale from 1 (not at all confident) to 5 (very confident) with which they could rate their confidence for each of the mentioned media literacy skills.

Table 2. Percentage of students surveyed who reported feeling various levels of confidence regarding specific media literacy skills (n=163).

On a scale from 1 (not at all confident) to 5 (very confident), how confident are you that you	5 (Very confident)	4	3	2	1 (Not at all confident)	No answer
can distinguish real news from fake news?	22.7%	50.9%	25.2%	1.2%	0%	0%
can recognize if a media content author is trying to manipulate you?	19.7%	41.7%	31.9%	5.5%	1.2%	0%
can recognize logical fallacies when they are used in media content?	13.5%	31.9%	39.3%	10.4%	3.1%	1.8%
can find quality information to use in your academic assignments, such as research essays, term papers, presentations, undergraduate thesis, etc.?	14.1%	41.7%	33.8%	8.6%	1.2%	0.6%

According to the results, students were most confident about their skills distinguishing fake news from real news, with 73.6% of students rating their abilities with "4" or "5." The skills students were next most confident about was recognizing whether an author of media content was trying to manipulate them, with 61.4% choosing "4" or "5." Next, 55.8% of students rated their confidence in being able to find quality sources of information as "4" or "5," which is concerning given how important this skill is in their university studies. Finally, only 45.4% of students rated their confidence in recognizing logical fallacies when used in media content.

For each of the four skills, there was a follow-up question asking students to give a specific example. Answers were marked as "correct" if they were determined to be fully accurate, "partially correct" if they were overly vague or incomplete, and "incorrect or empty" if they were inaccurate or if no answer was given. The results for these questions can be seen in Table 3.

Table 3. Percentage of students surveyed who wrote correct, partially correct, incorrect, or no responses to questions about specific media literacy skills (n=163).

	Correct	Partially correct	Incorrect or empty
What is one way to check whether news is "real" or "fake?"	69.3%	20.9%	9.8%
What sign could you use to recognize that a content creator is trying to manipulate you?	55.8%	11.1%	33.1%
What is one example of a logical fallacy that you can commonly find in media content?	10.4%	12.3%	77.3%
What is one example of a criterion you can use to determine whether an information source is of sufficient quality to use in your academic assignments?	51.5%	20.9%	27.6%

For the question "what is one way to check whether news is 'real' or 'fake?'" answers such as "compare the information with other sources" and "search for information about the publication" were marked as correct, answers such as "think logically" and "Google it" were marked as partially correct, and answers such as "I don't know, I just feel it" and blank responses were marked as incorrect. In this case, the number of students who provided a correct answer was slightly lower than the amount who rated their confidence in distinguishing fake news as "4" or "5." Nearly one third of the students who rated themselves as "5" for this skill provided an answer that was partially correct, incorrect, or empty, showing that some students are overly confident about their abilities.

For the question "what sign could you use to recognize that a content creator is trying to manipulate you?" answers such as "overly emotional language" and "trying to sell something" were marked as correct, answers such as "check the text again" or "know manipulation strategies" were marked as partially correct, and answers like "blocking" "I don't understand the question" were marked as incorrect. While the 55.8% of students who provided a correct answer is only slightly lower than the amount who gave themselves a "4" or "5," nearly a third of students who rated themselves as "5" had incorrect answers or no answers, showing a degree of disconnect between their perceived and demonstrated abilities.

For the question "what is one example of a logical fallacy that you can commonly find in media content?" answers such as "slippery slope" or "ad hominem" were marked as correct, answers such as "conflicting facts" or "exaggerated information" were marked as partially correct, and answers such as "grammatical mistakes" and "hate against others" were marked as incorrect. Only 10.4% of students were able to name a specific logical fallacy, with 12.3% being able to partially correctly describe one. Many students who answered incorrectly seemed to confuse spelling and grammar mistakes with logical fallacies. Of the 22 students who rated themselves with "5," only three of them were able to name an actual fallacy. Although this was the category in which students were the least confident with their self-assessments, even this evaluation seems to have been significantly overly confident.

For the question "what is one example of a criterion you can use to determine whether an information source is of sufficient quality to use in your academic assignments?" answers such as "reputation of the author" and "peer reviewed" were marked as correct, answers such as "author" and "popularity" were marked as partially correct and answers such as "ask the professor" and "ask AI" were marked as incorrect. Just more than half of students were able to correctly name a criterion that could be used, with just over a fifth not being able to partially correctly identify a criteria and more than a fourth naming an incorrect criterion or leaving the answer blank. Only 14 out of 23 students who rated themselves with "5" in confidence for this skill were able to correctly name a criterion.

5. Discussion

Though it is commendable that media literacy curriculum standards have been implemented at the secondary education level in Latvia, the results of this very limited study suggest that there is still much work to be done. Although students might have been reluctant to write out answers for each of the questions asking for specific examples at the time of the survey, it is concerning that the overall confidence level of students in being able to distinguish fake from real news, recognize manipulation, identify logical fallacies, and evaluate sources is consistently higher than their demonstrated ability to do so. This suggests the presence of the Dunning-Kreuger effect (Kruger & Dunning 1999), which would be consistent with findings by Lyons et al. (2021) that three in four Americans overrate their abilities to identify false news.

In conclusion, additional research needs to be conducted to more effectively evaluate the results of the implementation of media standards in Latvia's secondary level education. Despite the implementation of the standards, it appears that many students still lack both media literacy skills and confidence in those skills. More work needs to be done to effectively teach media literacy at the secondary education level, and it could be suggested that additional media literacy is also taught at the post-secondary level in order to further strengthen these skills which have been identified as so important.

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MOTIVATING DENTISTRY STUDENTS: A BIOFILM PROJECT TO FOSTER ENGAGEMENT AND INTERDISCIPLINARY LEARNING

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Abstract

Within the framework of the Teaching Innovation Strategies promoted at Universidad San Pablo-CEU, the BioFilm project has been developed in School of Medicine for first-year students enrolled in the Dentistry degree, which is offered to students from all nationalities in two languages: Spanish and English. Some dentistry students do not consider the application of basic science subjects "on real world" or their future profession, making learning process overwhelming. Within the School of Medicine, dentistry students take the subjects of Biology (1st semester), Genetics and Biochemistry and Physiology (2nd semester). To address the need to boost student motivation in these subjects, the BioFilm project was developed. This is a single project that spans various subjects across two semesters, with different student work submissions. The project involved 150 students and was mentored by 9 supervisors, also lecturers on the subjects, from two different departments and schools: Department of Chemistry and Biochemistry (School of Pharmacy) and the Department of Basic Medical Sciences (School of Medicine). To increase engagement and motivation, a transversal and multidisciplinary Project based learning approach was developed. Students were asked to present informative videos on chosen topics that cover all subjects involved in the learning project, thereby deepening the learning process. Using Information Communication Technology (ICT) tools, students were challenged and their willingness to engage in the work improves, as they are very familiar with these short videos in their spare time. Through the evaluation of these videos, it is determined whether the students have successfully integrated the knowledge acquired from the different subjects. Additionally, the project promoted a transversal and horizontal learning experience, ensuring that students develop a comprehensive understanding of different subjects. This method fosters project management, teamwork, critical thinking and the ability to communicate complex concepts effectively. In conclusion, the Biofilm project enhances the learning experience of the first-year student at Universidad San Pablo-CEU by facilitating interdisciplinary courses coupled with the integration of ICT tools as well as sharpening critical analysis, problem-solving, and communication skills. Creating didactic videos has twofold benefits in the context of the project, as it guarantees comprehension of the content and teaches the students how to use the acquired knowledge in their future profession. Such an innovative method of teaching and learning is believed to increase student's interest and participation in academic work which will raise overall achievement as well as enhance the quality of educational experience.

Keywords: *Project based learning, transversality, integration, dentistry, ICT tools.*

1. Introduction

Teaching basic sciences to first-year dentistry students is challenging due to the clinical profile of the class. Traditionally, their curricula have been structured in isolated subjects, compromising the opportunity to integrate the acquired concepts across diverse basic and clinical subjects. Furthermore, dentistry students often fail to see the application of these subjects to their future profession and struggle to integrate the syllabi, making the learning process overwhelming. Thus, the learning process hinders their ability to grasp essential topics across the integration of different fields of study that are essential to understanding biological systems (Nehm, 2019).

This scenario was identified by the lecturers of Biology (1st semester), Genetics and Biochemistry, and Physiology (2nd semester), three basic subjects often perceived as heavily memorization-based, with

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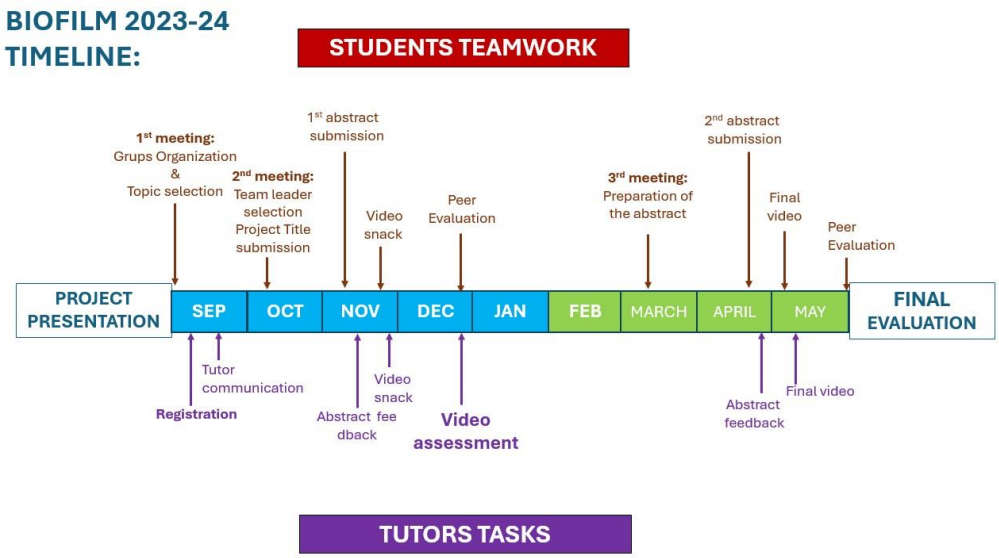
new and complex concepts that intimidate and disengage students. As Science, Technology, Engineering, and Mathematics (STEM) educators are often challenged and encouraged to refine their curricula to offer a balance between acquiring knowledge and its application to real-world contexts (Freeman et al., 2014), the Biofilm project, based on Project-Based Learning (PBL) strategies, was designed and tested in a pilot course during the academic year 2023/2024.

Figure 1. Project Biofilm timeline and key milestones of student tasks (top) and faculty tasks (bottom).



In this context, PBL engages students in a problem-solving scenario, promoting self-directed learning, the application of knowledge in practical settings, students' autonomy, capacity for communication and teamwork, and higher-order thinking skills (Freeman et al., 2014). It also creates a dynamic learning environment where students actively participate, learn from diverse perspectives and knowledge areas, and build transferable skills (Pranjol, Oprandi, and Watson, 2024). As this strategy not only promotes knowledge acquisition but also enhances communication, it would create a robust framework for effective and inclusive education given the multicultural origins of the CEU San Pablo University students. Thus, to ensure the integration of the acquired knowledge in the three previously mentioned subjects, first-year dentistry students were organized into work groups and selected a topic previously proposed by the lecturers. Throughout the academic year, they were encouraged to submit two videos, one per semester, in which they condense and integrate the knowledge from the different subjects in an engaging and informative manner.

2. Objectives

- Creating an innovative strategy to increase students' interest and motivation in the 3 subjects involved.
- Integrating the concepts acquired over the two semesters, promoting interdisciplinary learning.
- Using information and communication technologies in the presentation of PBL results.
- Facilitating the development of other competencies such as teamwork, critical thinking, and the transmission of complex concepts, skills necessary for their future professional careers.

3. Methods

3.1. Participants

The project involved 150 first-year students from the Dentistry degree, which is offered to students from all nationalities in two languages: Spanish and English. 72.47% were female, and the average age was 18-20 years old. The students were organized into working groups of 5-6 members. Nine professors supervised the groups, assuming responsibility for the subjects of Biology (1st semester), Genetics and Biochemistry, and Physiology (2nd semester). The project Biofilm was approved by the Ethics committee of the University San Pablo CEU with the reference 776/23/96.

3.2. Group distribution and topic assignment

Students freely selected their groups and the topic to work on from 10 predefined topics established by the instructors considering the common aspects of their syllabi. The topics were assigned at the beginning of the course to ensure proper organization of the work and encompassed transversal aspects across the subjects involved, such as renal physiology, glucose metabolism, and cholesterol synthesis, among others. After the distribution of groups and topics, a tutor was assigned to each group to monitor the progress of the work (Figure 1).

3.3. Video creation

During the first semester, students worked on creating a short one-minute video or “snack”, focused on the biological perspective of the assigned topic. In the second semester, they developed a second video lasting 3 minutes, integrating content from the subjects of Genetics, Biochemistry, and Physiology along with the knowledge acquired in the previous semester. In both semesters, students submitted a preliminary script for their videos and participated in tutoring sessions that provided guidance and support to enhance their work.

3.4. Use of technological tools

The TEAMS platform was utilized as a virtual space to coordinate the project, enabling the submission of videos, script summaries, and tutoring sessions. Through this platform, professors continuously monitored and supervised students' progress. For video production, students chose the tools they considered most suitable, enhancing the diversity of approaches and outcomes.

3.5. Evaluation

The project assessment was built on three main components. First, the preliminary scripts for the videos were evaluated, accounting for 5% of the total grade. Second, a peer evaluation was conducted, which contributed 15% to the final grade. In this evaluation, students assessed the videos produced by other groups using the same rubric that was later used by the professors. Additionally, each student evaluated their own group members and performed a self-assessment, both also based on the same rubric. Lastly, professors applied the same rubric to evaluate the final products, considering aspects such as originality, integration of subject content, ability to synthesize information, teamwork, and the formal quality of the presentation (80%). This project grade weighed 5% of the final grade in the three subjects.

3.6. Satisfaction surveys

At the end of the academic year, students were invited to share their impressions through an anonymous satisfaction survey that included multiple-choice questions selecting the statement they most identified with on a scale from 0 "strongly disagree" to 5 "Strongly agree" (Likert scale).

4. Results

Of the 150 participants involved in the Biofilm teaching innovation project during the 2023 pilot course, 43.33% completed the final satisfaction survey. Overall, the results reflected the students' satisfaction with the project, where on average, students rated their satisfaction level at 7.6, and 83.07% would recommend it to other classmates (Figure 2).

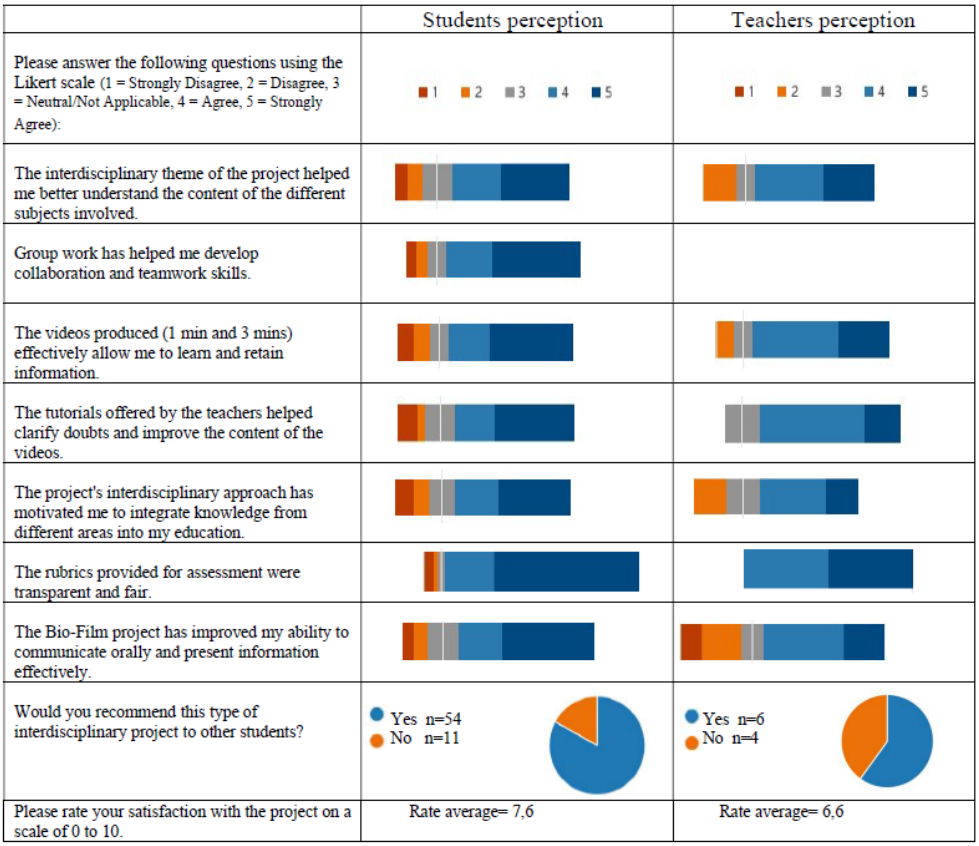
Most of the students consulted agreed or strongly agreed with the following questions about the development of the Project: When asked whether the interdisciplinary approach to biofilm has been effective in integrating the contents of the different subjects, if teamwork has helped me develop collaborative skills, if the videos made help me better understand the topic, if the tutorials offered were useful in clarifying my doubts and completing the work if the interdisciplinary approach has motivated me to integrate knowledge from different areas, if the rubrics provided for the evaluation were fair and clear and if the project has improved my ability to communicate orally and present information from different subjects. The perception of the teachers regarding these questions except (Teamwork question) was similar. For the teachers it was clear or very clear that the rubrics were clear and fair. However, when asked about the usefulness of the project, teachers from 0 to 10 rated it 6.6, one point less than the students' rating.

5. Discussion

This article presents the implantation and results of a transversal PBL that encompassed three basic subjects (Biology, Physiology and Genetics and Biochemistry) of 1st year of dentistry, which until now have always generated rejection and little motivation among the students. As PBL is not systematically integrated as a teaching method in higher education, usually focused on a lectured format, it often relies on

teachers its implementation and integration (Freeman et al. 2014; Shpeizer, 2019). Lecturers were responsible for designing and planning the different deliverables, assigning the tutors based on their area of knowledge for each topic, developing the rubrics, and selecting the format for the project presentation.

Figure 2. Students´ and teachers' perception in their learning and teaching experience during Biofilm project. Evaluation data were collected anonymously in Google Forms surveys at the end of the project.



In this pilot test, freshmen students were encouraged to freely form groups and choose the topic of the PBL during the first week of classes. These randomized assignments follow the suggestions by Burgess et al. (2020), where randomized group formation ensure a diverse background of students with different knowledge levels. This activity has created an ideal environment for first-year students to meet and allowed their quick integration into university life. Video creation in educational settings has demonstrated significant benefits in enhancing student learning and integrating various subjects. Thus, students not only consolidate their knowledge through the process of scripting, filming, and editing but also develop critical thinking and technical skills. This hands-on approach fosters a deeper understanding of the material, encourages creativity, and provides a platform for collaboration among peers. Moreover, the skills acquired such as digital literacy, storytelling, and project management, are invaluable assets that can aid students in their future academic and professional endeavors (Rasi & Poikela, 2016).

In recognition of the students' effort creating the Snack and final video throughout the semesters, their results were included in their final grade in each subject. This grade was based on both the professors' assessments and the students' evaluations through a peer review process, as well as the grades assigned among group members. While incorporating students' evaluations of their peers' PBLs into the overall grade can sometimes lack objectivity (such as potential conflicts arising from group work, lack of criteria for evaluation, and low engagement in reviewing videos), it can also encourage them to develop professional behaviour and actively participate in the project. Moreover, peer evaluations provided valuable feedback on team cohesion and the perception of actual productivity (Burgess et al. 2020).

The learning strategies adopted by the students not only involve their participation in a PBL making a commitment to their peers in the working group but also imply a change in dynamics with an increased workload that generates discontent and dropout among the students. In general, they prefer passive learning over the active despite the benefits of the latter (Taglieri et al. 2017). Nonetheless, the results of the satisfaction survey conducted at the end of the course reflected a high acceptance of the Biofilm project among the students, with 83.07% recommending it. There was a high proportion of "agree" and "strongly agree" responses to questions related to the improvement of integration, communication, and

teamwork skills (Fig. 2). This result aligns with those obtained by McInerley & Fink (2003), where after implementing Team-Based Learning (TBL), 81% of the surveyed students rated the project positively, stating that it not only benefited their learning but also the development of critical thinking, integration of concepts, and improved problem-solving efficiency. Despite this, the professors' perception of concept integration and their overall satisfaction was slightly lower. In this line, to ensure students learning, and develop additional tools for their future professional careers, several modifications have been made to Biofilm project in the present course 2024-2025. These include the introduction of three mandatory and assessable tutorials in the first semester and one in the second. Instead of the snack in the first semester, students will now present a three-slide overview of their project. The final video will be limited to 4 minutes, and Blackboard will be used as the communication platform. The increase in tutorials and the initial presentation aim to enhance students' supervision and ensure thorough integration of concepts across different subjects. Switching to Blackboard will facilitate communication, as it is the university's standard tool, whereas TEAMS caused issues due to students' unfamiliarity with it.

6. Conclusions

In the evaluation of the final product, which is the integrative video, the use of communication and video generation ICTs is emphasized. The assessment detects the ability to integrate knowledge, project management, teamwork and communication skills, including the correct use of oral and written language. Additionally, group work skills are promoted, which, in most cases, result in successful collaboration."

The motivation of the students, one of our primary objectives, is reflected in the results obtained from the perception survey, in which the majority would recommend this type of projects and perceive that it has helped them understand the different subjects that comprise the project. The correct coordination between professors and students is considered necessary for the success of the project. The use of communication platforms such as TEAMS and Blackboard has been crucial for the effective coordination of the faculty, both in the design of the project and subsequently during its implementation among professors and students.

The implementation of the pilot project in the past academic year (2023 -2024) has allowed us to make improvements, the most significant are the guidance provided by the tutor through three mandatory professor-student meeting sessions and making slight adjustments to the format of the first work submission.

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LEVERAGING H5P TO DESIGN INNOVATIVE ONLINE LEARNING ENVIRONMENTS: A CASE STUDY AT A SOUTH AFRICAN UNIVERSITY

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Abstract

The rapid shift to online learning has resulted in a need for innovative approaches to enhance student engagement and interactivity in higher education. This shift has allowed universities to explore their capability to design innovative online learning environments (ILE). Achieving an ideal innovative online learning environment for a South African university has been made possible with the introduction of the H5P open-source content creation tool. This tool has allowed lecturers to create, share, and reuse interactive and engaging online learning resources within Moodle LMS. Such developments permit lecturers to create dynamic and flexible learning environments that align with 21st-century teaching methodologies. An instrumental case study approach was adopted to explore how H5P's functionalities, such as interactive videos and quizzes, can be leveraged to design innovative online learning environments. The Unified Theory of Acceptance and Use of Technology 3 (UTAUT-3) model served as the theoretical framework and helped to interpret the data and ultimately frame the study findings. Following a qualitative research design model, six lecturers and eight pre-service teachers within the faculty of education were purposefully selected to participate in the study. Firstly, the participants engaged in a series of online activities, including online quizzes and interactive videos using H5P. Semi-structured interviews and qualitative questionnaires were used to collect data. Atlas Ti was used to analyse collected data, which followed a thematic approach, allowing for the identification of common themes and patterns in lecturers' practices and pre-service teachers' experiences. The findings indicate that lectures using the H5P tool have the potential to enhance student engagement, support diverse learning needs, and foster active participation. As such, this study provided practical recommendations for effectively integrating H5P into online learning environments and suggests its broader applicability in nurturing digital transformation in education.

Keywords: *H5P, online learning, higher education, innovative approaches, engagement.*

1. Introduction and background

In the rapidly evolving landscape of higher education, integrating digital technologies into teaching and learning processes has become increasingly essential (Huang & Yanan, 2024). This transformation is marked by a shift away from traditional educational paradigms and toward more innovative, flexible, and inclusive learning models (Mohamed Hashim et al., 2022). H5P has emerged as widely adopted in many universities to allow lecturers to easily and quickly create rich interactive content within the learning management system (LMS). According to Kuzminska et al. (2023), H5P is open-source software that allows lecturers to integrate into LMS systems to increase functionality and give them more privilege to use pedagogical technologies and disseminate their learning content. This versatile technological tool supports learning experience designers and content creators in developing engaging and mobile-friendly web content. López, Ramírez and Rodríguez (2021) highlighted that H5P is increasingly amalgamated into institutions of higher learning to improve learning experiences, making education more accessible and engaging for a diverse global student population. Likewise, integrating the H5P platform results in improvements in the presentation and interaction of students with the contents and materials of their courses, in addition to facilitating the creation of interactive learning content through lectures on various areas of knowledge (Singh and Scholz, 2017).

The widespread adoption of H5P is evident, with over 200,000 websites using it by January 2020, including universities, enterprises, school districts, schools, military organisations, and other teaching and learning institutions (Lopez et al., 2021). Students benefit from this technology as it enhances engagement through interactive content that encourages active participation and provides instant feedback to aid learning and progress assessment (Mutawa et al., 2023). H5P's accessibility and mobile-friendly nature make learning available to students anytime, anywhere. Lecturers and learning designers benefit from

H5P's intuitive interface, which streamlines the creation, sharing, and reuse of content, promoting collaboration and saving valuable time (Homanová & Havlásková, 2019). This adaptable tool integrates seamlessly with various platforms and allows for the customization of learning activities to suit specific educational goals.Pre-service teachers' experiences and attitudes towards integrating H5P software are essential for adapting to different learning styles that encourage active participation and a high level of engagement. Mutawa, Al Muttawa, and Sruthi (2023) supported this and found that H5P's interactive and engaging nature can make learning more enjoyable and effective for students, keeping them motivated and engaged throughout their studies. Similarly, Homanová and Havlásková (2019) outlined that H5P inspires students, captures their attention, improves learning quality, and assists students in retaining the material. However, the success of these systems depends significantly on the effective training provided to both students and lecturers. Understanding how lecturers navigate digital technologies such as H5P is essential to improve pedagogical skills, as this can create dynamic and immersive educational experiences that cater to diverse learning styles and students' needs (Rahmi, Fajri & Azrul, 2024). Research supports the efficacy of H5P, with Ploetzner's (2022) meta-analysis demonstrating the superiority of interactive videos for retention and comprehension compared to non-interactive videos. Studies by Jacob and Centofanti (2024) and Lopez et al. (2021) highlight the positive impact of H5P on student engagement and learning outcomes. Moreover, Mutawa et al. (2023) reported that 82% of students retained their focus and motivation throughout the learning process when using H5P. These findings underscore the importance of incorporating good practices in creating effective interactive content, such as ensuring accessibility, supporting learning objectives, and maintaining diverse content types to cater to different learning preferences.

2. Theoretical framework

This study was underpinned by the Unified Theory of Acceptance and Use of Technology 3 model (UTAUT-3) by Venkatesh et al. (2003) to understand and forecast user adoption and acceptance of new technologies. UTAUT-3 is an advanced model that explains and predicts user behaviour regarding technology adoption. It expands on the original UTAUT model by incorporating new constructs to provide a more comprehensive understanding of technology acceptance (Khan et al., 2022). UTAUT-3 explains why users intend to use specific technology by considering factors like performance expectancy, effort expectancy, social influence, and facilitating conditions (Gunasinghe et al., 2020). In this study, UTAUT-3 assisted the researcher in identifying, after undergoing lectures and pre-service teachers' experiences and attitudes on the acceptance of the use of H5P software within their Moodle LMS. Employing this theory offered valuable insights for lecturers in designing effective online learning environments that leverage interactive technologies like H5P.

3. Methodology

This study employed a qualitative case study research design to investigate the perspectives and experiences of lecturers and pre-service teachers using the H5P model (Creswell & Poth, 2016). As Spencer, Pryce, and Walsh (2014) noted, qualitative research is grounded in phenomenological philosophy, emphasising the construction of social reality through individual or collective responses to specific phenomena. This approach aims to describe social dynamics through the lived experiences of individuals. The design enabled the researcher to explore the experiences of lecturers and pre-service teachers while engaging with H5P software during teaching and learning. Creswell and Creswell (2017) highlighted that qualitative research methods are well-suited for investigating, interpreting, and describing scenarios and obtaining a general understanding of the subjects. Through this research design, the researcher gained an in-depth understanding of the lecturers' experiences, insights, and challenges in incorporating H5P, providing rich, detailed insights into how this tool impacts teaching and learning and fosters engagement.

3.1. Selection of participants

This research adopted a purposive sampling method to sample six (6) lecturers and eight (8) pre-service teachers enrolling for their third year of study. Unlike random sampling, where every member of the population has an equal chance of being selected, purposive sampling involves deliberately selecting participants with specific characteristics or experiences relevant to the research objectives (Etikan, Musa & Alkassim, 2016). Criteria for selection included the following: lecturers and pre-service teachers must be from the University of Johannesburg, within the faculty of education, and have experience using the H5P model within their modules to ensure that they have a baseline understanding of this technology and can operate it during teaching and learning.

3.2. Data collection and analysis

This study utilized semi-structured interviews and qualitative questionnaires as data collection methods. Semi-structured interviews were conducted to deeply explore lecturers' and pre-service teachers' collective perceptions and attitudes regarding their experiences with H5P. Longhurst (2003) emphasized that semi-structured interviews allow participants to express their opinions, feelings, and experiences, helping to identify emerging trends. This method was particularly suitable for this study as it provided valuable insights into using H5P software as a mediating tool for teaching and learning. Interviews were audio recorded with permission from the student and then transcribed using Microsoft Teams application software. Each interview lasted approximately 20-30 minutes, and they were audio recorded with permission from the participants and then transcribed using Microsoft Teams application software. In addition, qualitative questionnaires were employed to gather detailed, open-ended participant responses. Eckerdal and Hagström (2017) noted that qualitative questionnaires are designed to investigate complex phenomena, experiences, and opinions. These questionnaires were distributed online via Google Forms and captured the experiences and perceptions of lecturers and pre-service teachers regarding using H5P software in teaching and learning. The data was analyzed using thematic analysis, as described by Braun and Clarke (2006), which involves identifying, analyzing, and reporting patterns or themes within the data. The data was coded and organized to develop various themes. Atlas Ti software was used to facilitate this process, allowing for the identification of common themes and patterns in the practices of lecturers and the experiences of pre-service teachers.

4. Findings

Lectures indicated they had excellent experience integrating H5P software into their Moodle Learning Management System (LMS) to enhance student engagement and provide immediate assessment feedback. What worked to the lecturers' advantage was that they could create engaging activities that moved beyond static content, making learning more dynamic and participatory. Through this experiment, they designed interactive learning experiences with quizzes, interactive videos, and branching scenarios that actively involved pre-service teachers. As lecturers and pre-service teachers shared their experiences using H5P, they expressed their happiness about H5P. Some lecturers mentioned that H5P allowed them to incorporate teaching approaches that enabled student engagement and interactive learning activities during their teaching. Lecturers A and B shared their thoughts regarding their experience and stated:

Lecturer A: *H5P has made my approach to online learning more interactive and student-centred. It allowed me to create engaging activities beyond static content, making learning more dynamic and participatory. Instead of relying on traditional lecture methods, I now integrate interactive quizzes, videos, and simulations that promote active learning.* Similarly, Lecture B also explained that:

Lecturer B: *Using H5P has significantly enhanced my teaching approach to designing online learning environments by providing interactive and engaging content for students. It allowed me to incorporate multimedia elements such as quizzes, interactive videos, and games, encouraging student participation and engagement.*

These responses indicate that the H5P tool supports lecturers with various content types, such as quizzes, interactive videos and course presentations, with the advantage of creating mobile-friendly content that enhances student engagement and accessibility. This was evident when some pre-service teachers pointed out how they were willing to explore and engage in various activities, demonstrating an increased interest and motivation to utilize diverse educational tools and resources.

In addition to this experiment, some pre-service teachers outlined that this technology empowered them to understand content and kept them more engaged with the material. Pre-service Teacher 1 and Pre-service Teacher 2 highlighted that:

Pre-service Teacher 1: *H5P activities were incredibly engaging because they combined interactive elements with content, making learning feel more dynamic. Instead of passively consuming information, I participated actively through quizzes, videos, and interactive games. This active involvement helped me understand the content and kept me more engaged with the material. I find that H5P's interactive nature creates a more immersive learning experience than standard lectures or readings.* In addition to how Pre-service teachers experienced the tool during their online assessment, Pre-service Teacher 2 revealed that:

Pre-service Teacher *2: The H5P activities increased my comprehension and retention of course material. These activities were more hands-on in terms of engaging with content, which could allow me to make intangible concepts more relatable to everyday life. Instead of learning about motherboards from a textbook or YouTube videos, interactive activities like drag and drop could get me involved in the processes associated with the motherboard, even to the point of how each part can be used or is used in our everyday lives.*

Due to the lecturers' experiences with the H5P tool, some viewed this technology as an effective tool for enhancing teaching and learning. They mentioned that H5P permitted them to create real-life

scenarios and apply authentic learning activities to which students could relate. They highlighted that this interactive approach made learning more engaging and helped students better understand and retain complex concepts. Furthermore, lecturers found that by incorporating multimedia elements and interactive content, they could cater to different learning styles and needs, ultimately fostering a more inclusive and dynamic educational environment. From Lecturer D's response:

Lecturer D: *I improved student engagement by using H5P in a module with lengthy definitional content. I implemented the Accordion feature to break up the text into collapsible sections, making it easier for students to navigate and explore the material. I added interactive questions for long videos, turning passive viewing into active learning. Additionally, I used activities like drag-and-drop exercises and fill-in-the-blank questions to encourage further application and recall of knowledge. These interactive elements have led to better student engagement, focus, and content retention.*

Lectures utilizing the H5P tool in their classroom allowed them to instil essential skills such as collaboration and critical thinking among pre-service teachers. They were encouraged to work in smaller groups to discuss solutions and think critically about the materials presented. This collaborative approach enhanced their understanding of the subject and prepared them for real-world teaching scenarios. Lecturers D and F explained:

Lectures D and F: *H5P has the potential to foster critical thinking by allowing students to engage in interactive decision-making scenarios, problem-solving exercises, and self-assessment tasks. While it does not directly facilitate collaboration, it can be a springboard for discussions and group work. For instance, students can complete an interactive quiz individually and then discuss their responses in a live session. However, maximizing these benefits requires time for proper content development, often limited due to other academic responsibilities.*

Lack of exposure to the H5P tool significantly negatively impacts lecturers' ability to teach with this tool. In some instances, one lecturer revealed that one of the obstacles they encountered was a lack of exposure to this tool as they were not offered sufficient training by the relevant department within the university. They highlighted that this tool was still new, and they were unfamiliar with its associated features. The following response testifies to this:

Lecturer F: *One of the biggest challenges is the lack of formal training in using H5P. Many lecturers, including myself, have had to learn through trial and error, which is time-consuming. Additionally, time constraints are a significant issue. To address this, I have relied on online tutorials offered by the learning technologies centre at the university where I work, and I am trying to integrate H5P gradually instead of overhauling my entire teaching approach at once. Even though the centre offers H5P training, due to my workload, I cannot always attend due to my busy schedule*.

5. Discussion

Lectures indicated that their H5P experience was effective as it enhanced student engagement during their teaching and allowed them to create engaging activities beyond static content, making learning more dynamic and participatory. These findings concur with Mutawa et al. (2023), who revealed that the H5P tool enhances engagement through interactive content that encourages active participation and provides instant feedback to aid learning. While incorporating this tool, pre-service teachers could collaborate in smaller groups to discuss their learning activities, allowing them to think more critically towards the task. As a result, pre-service teachers were motivated and eager to learn more about the H5P tool and its various applications towards solving problems. This finding was supported by Homanová and Havlásková (2019), who found that H5P motivates students, captures their attention, improves learning quality, and helps students retain information. As lecturers engaged in this tool during their teaching, their pedagogical approaches allowed pre-service teachers to develop essential skills such as collaboration and critical thinking while relating their content to real-world situations. This was supported by Homanová and Havlásková (2019), who highlighted that H5P proved a valuable tool in promoting an interactive, collaborative learning environment that simplifies content and creates real-life scenarios among students. Lectures incorporating the H5P tool prepare pre-service teachers for real-world challenges, equipping them with essential skills while deepening their understanding of the subject matter (Jacob & Centofanti, 2024). However, lectures and students encounter various technological challenges that need institutions' provision of training and digital assistance (Mutawa et al., 2023). The authors furter highlighted that when remote learning is used, it is difficult for lectures to maintain their students' engagement and motivation due to the lack of exposure towards the tool.

6. Conclusion

This study aimed to explore how H5P was leveraged to design innovative online learning environments at a South African university. The findings revealed that lecturers' experience with the H5P tool was effective as they could deepen the subject knowledge and encourage active participation among

pre-service teachers. They could integrate this tool to enhance student engagement and foster essential skills such as collaboration and critical thinking. These findings further showed that lecturers could integrate interactive quizzes, videos, and simulations that aroused interest among pre-service teachers and promoted active learning. Additionally, using H5P allowed lecturers to create a more inclusive and adaptable learning environment catering to diverse learning styles and needs. Lecturers can make complex topics more accessible and engaging by using multimedia. Pre-service teachers also found that the H5P tool improved their learning experienceThey were encouraged by how activities were presented, making their learning more fun and dynamic. Pre-service teachers were further motivated by this tool as it allowed them to receive immediate feedback on their performance, helping them identify areas for improvement and reinforcing their understanding of the materials. These findings have implications for professional and competency development in teaching in a digital or virtual environment where the H5P tool is utilized to enhance teaching and learning.

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AN INCLUSIVE APPROACH TO INSPIRE CREATIVITY AND TEAM BUILDING THROUGH MODULAR ARCHITECTURE DRAWING

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Abstract

Integrating pedagogical innovations and inclusive approaches in university education represents a meaningful strategy to foster active and cooperative learning. Developing transversal skills such as collaboration and critical problem-solving is essential for the technical professions, such as engineers and architects, who face the increasingly complex problems of this millennium. This article describes a team-building experience as part of a first-year course in Building Drawing at Politecnico di Torino, aiming to enhance transversal skills and foster interaction between students from heterogeneous backgrounds. The experiential activity proposes a creative challenge in the field of modular architecture by using the 3D-printed basic element proposed by the architect Walter Gropius. The analysis of the results, conducted using questionnaires and qualitative observations, showed improved relational skills and strengthened student motivation. This experience shows how innovative teaching methodologies can contribute to academic success and prepare students to manage group dynamics in the professional context of building engineering.

Keywords: *Creative design experience, 3D printing, active learning, student engagement, higher education.*

1. Introduction

In recent years, team-building activities have emerged as effective tools for improving group dynamics and transversal skills in educational contexts, including university programs. In the field of building engineering, where multidisciplinary collaboration is a fundamental requirement for professional practice, the ability to work in teams is as crucial as technical expertise. However, traditional university courses tend to favour an individualistic approach to learning, overlooking the potential of cooperative methodologies in enhancing both student engagement and their preparation for the workforce. The scientific literature highlights that integrating team-building experiences into higher education can improve academic performance, foster a sense of belonging to the group, and enhance communication skills (Oakley et al., 2004). Recent studies show that approaches such as cooperative learning (Johnson & Johnson, 2017) and problem-based learning promote active learning and collaborative problem-solving for complex issues, thereby improving teamwork management skills. In particular, experiences in the engineering field have demonstrated that practical exercises and project challenges based on collaboration increase student motivation and engagement. Within this context, the present study describes a team-building activity designed for first-year Building Engineering students to develop transversal skills and promote a more cooperative learning process.

2. Methods

The team-building approach was experienced in the Building Drawing course at Politecnico di Torino, which lays the methodological foundations of Drawing as a communication language for engineers. As the first core course of the Building Engineering Bachelor's program, it brings together students who were previously distributed according to different criteria. Concerning this point, the objective of the experiential activity is to establish a collaborative environment and foster students' mutual acquaintance. These aspects are considered essential both for the course, which involves practical work in groups and for establishing effective interpersonal relationships that are fruitful for subsequent teaching. Sixty-five students from diverse educational backgrounds, including high schools, technical institutes, and surveyor schools, attended the experience.

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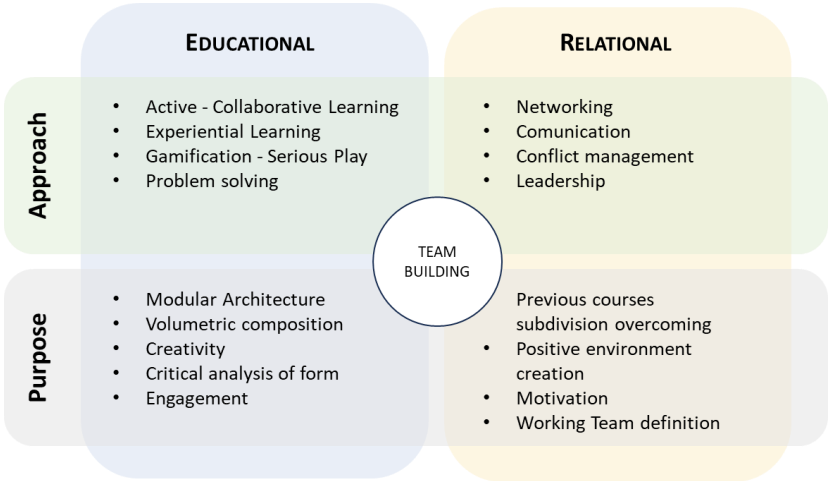
The participatory activity proposes a creative challenge in the field of modular architecture and involves the definition of volumetric forms using the basic modules proposed by the architect Walter Gropius (Seelow, 2018). It has been designed with the dual objective of strengthening the educational experience and developing relational skills, as summarized in Figure 1.

Figure 1. Methodological approach.



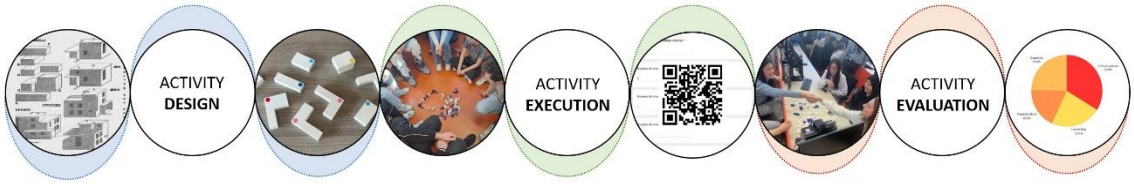
From a pedagogical perspective, adopting active approaches within the course (Ugliotti et al., 2023) is investigated to directly involve students in the educational process, stimulating their participation, reflection, and collaboration. Various techniques such as collaborative and experiential learning, gamification and serious play, and problem solving have been integrated into the experience to establish a synergy between theory and practice in order to facilitate the simultaneous development of disciplinary and transversal soft skills.

Engaging in active learning experiences compels students to confront and solve complex problems in collaborative contexts, thereby stimulating critical thinking, and adaptability. In this case, the activity was also able to foster the critical analysis of form, creativity, volumetric composition, and the use of modular architecture, prompting a deep reflection on expressive and constructive methodologies.

This type of learning impacts on the relational dimension of the students, stimulating skills of communication and networking and bringing out the predisposition to leadership and the need for conflict management. Creating a positive environment, and cultivating shared motivation contribute to forming cohesive and functional workgroups thereby rendering the team building experience a central and transversal component of the educational journey that integrates pedagogical goals with relational needs.

The activity involved three main phases: an initial design phase, a practical execution phase, and a subsequent evaluation phase (Figure 2).

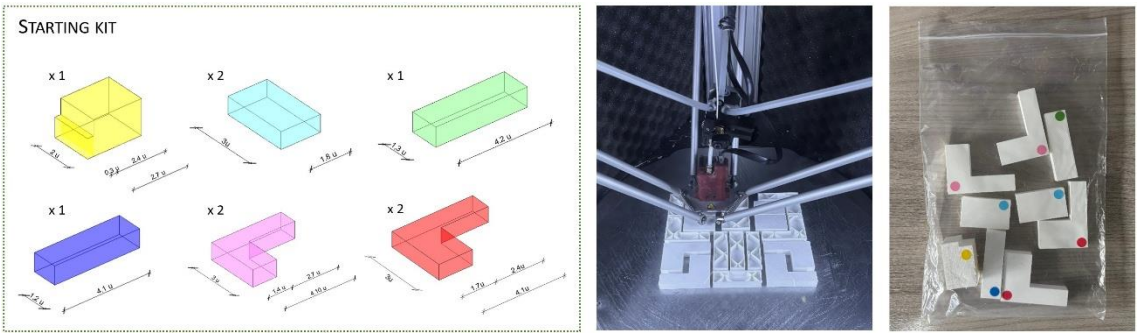
Figure 2. Activity phases.



2.1. Design of the activity

The preparatory phase of the activity entailed the digitalization of Walter Gropius's 1922 "Baukasten im Großen" modular forms, which were modeled in 3D using Autodesk Revit software. A basic kit consisting of 9 modules was then defined and 40 identical kits were printed via a 3D printer. A simulation conducted with a small group of individuals allowed for the optimal organization of timing, scheduling and dynamics of the activity, identifying its strengths and proactively addressing its weaknesses.

Figure 3. Design phase.

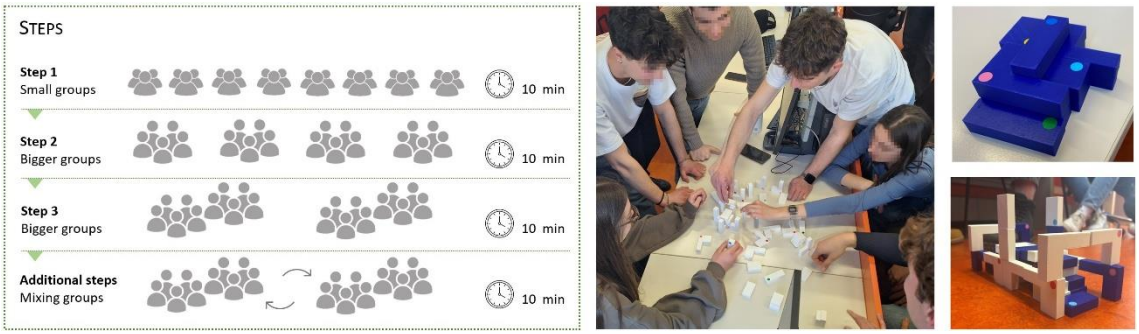


2.2. Execution of the activity

The team-building activity was structured into multiple phases. Initially, the students were divided into groups of two or three individuals based on their physical proximity to each other. Each group was provided with a starter kit and given specific instructions to assemble the modules into free compositions. To ensure a comprehensive record of the activity, each composition created was meticulously documented via the completion of a form specifying the students' names, the number and type of pieces used, the name given to the composition, and the attachment of a photograph. In the subsequent stage of the experiment, the small groups were joined two by two, thereby providing the students with the opportunity to construct using twice the number of modules. The groups were then further reunited without utilizing the logic of proximity, with the aim of fostering new interactions and increasing the number of available pieces. In the following phases, the groups were reorganized without increasing the number of participants, with the sole objective of facilitating interactions among as many individuals as possible.

Each phase lasted 10 minutes, in every phase each composition was documented using the form.

Figure 4. Activity execution.



2.3. Evaluation of the activity

During the activity, the teacher and collaborators paid special attention to qualitative observations of the dynamics among the students and the effectiveness of the planned task. Moreover, a questionnaire was administered to the students at the end of the last session to gather impressions of the teaching approach used and understand the level of engagement achieved.

3. Discussion

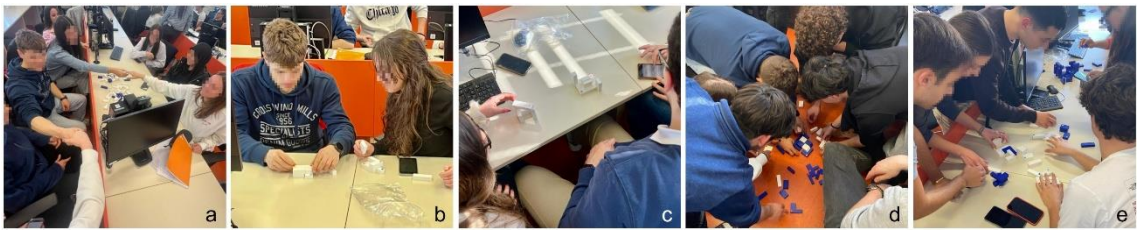
The team-building experience revealed several relational dynamics with important pedagogical and social implications. During the activity, the teacher and her collaborators observed that, through a spontaneous presentation phase (Figure 5. a), participants overcame interpersonal barriers, fostering a climate of openness and reciprocity.

From the first phase, devoted to small group formation, different approaches to problem solving emerged. Most participants adopted active collaboration (Figure 5. b), while in some cases a more individualistic approach was observed (Figure 5. c), in which each member focused independently on his or her own construction, emphasizing personal operational styles. In later stages, and thus with larger groups, the relational approach took on even more diverse forms. Some groups adopted parallel methods that facilitated a synergistic and equitable distribution of tasks (Figure 5. d), while others experimented

with sequential strategies (Figure 5. e) in which one segment of the group devoted itself to constructing the form and another to prototyping the composition.

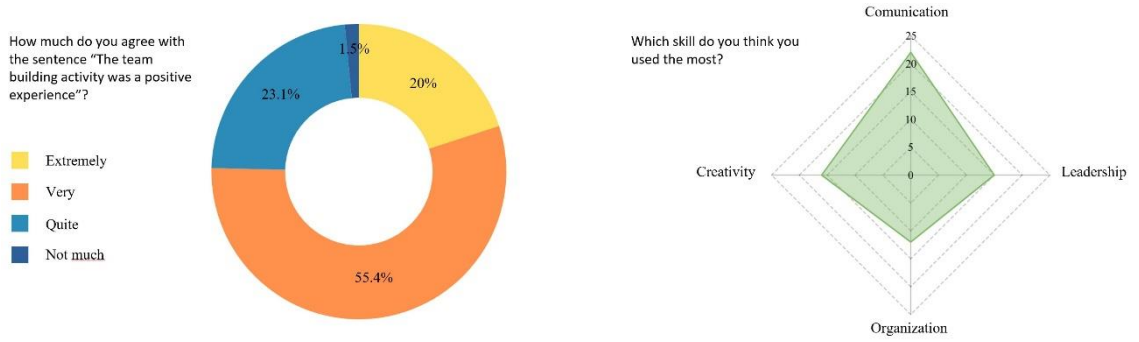
The latter dynamic is symptomatic of a spontaneous predisposition to effective coordination. Just in a few isolated cases, a lack of engagement by some participants was observed, highlighting the need to implement motivational and inclusive strategies, as well as to create an environment more conducive to collaborative activities, in order to encourage active participation and the development of optimal group dynamics.

Figure 5. Main relational dynamics observed.



The post-activity questionnaire highlighted additional experiential and relational dynamics. Over 75% of participants rated the experience as extremely or very positive. In addition, communication and creativity emerged as the most frequently utilized soft skills, proving to be essential for effective teamwork and problem-solving (Figure 6).

Figure 6. Valuation form results.



On the whole, these operational strategies contributed significantly to the development of key relational competencies and soft skills, including communication, networking, conflict management, and leadership. Such skills are indispensable for fostering cohesive and efficient teams in educational contexts, while simultaneously providing valuable preparation for the future Building Engineer.

4. Conclusions

This study has documented and analyzed, from a pedagogical perspective, a team-building activity aimed at enhancing transversal skills and fostering interaction among students from diverse backgrounds. The creative challenge, set in the context of modular architecture, involved the use of building modules inspired by Gropius' designs, modeled and 3D printed, offering participants the opportunity to reinterpret architectural space in their own personal way. In addition, it allowed them to investigate the compositional, graphic, and spatial principles that serve as its theoretical and practical underpinnings.

This approach fostered significant social interaction, stimulating empathy and the ability to critically tackle complex design challenges through dialogue and cooperation. The results highlight a marked improvement in relational and collaborative skills, along with a notable enhancement of creativity made tangible through the use of 3D printing. Furthermore, it is evident that the instructor's role has undergone a progressive transformation, from that of a mere transmitter of knowledge to a designer of comprehensive learning experiences that effectively maximize active student engagement.

Overall, this pedagogical model, replicable in various educational settings, significantly contributes to the discourse on educational innovation, demonstrating how advanced technological tools and interdisciplinary approaches can develop academic and relational competencies on solid, critical, and collaborative foundations, break the monotony of passive listening, and promote widespread, conscious participation.

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This contribution is the result of a common work of the Authors. However, specific sections can be attributed as follows: F.M.U. authored the Abstract, Introduction, and Evaluation of the Activity; F.M.U. and M.Z. worked on the Methods; M.C. was responsible for the Activity Design and Execution; M.Z. contributed to the Discussion and the Conclusions

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TEACHING AND LEARNING PHILOSOPHIES THAT SECONDARY SCHOOL TEACHERS USE TO DEVELOP CRITICAL-THINKING SKILLS IN LEARNERS IN SOUTH AFRICA

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Abstract

Learners' success and acquisition of critical skills depend on the philosophy of teaching and learning that teachers practise in classrooms. Critical thinking allows individuals to become more independent, creative and effective problem-solvers; skills that are essential for success in any field. The purpose of the paper is to examine how secondary school teachers use teaching and learning philosophies in classrooms to develop critical thinking skills in learners. The study used a qualitative research approach and a multiple case-study design to understand the participants' perspectives. The study population consisted of 43 Grades 10-12 secondary school teachers within a circuit of the Buffalo City Metro (BCM) District in the Eastern Cape, South Africa. The sample size consisted of 12 teachers. Purposive sampling was used to select the participants based on set criteria. The researchers used semi-structured and focus group interviews to collect data from participants. The study used thematic analysis methods to analyse data. The findings revealed that teachers used progressivism and social constructivism as teaching and learning philosophies to develop critical thinking skills in learners. The authors conclude that teachers who practise relevant philosophies of teaching and learning in the classroom help develop the learners' intellectual and perceptive capacity within the educational systems. The finding implies that when teachers applied the principles of the social constructivist and progressive theories, they created positive learning outcomes and academic success for their learners.

Keywords: *Critical-thinking skills, secondary school, social constructivism, South Africa, teaching and learning philosophies.*

1. Introduction and background of the study

Learners' success and acquisition of critical skills depend on philosophies of teaching and learning that teachers practise in classrooms. Critical thinking allows individuals to become more independent, creative and effective problem-solvers; skills essential for success in any field (Ssenkusu & Muganga, 2019). Critical thinking skills are one of the soft skills that secondary school learners ought to acquire to succeed in work or tertiary education. In this regard, the present paper examines the philosophies of teaching and learning used by secondary school teachers to help Grades 10-12 learners develop critical-thinking skills in Eastern Cape, South Africa. In the context of the paper, critical-thinking skills are defined as "(an) individual's thought process(es) that begin(s) with the intent to solve a problem or to answer a question, by examining different options and choosing the most suitable and loyal one." (Alsaleh, 2020. p. 21).

Secondary school teachers attempt to adopt philosophies of teaching and learning that promote learner engagement in the classroom and effective learning. A teacher's belief about how learners learn to acquire skills and knowledge will be informed by philosophies of teaching and learning. Nevertheless, some teachers underestimate the significance of education philosophies in the delivery of lessons. In the context of South Africa, it was reported that teachers did not consider philosophies of teaching and learning to be necessary in delivering lessons in classrooms due to the lack of knowledge, and time-consuming and multi-grade classrooms (Orchard & Davids, 2019). Zhou *et al*. (2019) note that the main elements of the philosophy of teaching and learning are the descriptive details of how the teacher thinks a child learns and how he/she will facilitate the learning process to meet the learning needs of the child.

2. Problem statement and study objectives

The concern in this paper is that many secondary school learners complete their secondary school education in South Africa without acquiring soft skills such as critical thinking and problem-solving skills

which could help them in their future work environment and tertiary education (DBE, 2022). The problem lies with teachers not having enough knowledge about philosophies of teaching and learning and therefore, cannot equip the learners with the necessary critical-thinking and problem-solving skills.

A study conducted in South Africa on the importance of soft skills and the consequent lack thereof explains that the lack of soft skills (such as critical thinking) prevents learners from adapting to tertiary education and thus makes it difficult to thrive (Taylor, 2016). To fully engage learners in active learning, critical thinking needs to be an essential part of the learning process. Therefore, the paper aims to examine teaching and learning philosophies that secondary school teachers use to develop critical-thinking skills in learners in South Africa.

3. Theoretical framework

The study utilised the social constructivist learning theory to collect and analyse data. It was suitable for the study topic because it is a theory for teaching and learning (Akpan, Igwe, Mpamah & Okoro, 2020). Vygotsky envisioned that knowledge would be socially constructed using interaction with people in various contexts (Frederick-Jonah, 2022). According to Elliott, Kratochwill, Littlefield Cook and Travers (2000, p. 256), constructivism is "an approach to learning that holds that people actively construct or make their own knowledge and that reality is determined by the experiences of the learner." Overall, the social construction of learning highlights the importance of understanding the complex and dynamic relationship between individuals, culture, and learning to promote effective learning and development.

The theory is based on the premise that learners construct new ideas based on their own prior knowledge and experiences. In other words, by reflecting on their experiences, learners construct their own understanding of the world they live in. The essence of the social constructivist theory is that it places the learners' own efforts at the centre of the teaching and learning process (Singhal, 2017).

4. Research methodology

The researchers used the interpretative paradigm to conduct the study and achieve its purpose. Kivunja and Kuyini (2017) define the interpretivist paradigm as a theory where emphasis is placed on trying to understand and interpret the viewpoint of the participant or how they interpret contexts. The interpretative paradigm helped the researchers interpret participants' viewpoints and analyse the data using thematic analysis. Furthermore, the researchers used a qualitative research approach in the form of a multiple-case studies research design to understand the phenomenon explored from the perspective of the participants. A multiple-case study design is defined as an in-depth analysis of an occasion or occurrence of a naturalistic phenomenon (Tracy, 2019).

4.1. Study population and sampling

The study population consisted of 43 secondary school teachers from Circuit Five (5) within the Buffalo City Metro (BCM) District in the Eastern Cape. The study considered Grades 10 -12 teachers only. The sample size consisted of 12 secondary school teachers. The researcher selected three (3) schools within the district. To avoid bias in the process of selecting the participants, four (4) teachers were considered from each school to make a sample size of 12 participants for the semi-structured and focus group interviews. In the context of non-probability sampling, the study used the purposive sampling method. Kumar (2011) notes that purposive sampling relies on the researcher's own judgment to select suitable participants who hold information to meet the research objectives. Purposive sampling was appropriate for this study because the teachers were recruited based on selection criteria.

4.2. Data collection and analysis

To obtain reliable data on the topic in secondary schools, the researchers conducted one-on-one semi-structured interviews and focus-group interviews. Semi-structured interviews were conducted individually with participants (Adams, 2015). The researchers conducted semi-structured interviews with the 12 secondary school teachers who formed part of the sample size. The focus-group interview with 12 teachers sought to understand the perspectives and experiences of the participants in the study. The reason behind choosing a focus-group interview was to gain detailed information on the philosophies of teaching and learning that participating teachers used in the classroom (Nyumba *et al*., 2018).

This study used the thematic analysis method to analyse data from semi-structured interviews and focus group interviews. Kiger and Varpio (2020) define thematic analysis as an analytical-qualitative method used to understand experiences across a data set. The thematic analysis helped to identify themes from data that proved to be beneficial to address the research question of this study (Maguire & Delahunt, 2017).

5. Findings

Table 1 presents the themes and sub-themes that emerged from both semi-structured and focus-group interviews with the participants. The interview questions related to teaching and learning strategies associated with the philosophies teachers used to develop critical thinking skills in learners in their classrooms.

Table 1. Themes and sub-themes about developing critical thinking skills in learners.

Themes	Sub-themes
1. Teaching-learning strategies to implement an education philosophy	1. Problem-based learning
	2. Sharing thoughts and ideas
2. Importance of critical thinking skills in learners	1. Participating in learning process
	2. Fulfilling aim and objectives of subject contents

The following sub-sections develop the themes and sub-themes presented in Table 1. The researchers first present the data under each sub-theme before analysing them. The discussions of the findings follow in another section.

5.1. Theme 1: Teaching-learning strategies to implement an education philosophy

Using strategies to implement an education philosophy requires a reflection of one's view regarding teaching and learning. During interviews, teachers reported giving learners a positive learning experience by putting their views into practice.

5.1.1. Sub-theme 1: Problem-based learning approach. Teachers reported that problem-based learning involved presenting learners with situations or challenges from the real world that called for them to come up with solutions as a team. They stated that problem-based learning was an effective procedure for implementing their chosen philosophy of teaching and learning. Teacher (P5) explained as follows:

> *I used problem-based learning to identify problems and interact with learners to determine solutions. A difficult and real-world problem or scenario is presented to start the learning process.*

The teacher (P12) commented the following:

> *The learners in my classroom were provided with challenges and allowed to use probing tactics to gain more understanding of the challenge. I guided them toward developing a solution for each challenge or problem provided.*

The analysis of the quotes reveals that teachers used problem-based learning as an approach to create critical-thinking skills in their learners. The finding implies that progressivism was used as a philosophy of teaching and learning to develop critical thinking skills in the learners. The quotes indicate that the teachers used to pose problems from real-life contexts to the learners, which helped them understand how the knowledge they acquired can be applied in real-world situations.

5.1.2. Sub-theme 2: Sharing thoughts and ideas. During interviews, teachers reported that they created a conducive environment where learners could feel respected and valued by encouraging collaboration and open communication. This strategy resulted in a more positive and inclusive learning environment. Teacher (P7) explained the process of sharing thoughts and ideas as follows:

> *I allow the learners to contribute to the lesson by sharing their thoughts and ideas on teaching and learning. This improves their communication skills. Sharing ideas guarantees exposure to various ideas and thoughts from other learners.*

Another teacher (P10) stated as follows:

> *I enable my learners to actively engage with the materials, take responsibility for their learning, and contribute their original perspectives and ideas to the educational process. Along with improving educational quality, this method equips learners with the skills they need for the rest of their lives.*

The findings reveal that teachers provided learners with opportunities to improve and enhance their critical thinking skills by encouraging them to engage with and critically analyse the ideas and opinions of their peers. The inference of these findings is that the application of philosophies that give priority to each learner's unique needs and strengths can be facilitated by the exchange of ideas.

5.2. Theme 2: Importance of critical thinking skills in learners

Critical thinking enables learners to carefully process information and identify areas of weakness. The following sub-themes have been generated based on teachers' responses on the importance of critical thinking skills in learners.

5.2.1. Sub-theme 1: Participate in learning process. Teachers reported that learners were allowed to form part of the learning process. During interviews, the teachers were asked to explain how they made learners participate during a lesson. Teacher (P3) explained as follows:

> *I allow my learners to participate in the learning process. This allows them to feel included in the lesson and become more confident. I urge learners to assess what they have learned, identify their areas of weakness, and set goals for future learning.*

Another teacher (P3) stated as follows:

> *Learner-centred practices allow learners to participate in the learning process. By doing this, teachers create a platform where learners broaden their knowledge by learning from others.*

The analysis of the quotes reveals that teachers promoted the active participation of learners in the learning process. Due to learners participating in the lessons, it became easier for the teachers to include them in all discussions and increase their confidence and seek knowledge by communicating with others. Therefore, teachers have utilised social constructivism as a philosophy of teaching and learning to cater to the tailored needs of learners.

5.2.2. Sub-theme 2: Fulfilling the aims and objectives of subject contents. During semi-structured interviews and focus group interviews, teachers stated that they ensured that their philosophy of teaching and learning assists them in achieving the lessons' objectives. Teacher (P4) reported as follows:

> *Teachers are required to set aims and objectives that are central to the subject contents. These aims and objectives should be achieved in a specific time frame. This allows learners to focus on the aspects that are relevant and ignore other aspects.*

Teacher (P6) said:

> *I find that aims and objectives are used to track the progress of both the teacher and the learner. I ensure that I teach the correct content and use adequate assessment strategies to test the learner's ability to successfully follow instructions and retain valuable information that I taught them.*

The analysis of the quotes reveals that critical thinking abilities are developed when the subject's aim and objectives are met within a social constructivist framework. Within the framework of social constructivism, learning is framed by the accomplishment of subject aims and objectives. When the aim and objectives are met, it shows that learners have engaged with the content and have gained a deeper comprehension of the subject.

6. Discussion of the findings

Teaching strategies and direct reports confirm that secondary school teachers were implementing the social constructivist philosophy to develop critical thinking skills. The findings revealed that secondary school teachers used problem-based learning and the sharing of ideas to implement a social constructivist philosophy in the classroom. This finding is supported by Akpan *et al*. (2020) who suggested that the social constructivist philosophy can only be implemented if learners create their knowledge and actively participate in learning by sharing what they have learned and experienced.

Social constructivism places a strong emphasis on the contribution that social interaction and dialogue make to the creation of knowledge and understanding. A study conducted by Singhal (2017) revealed that learners' ability to create knowledge stems from their understanding of society. This philosophy also holds that learning takes place when learners actively engage in social activities like teamwork, problem-solving, and group discussions. In the context of this present study, secondary school teachers believe that the creation of knowledge depends on the accomplishment of subject-related goals and objectives.

The teachers used progressive philosophy in classrooms, hence fulfilling course objectives. Participating in the learning process and fulfilling the aims and objectives led to teachers and learners realising the importance of critical thinking skills. According to Alsalem (2018), progressive philosophy encourages creativity and curiosity in addition to making learners consider the knowledge they obtained and the conclusions they made. In other words, it emphasises the importance of practical experiences and links these to learners' daily lives. The inference from the present findings is that critical thinking skills are developed when the aims and objectives of courses are met within a social constructivist framework.

7. Conclusions

The paper focused on examining the views of secondary school teachers on the philosophies of teaching and learning practised in the classroom to develop critical-thinking skills learners. Teachers used progressivism and social constructivism as philosophies of teaching and learning to develop critical thinking skills in learners. The present findings suggest that teachers practised progressivism to develop

problem-solving skills in the learners. Instead of being passive consumers of knowledge, learners in progressive classrooms actively participated in the process of their learning.

Based on the findings, the authors conclude that teachers who practise relevant philosophies of teaching and learning in the classroom help develop the learners' intellectual and perceptive capacity within the educational systems. The implication from the findings and conclusion is that, when teachers applied the principles of the social constructivist and progressive theories, they created positive learning outcomes and academic success for their learners. This paper contributes to the philosophy of education by identifying philosophies of teaching as one of the tools that can be used to develop learners' intellectual and mental capacity.

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EDUCATION OF PHYSIOTHERAPY STUDENTS IN THE FIELD OF MOVEMENT PATTERNS AND ANALYSIS OF THEIR LEVEL

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Abstract

Introduction: Physiotherapy is a physically demanding profession that requires optimal physical fitness to handle work demands. Early prevention of musculoskeletal disorders, which represent the most prevalent health issues in this profession, is crucial even during the course of study. Musculoskeletal health is significantly influenced by the quality of movement patterns. Therefore, it is essential to emphasize the development of proper movement patterns in physiotherapy students, both to support their own health and prevent injuries, as well as to ensure the long-term sustainability of their ability to meet professional demands. Methods: The research sample consisted of 42 first-year undergraduate physiotherapy students, including 33 women and 9 men, aged 19–21 years. The Functional Movement Screen (FMS) was used to analyze the students' movement patterns. FMS is designed to assess movement quality, including mobility, stability, symmetry, and overall movement patterns. The FMS consists of seven individual tests, with a maximum possible score of 21. Results: The students' average total score was 13.12. Women performed better in six out of the seven tests (except the trunk stability pushup). The highest scores were achieved by students in the shoulder mobility test (2.17) and on the contrary, they achieved the lowest score in the deep squat and trunk stability pushup (1.67). Previous studies suggest that individuals scoring ≤14 are more prone to musculoskeletal injuries and movement dysfunctions. Unfortunately, up to 78.58% of the tested students did not achieve an optimal score. Conclusion: The findings of the present study highlight the need to integrate exercise programs in the everyday life of physiotherapy students to improve their movement patterns. This study contributes to the prevention of musculoskeletal disorders, promotes lifestyle adjustments, and enhances the quality of life among university students. It also facilitates the transfer of acquired knowledge into practical applications within the students' future professional activities. Furthermore, the study enables students to gain experience in functional diagnostics of the musculoskeletal system and apply these insights in their professional practice.

Keywords: *Education, university students, musculoskeletal health, movement quality.*

1. Introduction

Physiotherapy is a physically demanding profession (Bello, Bonney & Opoku 2016; Al-Khlaifat et al. 2023). This profession requires high levels of physical fitness (Mirza et al. 2022). The work of physiotherapists includes carrying, moving a patient and performing physical exercises. Musculoskeletal disorders related to work are considered some of the most common health issues among physiotherapists (Tišlar, Starc & Kukec 2022). Therefore, maintaining a good physical fitness is necessary for mastering requirements of this profession (Taukobong et al. 2014; Boguszewski et al. 2021; Zhu et al 2021; Högstedt 2023).

Improving body posture and movement patterns can be considered as fundamental strategy in prevention of musculoskeletal injuries (Xu et al. 2022; Uzer et al. 2023; Koźlenia & Kochan-Jacheć 2024). The risk of musculoskeletal injuries increases with poor quality of movement patterns and low level of flexibility (Koźlenia & Domaradzki 2021). Improving the quality of body movements can increase their quantity, which in turn enhances overall health and quality of life (Swain, McNarry & Mackintosh 2024). The assessment of fundamental movement patterns has the task of determining the body segments with lack of mobility or stability. Among the general population can be lack of stability and mobility overlooked (Iljinaite 2024). The assessment of functional movement patterns and detection of movement imbalances play an important role in prediction of musculoskeletal injuries (Girard 2016; Monaco & Schoenfeld 2019; Alkhathami & Alqahtani 2024; Ünver et al. 2024).

The aim of the present study was to expand the professional knowledge of physiotherapy students in the field of movement patterns and their impact on musculoskeletal health. The sub-objectives included:

1. To familiarize students with the Functional Movement Screen test method as a way of analysing the level of movement patterns.
2. To enhance their understanding of the relationship between movement patterns, physical activity levels, and musculoskeletal health.
3. To emphasize the early diagnosis of movement deviations as a preventive tool for musculoskeletal disorders, with a focus on maintaining long-term work ability in the field of physiotherapy.
4. To provide students with theoretical and practical skills in developing intervention programs for the correction of poor movement patterns, which would contribute to the development of their professional competences.

The study also underlines the importance of comprehensive education for physiotherapy students, which prepares them for effective diagnosis, prevention, and intervention in the field of musculoskeletal health.

2. Methodology

This research was approved by the Ethics Committee of the University of Presov in Presov (No. ECUP062024PO). The research sample consisted of 42 university students (33 women and 9 men) from the Faculty of Health Care at the University of Presov, who study in the Physiotherapy study program. The average age of tested students was 19,95±0,79. The average body weight of women was 65,55±11,87, of men 82,32±12,47. The average body height of women was 168,22±6,75, of men 181,08±4,12. The Functional Movement Screen (FMS) was used to analyze the students' movement patterns. FMS is designed to assess movement quality, including mobility, stability, symmetry, and overall movement patterns. The FMS consists of seven individual tests, with a maximum possible score of 21. Data analysis was subsequently performed. Based on the data obtained about the level of their movement patterns, the students were introduced to the possibility of correcting any potential deviations.

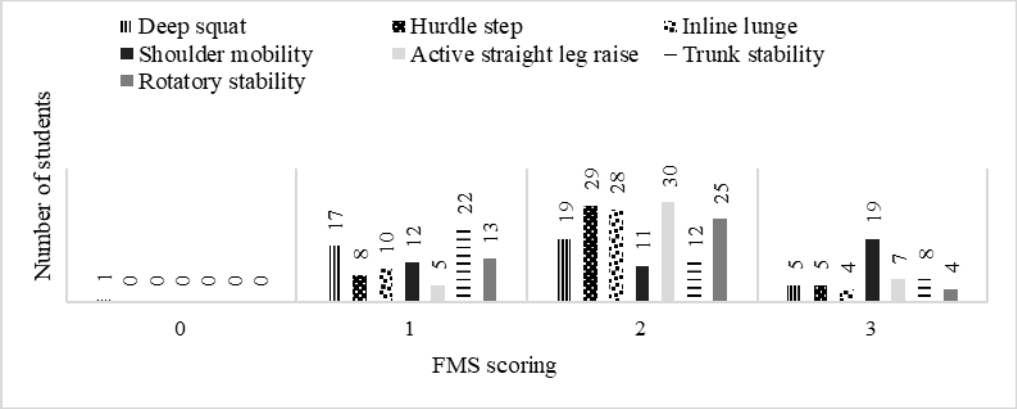
Figure 1. Functional movement screen (adapted from Vithanage et. al 2018).

3. Results

Previous studies suggest that individuals scoring ≤14 are more prone to musculoskeletal injuries and movement dysfunctions (Kiesel, Butler & Plisky 2007). In the sample of tested physiotherapy students, up to 78.58% did not achieve the established optimal score, which represents a high risk of developing musculoskeletal disorders, consequently leading to pain and injury.

The graphical representation in Figure 2 shows the score of the students in each of the FMS tests. From the data obtained, we can see that the highest score was achieved by the students in the shoulder mobility test, with 19 students achieving the highest possible score (3). On the other hand, the lowest score was obtained by the students in the deep squat and trunk stability tests.

Figure 2. Distribution of FMS score in individual tests.



In Table 1, we present the descriptive statistics of FMS score for each test, with a focus on gender differences. The analysis of the FMS results revealed that women achieved better score in 6 out of the 7 tests, namely the deep squat, hurdle step, inline lunge, shoulder mobility, active straight leg raise, and rotatory stability. In contrast, women scored lower than men in the trunk stability test.

Table 1. Descriptive statistics of FMS scoring.

		Total		Men		Women	
		Average	**SD**	**Average**	**SD**	**Average**	**SD**
Deep squat		1,67	0,72	1,56	0,73	1,70	0,73
Hurdle step	**P**	2,07	0,56	1,78	0,83	2,15	0,44
	L	2,07	0,51	2,22	0,44	2,03	0,53
Inline lunge	**P**	1,93	0,59	1,67	0,71	2,00	0,50
	L	2,02	0,60	1,78	0,67	2,09	0,58
Shoulder mobility	**P**	2,24	0,82	1,78	0,97	2,36	0,74
	L	2,36	0,76	2,00	1,00	2,45	0,67
Active straightleg raise	**P**	2,14	0,52	1,89	0,33	2,21	0,55
	L	2,17	0,58	2,00	0,5	2,21	0,60
Trunk stability		1,67	0,79	2,44	0,88	1,45	0,62
Rotatory stability	**P**	1,86	0,61	1,89	0,78	1,85	0,57
	L	1,81	0,63	1,89	0,92	1,79	0,55
Composite score		13,12	2,06	12,78	2,33	13,21	2,01

Legend: P- right limb; L – left limb; SD – standard deviation

4. Discussion

Several studies (Korpi, Piirainen & Peltokallio 2017; O'Connor et al. 2023) confirm that practical education is essential for the development of skills and competencies that are critical for physiotherapy practice. Studies by Mahmmod et al. (2019); Sawczyn (2020); Boguszewski et al. (2021); Al-Khlaifat, et al. (2023) also call for greater awareness of the physical demands of the physiotherapy profession. By familiarizing students with FMS, we have contributed to the acquisition of new professional competences of students. The most common mistakes made by students in the deep squat, hurdle step and inline lunge tests were flexion or extension of the trunk, insufficient range of motion, medial knee displacement and poor balance in asymmetric movements. These mistakes are caused by limited mobility of the lower limbs (hip, knee and ankle joints), upper limbs (shoulder joint) and also the spine (especially the thoracic spine). Another cause may be insufficient dynamic stability of the core, pelvis, knee and ankle joints. In the shoulder mobility test, the lack of range of motion may be due primarily to the shortening of the pectoralis major, latissimus dorsi, and rectus abdominis muscles. In addition, poor mobility of the shoulder girdle may also contribute. Low active straight leg raise test score may reflect shortened knee flexors and poor core stability and strength. Spinal extension and pelvic rotation are the two most common compensatory movements in trunk stability and rotatory tests. To limit these movements, it is necessary to improve the stability of the trunk, shoulder girdle and pelvis. Neuromuscular coordination and upper body strength are also essential.

By actively participating in the FMS, students learned how to correctly position the starting and ending positions of each test, how to assess the correct technique of movement execution during the tests, and how to evaluate the execution of proper movement patterns. They have acquired practical skills to identify lack of mobility and stability in the musculoskeletal system. Based on these findings, they can then apply appropriate compensatory exercises to correct the impairments.

The FMS is one of the most accessible methods available, allowing even undergraduate students the opportunity to use it in their future professional practice to assess potential injury risks (Zhang et al. 2024). Additionally, students can develop compensatory movement programs for potential patients to improve movement quality and correct movement patterns. Participation in these compensatory programs can lead to improved FMS score and enhanced movement quality in individuals (Boucher et al. 2021).

5. Conclusion

The findings of the present study highlight the need to integrate exercise programs into the everyday lives of physiotherapy students to improve their movement patterns. The study contributes to gaining experience in functional diagnostics of the musculoskeletal system and transferring the acquired knowledge to future professional practice. Additionally, study focuses on the ability to create compensatory exercise programs that aim to correct any deviations that may appear. The knowledge gained will enable students to effectively diagnose and prevent musculoskeletal disorders or impairments in the musculoskeletal system in their future practice, thereby contributing to injury prevention and the improvement of patients' motor functions. The study also contributes to the prevention of musculoskeletal disorders, lifestyle modification, and the enhancement of the quality of life for the participating students.

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THE BODY AS A VECTOR OF KNOWLEDGE: THE PSYCHOMOTOR APPROACH IN THE DEVELOPMENT OF THE SCHOOL-AGE CHILD

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Abstract

Human learning is closely linked to sensory and motor experiences. The body, with its movement, is not only a vehicle for exploring the world, but also an essential tool for the construction of knowledge (Barsalou, 2008; Wilson, 2002;). The most recent neuroscientific and pedagogical research supports the extent to which body plays, and motor activity plays a crucial role in the harmonious development of a child's cognitive and relational processes (Goodway et al., 2019). Indeed, through the body in action, not only motor skills can be improved, but complex cognitive skills such as problem solving, creativity and critical thinking can be enhanced (Gardner, 1993; Kontra et al., 2012). From this point of view, the psychomotor approach, working on the enhancement of perceptual integration, motor control and tactile, visual and proprioceptive exploration, is configured as an elective didactic methodology, with significant implications for the child's learning and general wellbeing, especially at the entrance to primary school. The pleasantness and naturalness of spontaneous motor investment builds a multidimensional bridge between physical experience and learning processes (Impara, 2019), fostering physical literacy and play literacy, and stimulating skills such as coordination and socialization (Colella, et al. 2024). The present contribution aims to explore the implications and results of the possible use of play-experiential strategies included within the curricular teaching practices in the first two years of primary school, in order to recognise the body, in accordance with the scientific literature of reference, as a primary instrument of knowledge. The possible educational implementation of motor workshops designed according to a psychomotor model, will require a sensitive and articulated design capable of overcoming the prevailing fragmentary logic of classical interventions, in favour of methodological variants characterized by a flexible, interdisciplinary and transdisciplinary vision.

Keywords: *Play literacy, motor education, motor development, psychomotor approach, primary school.*

1. Introduction

Modern pedagogical and psychological theories emphasize the importance of movement as a central component of learning supported by recent neuroscientific discoveries, which show how deeply movement influences motor, cognitive, emotional and social development of children (Priori, et al. 2009; Diamond & Carpenter, 2000; Sherrill, 2003).

Movement is not isolated from other cognitive functions, but acts synergically with perception, language and memory. Indeed, the body functions as the primary cognitive tool, a true embodied mind (Wilson, 2002), a concept that has spurred the birth of new theories and teaching methods that position movement at the core of learning process. The idea that the body is not just a physical entity separated from the mind, but a kind of vector of knowledge and awareness, has acquired increasing attention in the literature, especially in the neuroscientific and psychomotor fields, but its educational applications remain underexplored. The body is given the role of main vehicle of our experience in the world, actively partecipating in the process of knowledge construction. These assumptions are based on the integration of various scientific studies and phenomenological approaches that highlight the dynamic interaction between the body and its environment (Gallese et al., 2004; Gallese & Lakoff, 2005; Barsalou, 2008; Cottini & Rosati, 2008).

Several recent neuroscientific studies and discoveries (Chaddock et al., 2010; Iacoboni & Olivero, 2008; Jeannerod, 2012), have changed the way of conceiving the relationship between the body, action and cognitive processes, paving the way for their integration into didactics.

Embodied cognition claims that cognitive processes, such as perception and memory, are not confined exclusively to purely cerebral activity but are influenced by bodily experiences (Lakoff & Johnson, 1980); the body, in fact, through its sensory perceptions, posture, gestures and movements, contributes to structuring the way in which we understand and interpret the world, entailing profound implications in learning field because the understanding of a theoretical concept can be facilitated by direct experience, action and movement itself.

Motor experiences are thus not only a means of acquiring physical skills, but contribute directly to the development of cognitive structures that support learning by structuring images and mental pattern. If the body is the core of subjective experience, learning of a somatic origin also enables the important process of bodily self-awareness, which is crucial for developing consciousness of oneself and others, as well as one's own operating body pattern (Baccarini, 2010).

2. The growing conception of the body in education

Contemporary literature suggests that children learn more effectively through practical activities that involve the whole body, and this activate multiple intelligences (Gardner, 2012), in particular bodily-kinesthetic intelligence, readily recruited to develop and refine skills such as motor coordination, object manipulation, spatial awareness, while also enhancing abstract reasoning and comprehension skills.

Neuroscientific research shows how physical activity positively influences brain functioning by promoting neuronal plasticity, particularly during developmental age, where movement based-play strengthens brain connections (Wilson, 2020). In fact, exercise in general increases the production of "brain-derived neurotrophic factor" (BDNF), a protein that promotes brain cell growth and strengthens synaptic connections, thus improving learning and memory abilities (Ratey & Loehr, 2011). According to the literature, children who participate in regular motor education programmes show better emotional regulation skills and lower levels of anxiety and depression compared to their less active peers (Chaddock-Heyman et al., 2014).

Studies on the psychomotor approach, on the other hand, demonstrate that bodily play can act as an effective tool for the development of the body pattern, spatial-temporal coordination and motor control, and so on, children who participate in educational activities that include motor and psychomotor play show improvements in both motor and cognitive skills (Maulini et al., 2016) but also in social and relational skills (Sutherland et al., 2014). Moreover, the introduction of psychomotor programmes brings significant improvements in all developmental areas, suggesting that these kinds of educational interventions influence early and in a targeted way disadvantages resulting from motor difficulties (Piek et al., 2008).

3. The psychomotor approach

The psychomotor approach, developed during the 20th century thanks to the contributions of De Ajuriaguerra, Wallon, and Vygotskij, focuses on the relational and affective dimension of the educational process, claiming that the body is an essential vehicle for learning and the construction of the child's identity.

Psychomotor activity is configured as an elective teaching methodology, with significant implications for learning and overall well-being of children of developmental age, especially in the 2-8 age group. This approach leverages play as a multifunctional activity that fosters the overall growth of the child (Mancini & Rossi, 2018). In fact, the freedom and enjoyment inherent in play naturally support the development of motor and cognitive skills, creating a bridge between physical experience and learning processes (Impara, 2019). As highlighted by recent studies, motor play supports physical literacy and play literacy, stimulating skills such as problem-solving, coordination and socialization (Colella, et al. 2024).

In support of these theories, in the Italian context, educational policies have introduced experimental projects over the last two decades to promote motor literacy. These include the "Motor Literacy" project (2010-2012), which involved the participation of external experts to support the teaching of motor education in Italian primary schools. Subsequently, in 2015, the 'Sport di Classe' project was introduced, with the aim of fostering sports education through the presence of qualified tutors in the fourth and fifth grades. More recently the "Scuola Attiva Kids" programme, promoted by the Ministry of Education from 2021, aimed to encourage movement and sports culture since primary school, with the direct involvement of motor science experts, which currently involve only students of second and third grades. The most significant change occurred only in 2022 with the enactment of Law 234/2021, which introduced the motor education specialist teacher in primary school.

Since the 2022/2023 academic year, motor education for fourth and fifth-grade students has been entrusted to teachers of motor sciences selected through competitive procedures. This marks a historical turning point, because it recognises the importance of specialised teaching for motor activity since primary

school, fostering a greater awareness of the importance and dignity of the discipline of motor education defined as a 'hinge' discipline, therefore, integrative of other knowledge (MIUR,2018).

According to literature, neuroscience and current legislation, children's intellectual development is based on a continuous interaction between action and thought. They learn about the world through physical actions, such as catching, pushing, and handling objects, all within a complex tonic dialogue (De Ajuriaguerra, 1977), which in the educational context is expressed through physical actions and empathic observation. During the transition to primary school, children require need and resources to face complex emotions and establish meaningful relationships with peers. Structured play activities guide them in exploring their motor and communicative potential, employing multisensory stimulation to encourage creativity and free expression (Perrotta, 2011). By emphasizing the role of affective relationships in motor learning, the aim is also to develop body awareness and the ability to express emotions through the playing body, as a means of emotional, interpersonal and intrapersonal knowledge (Aucouturier, 2005).

4. Educational practices and pedagogical implications

The psychomotor approach can be effectively integrated into the educational field because it is characterised by practices that range from spontaneous movement to more conscious forms of body control. Children are invited to experience different ways of movement, using different materials such as fabrics, balls, hoops, which serve as tools for exploration and bodily mediation.

This approach works through laboratory-based didactics, offering valid alternative to the traditional frontal lesson: it allows to deal with disciplinary content in a dynamic and creative environment. Educational paths implemented in this way operate in line with school regulations (MIUR, 2018) that emphasise the need to promote active and integrative learning processes. The body becomes a fundamental part of didactics, that in order to be effective, theoretical knowledge must be placed combined with bodily experience, trying to create connections between the declarative knowledge of "knowing" and the procedural knowledge of "knowing how to do" (Sibilio, 2007).

Designing psychomotor pathways means enhancing perceptive integration, motor control, tactile, visual and proprioceptive exploration, all implemented according to the children's developmental peculiarities, with a progression from sensory discovery to emotional decentralization.

During psychomotor play, the child elaborates personal experiences, transforming them into symbols and learning to manage emotions through a continuous dialogue between body and mind, in a learning context that allows the connection of the sensorimotor dimension with the cognitive and emotional one (Vecchiato, 2007). Educational environments, redesigned from a psychomotor perspective, become spaces of exploration and discovery, where children can freely experience their motor potential, developing skills of coordination, balance and control of the body. Such activities are not merely physical training, they represent a profound opportunity for growth (Sarama & Clements, 2019). Through activities such as rolling, jumping or the manipulative use of simple materials such as mats, building blocks or boxes, children exercise control over reality.

Planning an educational action with a psychomotor approach means creating flexible and inclusive contexts that enhance each child's resources and promote their global development. Free body play is the type of activity that specifically promotes psycho-physical wellbeing, allowing the child to integrate emotions and movement in a controlled environment, and these processes activate a profound awareness of the bodily self, contributing to psychological balance (Finocchiaro 2006).

5. Conclusions

As an educating community, the school, is today called to reconsider traditional teaching methodologies, embracing approaches that place the bodily and playful dimension of the educational experience at the centre. Psychomotor activity is increasingly emerging as a scientifically based practice, capable of promoting the integral development of the child through an intentional and structured motor experience (Nicolodi, 2019). The educational implementation of an effective psychomotor model requires an articulated design that overcomes the fragmentary logic of traditional interventions. Practices should be characterised by a holistic vision that integrates bodily, cognitive and emotional dimensions, favouring playful-experiential methodologies. Through play, children can freely express their feelings, both positive and negative, and learn to manage them in a healthy way. Interacting with others during play also enhances the development of social skills, such as cooperation, sharing and respect for rules, and at the same time, stimulates cognitive development, encouraging the development of intelligence, creativity and learning. The teacher's role is fundamental in contextualizing the use of the body as a means of achieving multiple knowledge, creating safe and stimulating environments and offering children the opportunity to grow up healthy and ready to take on educational but also everyday challenges. This approach promotes autonomy

and interaction with peers and adults (Chiappetta Cajola, 2013; UNESCO, 2005). Despite growing recognition of play as an effective educational tool, challenges remain, particularly regarding the need for greater standardization in implementation methodologies and further research on its long-term impact. The psychomotor approach calls for a fundamental rethinking of teaching practices, promoting a vision of learning that values bodily experience and individual potential. In light of these considerations, teacher training represents a crucial challenge for the adoption of scientifically and pedagogically sound methodologies. Future research should focus on defining structured educational intervention models and assessing their long-term effectiveness.

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HEALTHTEK eLEARNING PLATFORM: AN ONLINE APPROACH TO ON BIOMEDICAL ENGINEERING

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Abstract

Learning-related Bioengineering and Biomedical Engineering are increasingly becoming societal needs and challenges. The study plans for each of these degrees offered by universities allow for a certain specialization in the different sub-areas within biomedical engineering through electives: orthopedics, microbiology, robotics, biosensors, or artificial intelligence applied to clinical data, among others. However, society demands subject knowledge that is not as extensive as that of a degree but is sufficiently complete for the population to be empowered in the field of technologies applied to health and quality of life. The objective of the HealthTEK virtual campus is to design, implement, and validate an eLearning platform focused on open access training in different areas as an introduction to biomedical engineering: Health 4.0, biomechanics, surgical robotics, biosensors, genetics and genomics, anatomy and physiology, and artificial intelligence applied to health and wellbeing. The methodology followed was based on four steps: a) planning a gamified pedagogical strategy, building structures for the educational units; b) designing and implementing units; c) deploying with students/users; d) validation. The methodology included one iteration, adjusting content based on feedback obtained after assessment using SUS and USE standardized tests. An international co-teaching strategy has been implemented, as professors from four different institutions have participated in the co-creation of the content. This allows students to have a more realistic experience of the use of technologies for biomedical applications, but within an international network. The virtual platform presents the units under asynchronous access, which includes the use of gamified activities for both content presentation and evaluation. These stages promote students' active engagement in building the learning content and effectively integrating that knowledge, enabling its later retrieval, use, and transfer.

Keywords: *eLearning, biomedical engineering, asynchronous online teaching, gamification, international co-teaching.*

1. Introduction

Health has consistently been a central focus in education and research, particularly with the integration of digital technologies in recent decades. In this context, the HealthTEK: Technology for Healthcare education using smart Gamification project has been actively advancing over the past three years.

The project aims to establish a virtual campus for students in medicine and medical engineering, facilitating the development and hosting of interdisciplinary modules such as biosensors, data analysis, and artificial intelligence. A key deliverable of the project is a pedagogical manual that provides recommendations for effective teaching strategies, emphasizing gamification and interactive learning approaches (Van Gaalen et al., 2021; Dost et al., 2020; Subhash & Cudney, 2018). The manual underscores the importance of fostering an engaging and enjoyable learning environment while moving away from traditional classroom dynamics, where rigid teacher-student roles are prevalent.

An innovative smart module was developed to evaluate student knowledge acquisition through interactive methods. This module incorporates a time-based escape game with a variety of question types, including multiple-choice (single and multiple correct answers) and true/false formats.

The proposed methods were piloted in several European educational institutions, including the University of Deusto (Spain), ESTIA Institute of Technology (France), Francisco de Vitoria University (Spain), and Bialystok University of Technology (Poland). Student satisfaction was assessed through both quantitative and qualitative methods, providing essential insights for refining the teaching process

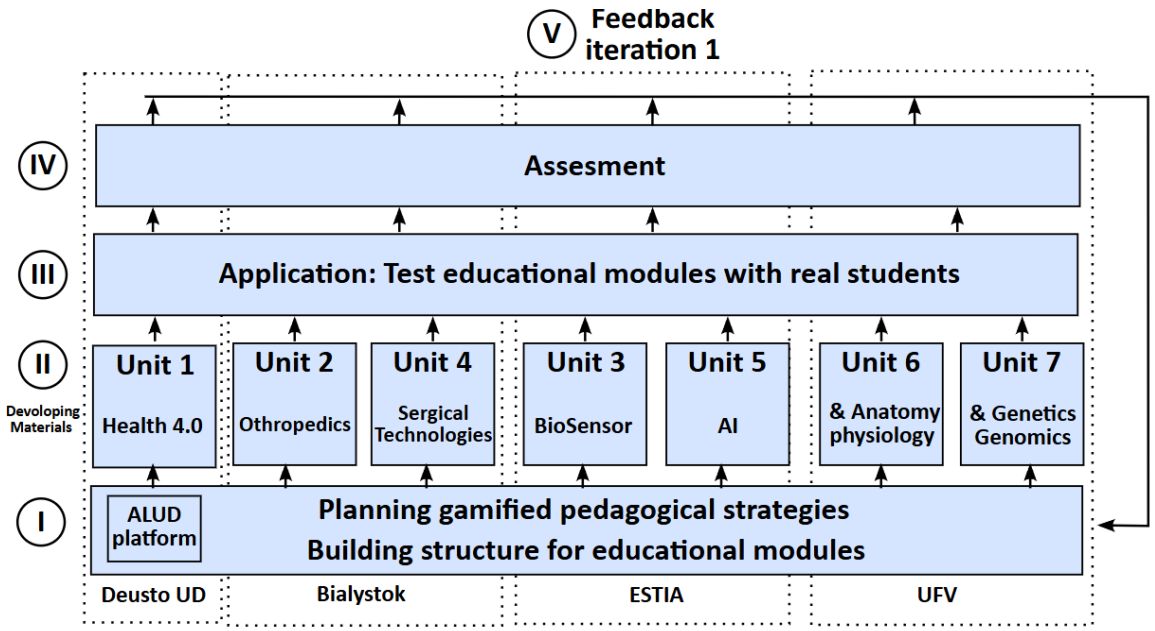
All materials developed through the HealthTEK project, including the pedagogical manual and smart module, are publicly available to educators and institutions, promoting broad adoption and adaptation of these innovative approaches in healthcare education taking as references previous works as Johnson & Patel, 2021.

2. Methodology and proposed design

The diagram of figure 1 outlines a structured process for developing and testing educational modules, focusing on health and medical technologies. It follows a phased approach, from planning to implementation, assessment, and feedback. The process is divided into five key levels: a) Level I: Planning and Structure Building, b) Level II: Developing Educational Materials, c) Level III: Application & Testing, d) Level IV: Assessment, e) Level V: Feedback & Iteration.

The diagram highlights a cyclical approach, where feedback from the assessment stage is looped back into the development process to ensure continuous improvement.

Figure 1. Proposed methodology of the HealthTEK learning platform.



Level I: Planning and Structure Building: this stage focuses on designing gamified pedagogical strategies and building the foundation for educational modules. The ALUD platform plays a key role in supporting this phase. Different institutions (Deusto UD, Bialystok, ESTIA, UFV) contribute to the development of these strategies.

Level II: Developing Educational Materials: Various units (topics) are created, each focusing on a specific area of health technology: Unit 1: Health 4.0, Unit 2: Orthopedics, Unit 3: BioSensor, Unit 4: Surgical Technologies, Unit 5: Artificial Intelligence (AI), Unit 6: Anatomy & Physiology and Unit 7: Genetics & Genomics.

Level III: Application & Testing: The educational modules developed in Level II are tested with real students to evaluate their effectiveness in learning environments.

Level IV: Assessment: This stage involves assessing the impact of the educational modules, gathering data on student engagement and learning outcomes.

Level V: Feedback & Iteration: Based on the assessment, feedback is collected and used to refine the educational modules in an iterative process to improve their effectiveness.

3. Results

The HealthTEK project successfully developed and implemented a virtual campus aimed at revolutionizing healthcare education through gamification. A key output was the creation of the HealthTEK virtual campus itself, a gamified learning platform designed to enhance student engagement and improve learning outcomes. This platform integrated a Moodle-based Learning Management System (LMS) with interactive modules, educational games, and virtual patient simulations. Key features included gamified games such as Clinical Cases Game, Biomedicine Game (an escape room), Genomics Case Game, and a Maze Game designed to reinforce knowledge. The platform emphasized flipped learning, personalized learning experiences, and international collaboration among students.

Regarding the evaluation of the Virtual Campus HealthTEK, we learned from previous experiences (Vaughan & Williams, 2025; Singh & Thomas, 2024) and designed a methodology based on various questionnaires, including the SUS questionnaire, USE questionnaire, and a private questionnaire, were used to gather quantitative indicators related to the assessment of the accessibility and usability of the virtual campus. The virtual campus HealthTEK engaged both staff and students. Indicators defined for this case included the number of students testing the virtual campus, the number of staff using it, and the number of stakeholders reviewing its content. In each category, we achieved a sample size of over 30 participants ("n = 30") for each indicator.

Another significant achievement was the integration of the HealthTEK platform into the academic programs of several partner institutions. Specifically, the platform was incorporated into three official degree programs at the University of Deusto, ESTIA, and Bialystok University of Technology for bioengineering specializations, as well as at the University Francisco de Vitoria and the University of Deusto for medical studies. This integration allowed a diverse group of students to benefit from the innovative teaching methods offered by the platform.

The project also focused on the creation of high-quality educational content. Modules were developed covering a range of topics, including cardiology, biomechanics, genomics, computer-assisted orthopedics, rapid prototyping, and digital radiology. In addition, a dedicated "Health 4.0 Unit" was created, which focused on advanced digital health technologies and included case studies on the application of gamification in healthcare and the improvement of quality of life. Interactive resources such as video tutorials, self-assessment tests, and gamified activities were designed to further enhance autonomous learning.

To support the effective use of the HealthTEK platform, a comprehensive methodological handbook was developed. This handbook provided EU-adapted guidelines for teaching biomedical engineers and doctors using immersive gamification techniques. The handbook served as a valuable resource for educators, ensuring they were equipped to effectively integrate the platform into their teaching practices.

A standout feature of the HealthTEK project was the development of a smart module to personalize suggestions adapted of every student using a gamified activity. This personalized learning system used gamified approach to adapt content to individual student profiles, providing a tailored learning experience. The system incorporated learning analytics capabilities to provide descriptive, predictive, diagnostic, and prescriptive insights into student performance, allowing educators to better understand and support their students' learning journeys.

To ensure the successful adoption of the HealthTEK platform, online practical training sessions were conducted for faculty members from partner institutions but there are still some challenges (Gupta, Sahu, & Sharma, 2020) to face. These sessions familiarized them with the platform's features and methodologies, enabling them to confidently integrate the platform into their teaching.

Dissemination activities played a crucial role in raising awareness and promoting the project's outcomes. Multiplier events were organized to inform the Life Sciences community about the innovative teaching technologies developed within the project. Additionally, publications and conferences were used as platforms to share insights on gamified learning in healthcare education.

4. Conclusions

The HealthTEK project laid the groundwork for long-term impact in the field of life sciences education. By offering virtual campus services to professionals seeking skill upgrades, the project fostered a culture of lifelong learning. It also facilitated the creation of international networks of educators and researchers interested in advancing technology-driven education in life sciences, ensuring the project's impact extends beyond its initial duration.

A gamified learning approach makes education more engaging by incorporating elements like points, badges, and challenges. By turning lessons into interactive experiences, students feel more motivated to participate and progress.

This method encourages a sense of achievement, reinforcing positive learning habits and making the process more enjoyable. Gamification also introduces friendly competition, problem-solving, and storytelling, which help keep learners focused and invested. Additionally, instant feedback allows students to track their growth and make improvements along the way, leading to a more dynamic and effective learning experience.

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PRESENTATION DESIGN FOR THE COURSE TUNNEL ENGINEERING

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Abstract

To play an active role in this situation, high education would be in a transforming way to meet the diverse needs of the society. As a traditional course needs redesigning, well-designed presentations for the course are necessary. Here is the presentation design for the course Tunnel Engineering at Chang'an University in China, with the considerations of the practical situation, the contents and features of the subject knowledge, the styles of the information available, the focus for the course stages, the efficiency of the students' knowledge building and the evaluation of the course procedure. The design plan is executed in a dynamic way, in which the contents and styles of the presentation are tuned according to the evaluation results of the student's knowledge learning levels at a specified stage. The practice shows that: (1) students are skillful to find information, but they need instruction in information sampling and knowledge system building; (2) instructors should focus on the presentation of key concepts, the connections of the knowledge points, student's learning skill and capacity development; (3) adequate evaluation and active motivation are necessary and favorable to student knowledge building.

Keywords: *Design, knowledge presentation, course, tunnel engineering.*

1. Introduction

The world is increasingly changing, especially in the industrial fields. To play an active role in this situation, high education would be in a transforming way to meet the diverse needs of the society, as engineering education would play a fundamental, global, and leading strategic role in the social development (Li, 2020). Since the engineering profession need to embrace diversity and globalization in the engineering workforce and in the professional activities, the young engineers will be the well-rounded or more rounded (NAE, 2004, 2005). Therefore, engineering education is increasingly challengeable to face the practices (NASEM, 2018) and this trend will be increasingly significant in the future (OECD, 2015). On the other hand, the rapid evolution of digital technology is reshaping the educational landscape. As the Artificial Intelligence (AI)-driven technologies are reshaping both academic environments and human resource practices, the intersection of AI and education gives new ways to enhance learning experiences, personalize student engagement, and foster skills critical to the future workforce. We educators need not only to consider how to teach, learn, and adapt to the emerging trends in educational technology, but als to take advantage of the contemporary technologies. Some emerging engineering education models (Graham, 2018; Stanford2025) or New Engineering Education Plan (Li, 2020) have been in practice to meet the requirements. All of these well-accepted learning and teaching styles prefigure changing in the conventional course presentation. A traditional course needs redesigning and well-designed presentations for the course are necessary. Here is the presentation design for the course Tunnel Engineering at Chang'an University in China.

2. Background the course

In a traditional mode, engineering education contents include the fundamental scientific principles and discipline-specific knowledge, and design techniques in later years. Young engineer learns in practice, such as the on-the-job skills of teamwork, communications, ethics, etc. However, nowadays, there need a broadened engineering curriculum, with the features of diversity. Students could acquire a set of pluralistic skills and dispositions necessary for today's diverse workforce and society under an educational system, with across disciplinary contexts (Engberg, 2007). As the roles of heuristics, empiricism, rationalism, logic, ethics, and aesthetics are considered illustrating the relevance of philosophy to the practice of engineering, the modern engineering education should focus on the development of a range of attributes both from the

engineering pedagogy and liberal arts (NAE, 2004). As the reports (NAE, 2005) stated that " …engineering educators and curriculum developers must anticipate dramatic changes in engineering practice and adapt their programs accordingly" to prepare them for addressing the complex technical, social, and ethical questions raised by emerging technologies. Some of the skills identified include: good communications, high ethical standards, an ability to think critically and creatively and independently, the ability and self-confidence to be flexible, and an understanding of the importance of teamwork. The world needs well-rounded or more rounded engineers. The engineering education must adapt to this situation.

On the other hand, universities must continue to focus on the key skills, such as to teach 'core engineering' and not dilute course content with peripheral subject matter (RAE, 2007). As it is said that 'if everything on the Earth were rational, nothing would happen'. The practical situation is always not a standard or totally predefined procedure, such as to finish a civil engineering project. For example, a tunnel project is often unique indeed. This means an engineer must consider it in a logical way, with specified professional characteristics, such thinking and making decision with the help of engineering judgement. Against such a background it is proposed that a framework based on both philosophy and the history of engineering, science and technology constitutes a valid footing upon which engineers can be enabled to see and develop their profession in a suitably rounded manner (NAE, 2005).

In brief, we need a more adaptive, diverse and inclusive system of engineering education. There need changes in the curricula to broaden the context of engineering, enhance the status of the engineering profession and improve technology literacy and the public understanding of engineering. In terms of student-centered principle, the presentation style should accordingly be robust and more favorable to student knowledge acquisition.

3. Design of the course presentation

3.1. Design considerations

The considerations for the course presentation design include the followings: (1) the practical situation of the course, such as to cope with increasing knowledge points within decreasing course hours; (2) the contents and features of the course knowledge; (3) how to use the various styles of the course-related information available; (4) to design focus for each stage of the course procedure and to present them in a proper mode; (5) how to make the stage key points being connecting nodes in the students' course knowledge system; (6) how to dynamically evaluate the results of the presentations during the course procedure.

3.2. Social requirements and course focus

We are in an innovation-driven society, knowledge creates pathways to a sustainable future. For example, the social focus is shifting with a decreasing time interval, with the new technology taking the place of the old one. This situation requires students being robust and flexible. Education activity should skillfully manage both the general and professional knowledge. Engineers need not only fit to a specified engineering position but also create or lead a new engineering field. The basic attributes of an excellent engineer are of being professionally qualified and flexible to the changing world. Therefore, one of the education key features should be timely and effectively tuned, with the focus on students' knowledge building and capacity development.

3.3. Features of knowledge building

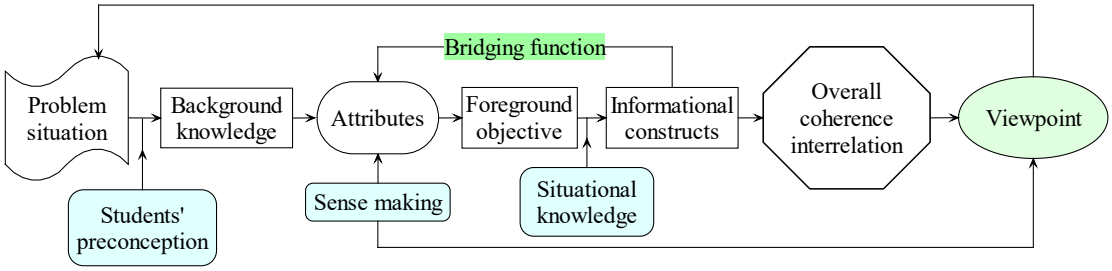
Effective learning is a knowledge building procedure. Data and information accumulation is the starting point of the process. The epistemological features of the process of intrapersonal knowledge building or creation (Labour, 2014) is sketched in Figure 1. Sense making and knowledge building require the personal ability of verbal formulations to capture the essence of various aspects of unformulated experience, such as in terms of a step towards theorizing key aspects of an informational process. It is situational interactions between a learner and the information in his or her sense-making process. This means a fusion of the perceived "external" object and learner's "internal" interpretive process related to a person's situational knowledge and expectations about an identified problem situation. This process is strengthened by the bridging function of informational constructs and bringing together attributes that deduce from learner's sense-making process. On the contrary, without reflection, such as no interaction between the students' set objective and situational knowledge, there is no viewpoint about the problem situation. The loosely built knowledge will eventually become meaningless or dissipated (Labour, 2014).

3.4. Techniques available

In terms of presentation styles, education is in a changing era. Various digital forms are emerging. It is challengeable to effectively use the techniques available in practice (Ma, 2023). As a traditional way,

such as speaking, writing on a blackboard and body language, is using, the digital mode of PPT, video, flash, online information, is increasing in presentation. The design would consider how to apply available technology at a specific learning and teaching issue or knowledge point.

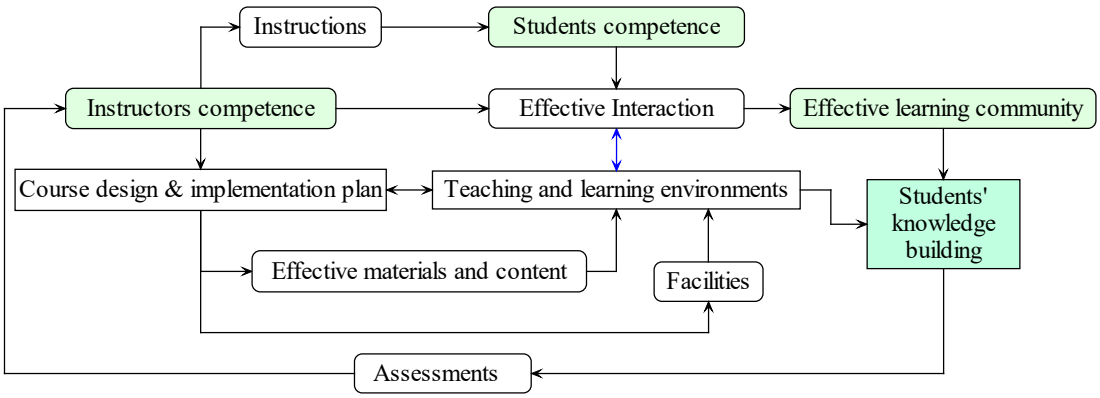
Figure 1. Sense making and knowledge building procedure (*modified from Labour, 2014*).



3.5. Presentation design

Teaching serves for learning, with special focus on the students' knowledge building and capacity development (Figure 1). Well-designed presentation will help the interaction among the students, teachers and knowledge under certain context (Kozulin, Gindis & Ageyev, 2003), as shown in Figure 2. The results of a course teaching depend on various factors, such as the competence of the instructors and students, learning environment, facilities available in teaching and learning procedure, the features of the interaction between instructors and students. As the students' learning capability is various and changing, the course presentation should be dynamically tuned under the above-mentioned considerations. A design would be in details, such as in terms of the learning objectives, presentation styles, instructional strategies and evaluation measures.

Figure 2. The key factors and their interaction in learning and teaching procedure.



3.6. Implementation and evaluation

Under a student-centered education situation, course presentation works for student's capability development (Figure 2) and the presentation design would be executed in a dynamic mode. To meet the various social requirements, the course presentation will be with college characteristics, such as in terms of knowledge-level, personal abilities and objectives. There are well-accepted parameters of personal capacity in social evaluation field, such as the Bloom's taxonomy (Anderson & Krathwohl, 2001) in thinking skills and cognitive domains. Creative thinking is in the top-level or higher-order. Therefore, the assessment should focus on the level of student achievement indicating the learners' knowledge building and capacity development, especially the potential progress in the future (Daneshfar & Moharami, 2018).

4. Presentation practice

The course presentation is dynamically designed and tuned in terms of content sampling, interaction between the learning and teaching, as well as results evaluation.

4.1. Content sampling

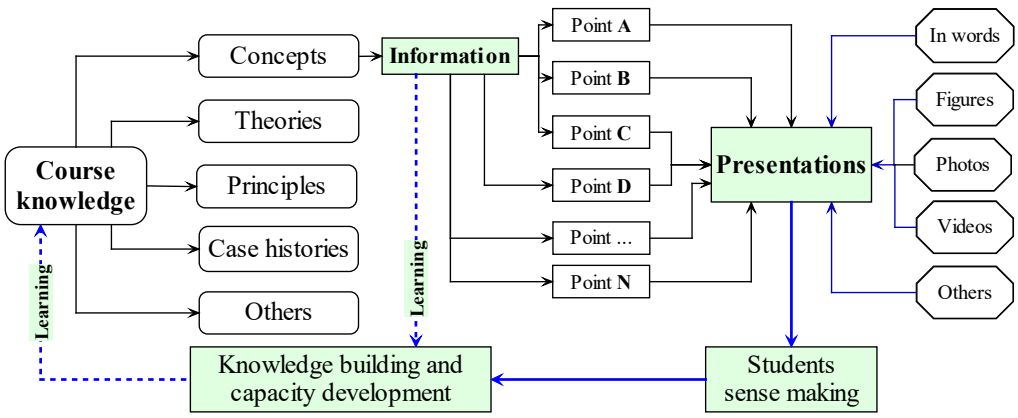
The presentation contents of the course Tunnel Engineering should include planning, design, construction, operation and management in a system mode (Ma, 2022). The subject contents related the course are increasing with time and the time assigned to the course is relatively short. For example, as tunnel and underground structures are well used in the field of transportation system, the knowledge of Tunnel Engineering is increasing with time, in terms of types, applications, building technology, the complexity of structures. From 1990 to 2024, the mileages of the tunnels in China increased 24 times and the mileages increased exceeds half of the world's total. At present, the total length of the railway and road tunnels is beyond 50000 kilometers. This situation gives China the leading position in terms of the number of tunnels, the construction market, high-speed railway and highway networks, and the development speed. Some new types are built, such as immersed tunnels, under sea TBM tunnels. There also need new tunnel and underground structures in the infrastructure system.

To be favorable to the students' knowledge building, the course information sampling is specified to each step and stage in the learning and teaching procedure, respectively. For example, considering the both features of the students' knowledge building procedure and the course contents in terms of the relationship between information, concept, structure and their components, activating points are designed to increase student engagement and systems thinking application (Ma, 2022), with evaluation measures and scales under consideration.

4.2. Presentation procedure

We need understanding of what data, information, knowledge, and wisdom mean to us and how their interrelating enables us to define and move along a knowledge building pathway (Kaipa, 2000). People learn in practice, such as through borrowing styles and ideas from diverse sources for whatever he or she is working on. For example, engineers take ideas, knowledge and techniques from wherever engineering project in pursuit of completing its goal. Date and information could indicate us hints to do things right, while knowledge means knowing how and why to do the right things. Presentation would be helpful to students making sense on what to do, how to do, why it should (or should not) be done for specified situational knowledge. Students would transform from information accepting into an information assimilating in terms of knowledge building and capacity developing. For example, presentation starts from information, concept, as presentation points with the designed ways, such as words, figures, photos, videos, etc. And then it helps students transferring specified information and concepts into subject principles, rules, theories, as well as sense making. It is a procedure of making the information separated to be assembled into a student's knowledge system, as shown in Figure 3. It is noted that the course presentation is not only in styles of class activities but also others modes, such as self-learning, test, assignments, project working. To meet the social requirements of comprehensive capacity and underline the knowledge building, the time period of design project account for one-third of the course time, since a project-based learning would be helpful for students' information distilling and sense making (Beneroso & Robinson, 2022; Guo, Saab, Post, 2022).

Figure 3. The presentation tactics with student's knowledge building under consideration.



4.3. Evaluation

Considering the course objectives, the more effective of the transferring process of the course knowledge into students' knowledge system, the more favorable to the course procedure. The presentation score evaluated will be high. The checking of the knowledge building results would use the indexes of the thinking skills following the Bloom's taxonomy system. Effective reflection to the goal achievement or the

students learning outcomes (Figure 2) is helpful to the next learning and teaching procedure. The experience shows that it is favorable to the student's capacity development that the students' performances are positively and timely evaluated with objective-specified modes (Ma, 2023).

5. Conclusions

Base on the practice of the course presentation design and implementation, conclusions are as followings. (1) Students are skillful to find information, but they need instruction in information sampling and knowledge system building. (2) Instructors should focus on the presentation of key concepts, the connections of the knowledge points, student's learning skill and capacity development. (3) Adequate evaluation and active motivation are necessary and favorable to student knowledge building.

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GROWTH THROUGH EDUCATION: A PERSPECTIVE RESEARCH ON SHORT-CYCLE PROGRAMS

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Abstract

This study examines the implementation and impact of Short-Cycle Technical Higher Education Programmes (Cursos Técnicos Superiores Profissionais – CTeSP) at the Polytechnic University of Cávado and Ave (IPCA), located in the Minho region of northern Portugal. Drawing on document analysis and institutional data, the research explores how CTeSP respond to regional labour market demands, strengthen cooperation between higher education and industry, and promote social inclusion through flexible learning pathways. Between 2017 and 2020, IPCA developed over 8,000 internships in partnership with 2,650 companies—mainly small and medium-sized enterprises—demonstrating a strong alignment with the local economic profile. The results highlight the value of co-designed curricula, hybrid teaching models, and work-based learning in enhancing graduate employability. With 35% of students attending evening or part-time programmes, CTeSP show particular relevance for adult learners and non-traditional students. Despite the positive outcomes, challenges remain concerning the transferability of this model to less industrialised regions, its dependence on European funding, and the limited academic progression options. The study concludes with recommendations to support the sustainability and expansion of short-cycle higher education, including stable funding, enhanced vertical mobility, and context-sensitive replication of best practices.

Keywords: *Short-cycle higher education, employability, regional development, TeSP*.

1. Introduction

In recent decades, European higher education has undergone significant reforms, driven by the Bologna Process and policies aimed at enhancing its social and economic relevance (OECD, 2022). Within this context, the Cursos Técnicos Superiores Profissionais (Cursos Técnicos Superiores Profissionais (CTeSP) – Short-Cycle Technical Higher Education Programmes) have emerged as a response to regional needs, promoting employability and strengthening the relationship between higher education institutions and the productive sector. Lasting two years (120 European Credit Transfer and Accumulation System (ECTS)) and positioned at level 5 of the National Qualifications Framework (NQF) and the European Qualifications Framework (EQF), CTeSP represent a shorter, more flexible and practice-oriented route within higher education (Kirsch & Beernaert, 2011).

The Polytechnic University of Cávado and Ave (Polytechnic University of Cávado and Ave (IPCA)), located in the Minho region of northern Portugal, has played a key role in implementing these programmes. In the 2023/2024 academic year, IPCA recorded over 2,500 students enrolled in CTeSP, including around 750 (35%) in evening or part-time study, reflecting the programmes' capacity to reach diverse groups. This growth has been accompanied by a strategy of collaboration with businesses and local authorities, through curricular internships, co-designed courses, and support mechanisms for labour market transition.

Despite their regional impact, questions remain regarding the transferability of this model to other contexts, due to the heterogeneity of local economies, the reliance on European funding, and institutional capacity. This article critically examines the impact of CTeSP at IPCA, focusing on their alignment with regional labour market needs, collaboration strategies with local stakeholders, and implications for public policy in short-cycle higher education.

The article is structured into five sections. Following this introduction, a literature review contextualises short-cycle higher education within the European landscape. The third section outlines the qualitative methodology adopted. The fourth presents and discusses the empirical findings. The final section offers recommendations for the consolidation and sustainability of this model at IPCA and in other European regions with similar socioeconomic profiles.

2. Literature review

Recent developments in European higher education have reinforced the demand for flexible, accessible, and employment-oriented models. Short-Cycle Technical Higher Education Programmes (Cursos Técnicos Superiores Profissionais, CTeSP), aligned with Level 5 of the National Qualifications Framework (NQF) and the European Qualifications Framework (EQF), respond to this demand by offering technical education with strong regional ties and a practical focus (Kirsch & Beernaert, 2011; OECD, 2022). These programmes have become central to the European Union's strategic vision for employability and lifelong learning (EURASHE, 2011).

Modelled on international frameworks such as the German Fachhochschulen and North American community colleges, CTeSP were introduced in Portugal in 2014 to bridge the gap between secondary education and bachelor's degrees. They aim to provide shorter, employment-oriented programmes (Hasanefendic, Heitor, & Horta, 2016). The curriculum is organised across four semesters and includes general and technical components, along with a work-based placement in the final year, typically lasting between 610 and 840 contact hours. These programmes are particularly well-suited to peripheral regions and smaller institutions, as they contribute to territorial cohesion and the diversification of higher education (OECD, 2022; Ministry of Science, Technology and Higher Education, 2018).

The core value of CTeSP lies in their curricular flexibility and responsiveness to regional needs, preparing professionals with sector-specific skills aligned with local economies (Alves et al., 2015; OECD, 2022). At the Polytechnic University of Cávado and Ave (IPCA), this alignment is evident. Between 2017 and 2020, over 8,000 internships were organised in collaboration with 2,649 companies—mainly small and medium-sized enterprises (SMEs)—highlighting the region's industrial profile. Case studies show that employer involvement in curriculum design, alongside lecturers with industry experience, contributes positively to graduate employability and enhances company competitiveness (Hasanefendic et al., 2016; OECD, 2022). IPCA's "Courses with Companies" model, which integrates teaching in industrial environments with direct business collaboration, exemplifies this innovative hybrid approach (IPCA, 2023).

Beyond employability, CTeSP play an important role in promoting social inclusion and widening access to higher education, particularly for non-traditional students and those from disadvantaged backgrounds (Urbano, 2011). National data indicate that CTeSP students benefit more frequently from social support grants compared to bachelor's students. Additionally, perceived employability, vocational exploration, and intrinsic motivation have emerged as crucial predictors of academic adjustment and retention in these programmes (Silva, Gamboa, & Taveira, 2023; Taveira, 1997). Nonetheless, structural challenges persist. The heavy reliance on European structural funds—currently secured until 2027—raises concerns about long-term sustainability (OECD, 2022). Moreover, the limited availability of progression pathways and the lack of full academic recognition for CTeSP graduates may reduce the attractiveness of this model (Hasanefendic et al., 2016). National and European recommendations emphasise the need to enhance vertical mobility, expand recognition of micro-credentials, and secure stable, diversified funding mechanisms (OECD, 2022; EURASHE, 2011).

In addition, research on similar programmes in other European contexts—such as the Netherlands and Germany—confirms that short-cycle higher education is most effective when supported by strong partnerships with employers and flexible institutional frameworks (Hasanefendic et al., 2016; Dias & Gomes, 2018). These findings underscore the strategic relevance of CTeSP in addressing both regional development and innovation challenges.

This study adopts an exploratory qualitative approach, focusing on a single institutional case study—the Polytechnic University of Cávado and Ave (IPCA)—and the CTeSP programmes it offers. The central aim is to examine how CTeSP contribute to regional development, graduate employability, and the interface between higher education and industry, while also questioning the conditions for transferring this model to other contexts with different socioeconomic profiles.

3. Methodology

This study is based on document analysis and the examination of institutional and national statistical data. Primary sources included internal reports produced by the Polytechnic University of Cávado and Ave (IPCA, 2023), particularly the "IPCA in Numbers – School of Technical Short Cycles" report. Policy documents from the OECD (2022), EURASHE (Kirsch & Beernaert, 2011) were also consulted.

A qualitative approach was selected to allow for an in-depth understanding of local dynamics, with a focus on the Minho region and IPCA's role in implementing short-cycle higher education programmes (CTeSP). This methodology supports interpretative analysis within a specific regional context.

4. Results

The analysis of the data collected reveals three key areas of impact of the Cursos Técnicos Superiores Profissionais (CTeSP) at the Polytechnic University of Cávado and Ave (IPCA): (1) engagement with the regional business sector, (2) contribution to economic development, and (3) professional advancement of students.

Between 2017 and 2020, IPCA established 2,649 cooperation agreements with local companies, resulting in 8,267 curricular internships—an average of 3.1 internships per organisation. The majority of these companies are small and medium-sized enterprises (SMEs), with 65% employing fewer than 50 workers, reflecting the industrial structure of the Minho region. These figures suggest an effective strategy of embedding CTeSP within the local economy and tailoring training to real labour market needs. The connection between education and industry is further strengthened by the "Courses with Companies" model. In this approach, part of the teaching takes place on company premises and is delivered by professionals currently working in the field. This model has been implemented in collaboration with companies such as Deloitte, Primavera, Hydra IT, Ceiia, and Capgemini—some of which also provide scholarships or tuition support for students.

Survey responses from 161 companies that hosted CTeSP interns indicate high levels of satisfaction. Employers highlighted students' punctuality, adherence to rules, task commitment, interpersonal skills, and the technical value of their contributions. Over 90% of companies expressed willingness to host future interns. Institutional data from 2022/2023 show a total of 2,162 students enrolled in IPCA's CTeSP programmes, including 752 (35%) attending in evening or part-time mode. This proportion reflects the relevance of CTeSP for adult learners and working students, underscoring their role in reskilling and lifelong learning, as well as their inclusive potential. (Table 1)

Table 1. Key indicators of the implementation and outcomes of CTeSP at IPCA (2017–2023).

Analysis Dimension	Value
Agreements with companies (2017-2020)	2.649
Internships established (2017-2020)	8.267
Companies with <50 employees	65%
Companies with >250 employees	5%
Companies available to take on new interns	>90%
Students enrolled in CteSP (2022/2023)	2.162
Students studying after work (2022/2023)	752 (35%)
Number of companies surveyed	161

In summary, the results demonstrate the effectiveness of the CteSP model in aligning higher education with labour market demands, with measurable impacts on student employability, pedagogical innovation, and the capacity-building of the regional business sector.

5. Discussion

The findings of this study confirm the strategic role of Cursos Técnicos Superiores Profissionais (CTeSP) as tools for regional development, employability, and innovation in short-cycle higher education. The case of IPCA illustrates a successful model based on strong collaboration with local businesses, responsiveness to labour market needs, and the promotion of inclusive educational pathways.

As highlighted by Kirsch and Beernaert (2011), the success of short-cycle higher education (short-cycle higher education (SCHE)) programmes depends on their contextual relevance and the involvement of local economic actors. At IPCA, partnerships with SMEs and the adoption of co-designed training models support this view and reinforce the importance of territorially grounded higher education. This alignment between educational provision and regional context not only improves graduate employability but also contributes to the modernisation and competitiveness of businesses themselves. Survey data indicate that host companies recognise the technical contributions of interns, thereby confirming the positive economic impact of CTeSP at the local level (Hasanefendic, Heitor, & Horta, 2016; OECD, 2022).

CTeSP have proven effective both for the professional integration of recent secondary school graduates and for the requalification of adult learners. The high proportion of part-time students (35%) suggests that these programmes are reaching groups traditionally underrepresented in higher education. This inclusive dimension aligns with the objectives of European lifelong learning strategies (ET 2020). Despite their effectiveness in the IPCA context, questions remain regarding the scalability and long-term sustainability of the CTeSP model. Its current reliance on European structural funds—secured only until 2027—raises concerns about future viability in the absence of continued external financing. The OECD (2022) also identifies this as a critical constraint for the consolidation of short-cycle provision. In addition, replicating the model in other regions may be hindered by structural challenges, such as lower business density, limited institutional capacity for coordination, or economic profiles that do not support work-based learning. As Kirsch and Beernaert (2011) caution, the diversity of national and regional contexts requires careful consideration before generalising such approaches.

This study also reinforces the role of polytechnic higher education in promoting proximity, innovation, and employability. By positioning CTeSP as action-oriented programmes, the model revives the practical tradition of technical education and integrates it into a broader framework of lifelong learning, industry collaboration, and territorial development. In doing so, it contributes to strengthening the identity and mission of the polytechnic sector.

6. Conclusion and recommendations

This study examined the role of Cursos Técnicos Superiores Profissionais (CTeSP) at the Polytechnic University of Cávado and Ave (IPCA) as a model for regional development, employability promotion, and strengthening the link between higher education and the local economy. Drawing on qualitative analysis supported by institutional data, employer surveys, and academic literature, the study identified a successful model characterised by proximity, flexibility, and relevance in short-cycle provision.

The results confirm a strong alignment between CTeSP and the business ecosystem of the Minho region, particularly through partnerships with SMEs, co-designed programmes with companies, and high satisfaction levels among internship hosts. These elements reinforce the recognition of CTeSP as effective instruments for workforce qualification and innovation within the polytechnic sector. Furthermore, the high proportion of part-time and evening students highlights the programmes' capacity to attract non-traditional learners and promote social and educational inclusion, in line with lifelong learning (lifelong learning (LLL)) and territorial cohesion objectives.

However, the study also identifies key risks and limitations, notably the reliance on European funding, the difficulty of replicating the model in less economically active regions, and the lack of a comprehensive national framework for academic progression and recognition. To ensure the sustainability of the model, the following measures are recommended:

- Establish stable funding mechanisms for CTeSP to reduce dependence on European structural funds;
- Strengthen vertical pathways into bachelor’s programmes through clear progression routes and recognition of prior learning;
- Adapt and expand institutional good practices in collaboration with businesses to other regions, considering their specific economic contexts;
- Implement continuous monitoring and evaluation systems, involving local stakeholders to assess the quality and impact of CTeSP.

In summary, CTeSP represent a relevant response to the current challenges facing higher education, provided they are embedded within a coherent territorial strategy and supported by appropriate resources. The IPCA case offers valuable insights for the expansion and deepening of this model in other European regions, while acknowledging their distinct social, economic, and institutional conditions.

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INCORPORATING GEOGEBRA DISCOVERY INTO TEACHER TRAINING FOR THE PLANE GEOMETRY STUDY

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Abstract

The teaching of Plane Geometry is one of the pillars of Mathematics Education, and its understanding is essential for the development of students' logical reasoning. However, the way this content is taught can be significantly improved with the use of digital technologies, such as GeoGebra Discovery, an experimental version of the GeoGebra software that incorporates automated reasoning tools, known as Automated Reasoning Tools (ART). These commands allow teachers and students to explore geometric properties in greater depth, visualizing relationships and verifying theorems directly in the software, allowing them to verify conjectures and perform automatic proofs in geometric constructions, making the teaching and learning process more efficient. more interactive and dynamic. This article explores the use of GeoGebra Discovery software in continuing education for Mathematics teachers and investigated how GeoGebra Discovery's automated reasoning tools (ART) can contribute to teaching properties of Plane Geometry. The theoretical basis of the study is based on the Technological Pedagogical Content Knowledge (TPACK) theory, proposed by Mishra and Koehler (2006). This model recognizes that the effective use of technology in teaching requires a coherent integration between content, pedagogical and technological knowledge, and this article discusses the software's potential for mobilizing this knowledge. Considering the Design Research methodology, which allows the creation, execution and analysis of educational interventions in real contexts, the continuing education was organized in synchronous meetings, held via the Microsoft Teams platform, in which participants carried out practical activities with the software, developing geometric constructions and using automated reasoning commands to verify properties and theorems, mobilizing technological, pedagogical and content knowledge. Among the challenges faced, the initial difficulties in using GeoGebra Discovery commands and the need for more practice time to master the software stand out. However, teachers reported that the use of ART facilitated the understanding of geometric concepts and brought new possibilities to their teaching practices. The use of GeoGebra Discovery in the teaching of Plane Geometry has several didactic implications because it allows students to explore geometric properties interactively, visualizing relationships that would be difficult to perceive in static constructions. The results of the research demonstrate that the use of GeoGebra Discovery and similar digital tools should be encouraged in educational contexts, as a way to enrich the teaching of mathematics and promote the development of essential skills for the 21st century.

Keywords: *Plane geometry, GeoGebra discovery, teacher training, mathematics education.*

1. Introduction

Technological advances have impacted Mathematics Education, providing new methodological possibilities for teaching and learning. In this context, Dynamic Geometry Systems (DGS) stand out as innovative tools that allow an exploratory interactive approach to the study of Geometry. Unlike traditional methodologies, which use static representations, DGS enable the dynamic manipulation of geometric figures. This dynamism favors not only a greater understanding of geometric concepts but also stimulates critical thinking and student autonomy in the learning process (Lima & Rocha, 2022), relevant skills to be developed in the 21st century.

However, initial teacher training courses have not prepared teachers adequately, nor have they satisfactorily used the potential of digital technologies (Colling & Richit, 2019). Discussions and training take place in generic ways and are poorly contextualized with real situations (Santos & Vasconcelos, 2019).

In this work, GeoGebra Discovery was used as DGS, an experimental version of the GeoGebra software that incorporates a set of automated reasoning tools, the Automated Reasoning Tools (ART), of which the following were used in this study: *Relation*, *LocusEquation* and *Discover*. These commands

allow the user to automatically conjecture, discover, prove and verify statements about different elements of a given geometric construction, for example, congruence relations, inequalities, perpendicularity, parallelism of segments and concyclic points, as well as generate the implicit equation of a geometric locus associated with a property to be validated (Kovács, Recio, & Vélez, 2022).

The objective of this work is to present possibilities of how to incorporate the automated reasoning tools (ART) of GeoGebra Discovery in the training of mathematics teachers, since they can contribute to the teaching of properties of Plane Geometry, in addition to presenting the possible difficulties faced during this process.

In this context, the theoretical contribution, the TPACK model (Mishra & Koehler, 2006), provided conditions to explore the technological and pedagogical knowledge of the content that is mobilized by mathematics teachers during the manipulation of the GeoGebra Discovery software when developing the proposed activities. It was found that the dialogue developed during the proposed activities, the answers provided by the teachers to the questions asked by the trainers and the doubts shared by them in the meetings, in addition to the tasks produced, made it possible to conduct the analyses.

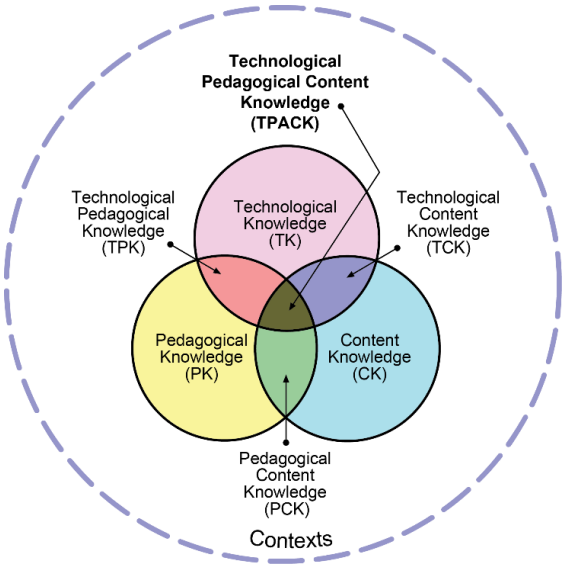
2. Theoretical framework

The TPACK (Technological Pedagogical Content Knowledge) theory, developed by Mishra and Koehler (2006), aims to analyze the integration between technological and pedagogical knowledge linked to the specific content to be taught. This approach enables understanding and description of the different types of knowledge, which is essential for a teacher to develop an effective pedagogical practice in technology-mediated learning contexts.

The authors emphasize in their work that technologies are constantly changing, an inherent characteristic of technological knowledge, which makes it essential for teachers to continually update themselves for their professional development (Koehler & Mishra, 2009). This model was conceived as an expansion of the concept of pedagogical content knowledge (PCK), introduced by Shulman (1986).

Figure 1 presents the components of the TPACK model and their intersections, all of which are part of a broader context that encompasses variables that are external to the control or specific knowledge required of teachers to teach. Furthermore, Koehler and Mishra (2009, p. 66) add that the set of knowledge that teachers need to develop encompasses “knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face”, as well as the technologies that can be used to strengthen students’ old knowledge and enable the creation of new epistemologies.

Figure 1. The TPACK framework and its knowledge components.



3. Methodology

This qualitative study used the Design Research methodology, characterized by Collins, Joseph and Bielaczyc (2004) as an approach aimed at conducting research and improving educational projects, based on empirical evidence. In addition, this methodological support allowed adjustments to be implemented throughout the process.

This methodology permeated the creation, execution and conduction of the training course, as it makes it possible to observe points for improvement and implement improvements during the investigative process – redesign – based on feedback from the five Basic Education and Higher Education teachers in Brazil, and in the trainers' meetings.

Nine synchronous meetings were held, each lasting an hour and a half, via the Microsoft Teams platform, and the data was produced by recording the interactions that occurred during the meetings, which included the sharing of screens and dialogue between participants, in addition to viewing the development of the proposed activities.

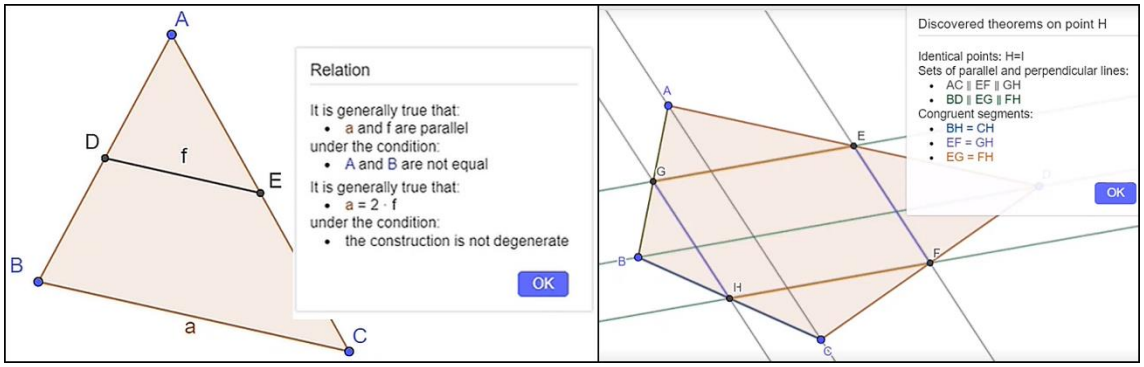
4. Discussion

To explore one of the proposed activities, which addressed the midpoint of a triangle and its reciprocal, the *Relation* and *LocusEquation* commands were used. In this context, the theorem can be stated as follows: the segment that joins the midpoints of two sides of a triangle is parallel to the corresponding base and has half its length. In addition, in the development of another activity, a question was formulated to the teachers, starting from the construction of any quadrilateral, in order to investigate the properties and the figure formed from the midpoints of its sides.

The first activity allows teachers to work with the question of how to motivate students in the classroom in the ability to formulate conjectures and, through the *Relation* tool, verify the validity of the relations (Abar & Souza, 2024). Regarding the second proposal, it is worth noting that, at first, the teachers had not understood or visualized that the figure formed was a parallelogram, and not just any quadrilateral.

Figure 2 shows on the right the result of the search for some relation between segments a and f, using the *Relation(a,f)* command. On the left, the results provided after processing the GeoGebra Discovery ART are shown, using the *Discover(H)* command. It should be noted that, to use this last resource, it is necessary to choose a point of construction to apply it, and the possible properties found will be related to this point.

Figure 2. Results of the ART responses in the triangle and quadrilateral activities.



Souza (2024) highlights the possibilities of using the *Discover* command to work on discovering geometric properties in flat figures, which involve congruence, parallelism and perpendicularity of segments and lines. This resource has the potential to develop geometric visualization skills, which allows exploring the identification of relevant geometric information in the figure, through the interpretation of the data provided by the software.

Arcavi (2003) considers that a context, in a situation involved, can enable the articulation of the formation of mental and non-mental images in the development of geometric visualization skills. In this sense, observing the TPACK model (Mishra & Koehler, 2006), evidence of the mobilization of Technological Content Knowledge (TCK) by mathematics teachers stands out, when conjecturing and thinking of possible paths, to define the location of the point that satisfied the property of the average base of the triangle or when they were articulating the interpretation of the information in the *Response Window* of the *Discover* command, with the construction and their own knowledge of the content of Plane Geometry (Souza, 2024).

Design Research Methodology (Collins et al., 2004) made it possible to carry out an analysis of the challenges faced during the training process, in order to seek changes and improvements that would overcome the difficulties experienced. The initial difficulties in using the GeoGebra Discovery commands stand out, since some teachers did not clearly understand how to apply or in which situations to use the *Discover* command. In addition, the need for more practice time to master the software.

5. Conclusions

In view of the discussions presented, it is concluded that the use of GeoGebra Discovery ART, in particular, the *Relation*, *LocusEquation* and *Discover* commands, proved to be an effective strategy for the exploration of geometric properties, contributing to the development of teachers' geometric visualization skills, during the continuing education process, by allowing them to conjecture, test hypotheses and articulate different concepts of Plane Geometry.

However, for the integration of these digital tools to be effective in the teaching process, it is necessary to consider the challenges and limitations involved. In this sense, the TPACK model considers the so-called contextual factors, for example, institutional bureaucracy and access to technological support, whether computers or internet connectivity. It is necessary that these elements be considered by teachers when developing their plans, since, in addition to specific training for mathematics teachers, it is important that they are able to prepare activity proposals that articulate the programmatic contents with the technological resources and the need to observe the contextual factors mentioned.

The data showed that the teacher training process, involving digital technologies, needs to be active and for a long time, that is, asking teachers to reflect on their practice, to produce weekly tasks that refer to their experiences in the classroom (Souza, 2024).

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'NARRATIVES OF BELONGING': VISUAL LITERACY THROUGH THE WORDLESS PICTUREBOOK 'CLOWN'

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Abstract

Wordless picturebooks give an opportunity to the nonreader children to create the story on their own and bring in their own understanding of the world to the text. Preschoolers' visual literacy which can be defined as the abilities to understand (read) and use (write) images, as well as to think and learn in terms of images, can be influenced by their exposure to wordless picturebooks. A reading of Quentin Blake's 'Clown' that presents a clown toy searching for a place to fit in is ventured. Following the hero's quest issues of belonging are implied and the moral 'one person's trash is another person's treasure' is woven. Questions are raised referring to the conditions and terms of matching, adjustments and modifications to be included. The study explores preschool children's transaction with the visual codes of 'Clown', their making sense of the notion of belonging conveyed by this wordless picturebook, and their ability of storytelling by reproducing this wordless picturebook' s narrative structure. A sample of six children, each six years old, participate in this case study, where in their reading of the wordless picturebook they interpret the visual cues in terms of the message conveyed concerning the notion of belonging, and build their own wordless narratives by following the three-act structure technique. In the qualitative content analysis of children's produced narrative speech, data from their leporello wordless narratives are coded to interpret the speech patterns of the three-act structure of the character set up, the confrontation/twist, and the resolution. Results indicate the six year old children's ability to interpret the visual code in order to comprehend the message conveyed by a wordless picturebook, and to use the visual code in combination with a narrative strategy in order to produce their own wordless narratives conveying their own experiences. The study contributes to both the fields of literature and early childhood education since it promotes the discussion on the integration of the former to the latter while attempting to develop nonreaders' visual literacy and narrative skill by exploiting wordless picturebooks' possibilities.

Keywords: *Clown, wordless picturebook, visual literacy, three-act structure, early childhood education.*

1. Introduction

Wordless picturebooks jump out from the words, enable the readers to enjoy space of imagination and creation of stories. Since there are no words at all, the reader tends to pay attention to the messages of sense of vision. Given the complex range of multimodal texts, like wordless picturebooks, Arizpe and Styles (2003) in their earlier work highlighted the sophisticated nature of children's responses to visual texts, and showcased the indispensable role that visual literacies can play in developing and supporting creative and critical thinking. It can be strongly argued that children need 'visual literacy skills, the ability to understand, to interpret, to engage critically and to create multimodal visual narratives' (Arizpe, Noble, & Styles, 2023, 96). The current study presents Quentin Blake's 'Clown' as a case of a wordless picturebook that could convey messages of the notion of belonging and be used by preschool children to inspire the generation of three-act structure through comic-strip cartoon conventions.

2. Literature review

2.1. Wordless picturebooks influence on preschoolers' visual literacy development

Wordless picturebooks connect visual literacy (learning to interpret images), cultural literacy (learning the characteristics and expectations of social groups) and literacy with print (learning to read and write language). This genre supports learners who are not yet deciphering print and build their confidence as readers and writers (Jalongo et al. 2002). Wordless picturebooks mostly rely on visual narratives, such

as images, drawings, photos, and paintings to construct narratives, where children can focus on the visuals that are the narratives themselves. Wordless picturebooks give complexity, details, consistency continuity and every complex page is completely facilitated with detail (Rizqiyani & Azizah, 2019). In reading wordless picturebooks, readers face the variety of visual signs. These sign systems help them form a type of framework that show their interpretation of the text and helps them build construction of the story (Arizpe, 2013; Crawford & Hade, 2000).

Wordless picturebooks have comprehending gaps, serving a purpose of indeterminacy, that support readers to actively engage in comprehension activities and develop multiple aspects of literacy skills (Zhang, Xue, & Lysaker, 2022). The pictorial narratives embed implied and omitted information that require readers' active effort in reading (Arizpe, 2013). Gap filling activities welcome young children's agency in meaning-making, where children can activate their skills of inferencing, imagining, and using personal experiences and background knowledge to support comprehension (Mantei & Kervin, 2014).

Jalongo et al. (2002) noted that as they invent narratives, children develop their sense of story, demonstrate an understanding of sequence, practice oral or written storytelling skills, and expand their cognitive abilities. Isbell et al.'s (2004) research has made it clear that a book with no words can provide a strong literary experience to influence the development of spoken language and children's story comprehension, especially in the development of their literacy. Moreover, more recent findings by Lysaker & Hopper (2015) on the use of wordless picturebooks indicated that when text is removed, children are able to demonstrate a greater understanding of the concept of story, as well as making inferences about the events taking place, creating dialogue and following narrative action.

2.2. A reading of notions of belonging at 'Clown' - *'One person's trash is another person's treasure'*

Quentin Blake's drawing technique, a spontaneous-looking free-flowing pen-and-ink line (Hopper Swain, 2014), creates a wordless picturebook energetic style that is encompassed in its protagonist, a clown toy running, jumping, somersaulting, miming and searching for a place to fit in. Following the hero's quest after his abandonment, issues of belonging are implied and the moral 'one person's trash is another person's treasure' is woven. Questions are raised referring to the conditions and terms of matching, adjustments and modifications to be included in and open space for interpretation is left according to readers' background experiences (Mohd Arif and Hashim, 2008) of the idea of belonging.

Pictures in Clown are presented in a cartoon style that exaggerates the protagonist's actions and appearance, a style that, according to Nodelman (1988, as cited in Hopper Swain, 2014), serves the need to be clear in their intention for the beholder to understand what is going on. The humour of the little clown's appearance is often offset by an element of pathos which could imply the smallness and vulnerability of children (Hopper Swain, 2014). These can be important factors in reading the body language of the little clown who has human characteristics when he is not playing at being a limp, soft toy. Thus, the protagonist is often placed in isolation against a white background so that the readers' attention can be completely focused on him, a strategy, which Doonan (1993, as cited in Hopper Swain, 2014) referred to as the placing of a component in a detached situation for emphasis. Establishing this interest and, perhaps, a sense of rapport with the main protagonist early on can help the readers become more involved in the unfolding narrative which is the character's search for a place to belong and the efforts that need to be made to fit in. Clown nature adjusts from animus to non-animus depending on whom it is referring to (animus in front of children and animals, non-animus in front of adults). Clown behaviour is changed from formal to informal (from entertainer/mime to defender of the rest of the abandoned toys). Clown roles are taken according to the situation (i.e., toy, mime, helper in household chores, rescuer). As Prior, Willson, and Martinez (2012) showed, children are drawn to images depicting characters' actions, facial expressions, body posture, colour and lines to explore characters' feelings. The clown's body language, expressive hands and facial expressions say it all, and Blake has given him unconfined, or unframed, space in which to perform. Frequently in this wordless picturebook there are no shadows at all to indicate the ground on which he stands, and this can accentuate the light, fleeting quality of the clown's antics (Hopper Swain, 2014). The use of framed and unframed illustrations in a way that can heighten the pictorial narrative's progress is also quite apparent in 'Clown'. In this way pictures that frame the clown's presence in concrete spaces (i.e., the dustbin, a member in the line of children in costumes, the rich apartment, the unprivileged family) appear more contained and less busy, whereas the frameless pictures depicting the clown's efforts to find a place to belong to, focus on physical action (Hopper Swain, 2014). It can be supported that the absence of frame implies a notion of shared experience between the protagonist and the reader. These sets of semantic cues, like the repetitive act of throwing (clown is thrown in the dustbin, thrown out the window, thrown like a hammer to be sent far away), according to Prior, Willson, and Martinez (2012) function as a visual strategy to generate progressive messages, messages about notions and definitions of rejection and belonging in this case.

2.3. Aim of the current study

Given that visual literacy can be defined as 'the abilities to understand (read) and use (write) images, as well as to think and learn in terms of images' (Avgerinou & Pettersson 2020, 439), as well as children are able to handle multimodal semiotic systems, to understand how and why multimodal books are produced, and to connect their conclusions after reading works such as wordless and wimmelbooks with their own experiences (Angelaki, 2024), the hypothesis of the current study is that the use of Clown's visual signs, cues and modes from preschool children could enable them to generate wordless visual narratives which notably include the basic three-act structure. In particular, the study explores 6year-old children's transaction with visual codes, their making sense of the notion of belonging conveyed, and their ability to create narratives of belonging by reproducing this wordless picturebook' s three-act narrative structure.

3. Methodology

3.1. Sample

A sample of six 6-year-old children of typical development from a Greek public Kindergarten formed the focus group in this case study. The age was chosen since their narrative skill is developed radically into distinctive developmental stages enabling the comprehension and generation of specific structural and morphological narrative elements (Applebee, 1978). In their reading of the wordless picturebook 'Clown' they interpreted the visual cues in terms of the message conveyed concerning the notion of belonging and built their own wordless narratives by following the three-act structure technique.

3.2. Framework

The present study was based on the framework of previous One Group Pretest-Posttest Design approach by Rizqiyani and Azizah (2019) concerning the use of wordless picturebooks to improve preschoolers' ability of storytelling and Kalaitzi and Panos' s (2023) P.R.O.S.E. framework to evaluate the development of narrative elements in 5 and 6-year-old children's speech through the exploitation of picture-text interaction types. Preschoolers were introduced to the reading of 'Clown', they discussed the messages conveyed regarding the notion of belonging, they distinguished the narrative's three-act structure, and they generated their own wordless narratives on the topic of belonging by reproducing the three-act structure.

4. Content analysis of preschoolers' wordless narratives of belonging

Preschoolers' performance was evaluated through content analysis of their visual narratives, on the basis that this qualitative approach treats data as representations of image patterns identified and interpreted by the researcher's personal judgment (Huckin, 2004). Specific visual cues of the three-act structure and the notion of belonging were set before the wordless picturebook reading to form the data for identification and interpretation by the researchers. After the generation of visual narratives, data from the wordless leporello folds were coded to interpret the visual patterns of the three-acts, the character set up, the confrontation, and the resolution. Table 1, below, oulines the visual patterns of the three-act structure of preschoolers' wordless narratives and the identification of the notion of belonging portrayed.

Table 1. Visual patterns of the three-act structure identified in preschoolers' wordless narratives of belonging.

	First act of character set up	Second act of confrontation	Third act of resolution	The notion of belonging connotations identified
M_Girl				***Connotations of the notion of belonging identified in divergent gender-related activities:*** *The heroine is rejected by the boys' basketball team because of her gender. She creates her own basketball team that consists of girls where she is accepted and feels she belongs.*
F_Boy				***Connotations of the notion of belonging identified in family role inequality:*** *The heroine feels as treated unfairly by the members of the family as she is doing all the household chores by herself. After the members of her family start sharing the chores she feels as an equal member that is being treated fairly.*

A_Girl				***Connotations of the notion of belonging identified in social constructions (i.e. dressing codes):*** *The heroine is being rejected by the rest of people because of her dressing choices. After insisting on wearing pants, the rest of girls start wearing pants too, so the heroine feels she can fit in.*
B_Boy				***Connotations of the notion of belonging identified in gender-associated toys:*** *The hero likes to play with a toy that is not associated with his gender. Due to his toy choice, he is marginalised until he invites his peers to play with his toys.*
K Girl				***Connotations of the notion of belonging identified in cultural constructions:*** *The hero feels alienated from his cultural customs due to his occupational choice. He feels liberated and a member of his cultural group when he joins other people doing the same occupation.*
M-E Girl				***Connotations of the notion of belonging identified in peer play:*** *The hero is separated from his friends because of his play choices that differ from the others. He becomes part of the group as soon as they all decide to share their different toys and play all together.*

All six children drew a hero for the character set up act by choosing a fictional one already encountered in their readings. They presented their characters' unique feature (i.e. a Saudi Arabia boy, a girl who wears pants in an era where women are only allowed to wear dresses, etc.). For the confrontation act, they all drew a twist that makes the hero feel isolated, rejected or alone (i.e. the boy who plays with dolls is marginalised by peers, the girl who plays basketball is rejected by the boy's team, etc.). In the resolution act, the children drew the solution to the hero's problem by placing them into a group where they belong to (i.e. a family that shares the chores makes the mother feel equally treated, etc).

Regarding connotations of belonging, children associated the notion with different concepts in their narratives. The implication of the notion of belonging was identified as the visual cue of diversity in gender-related activities, the confrontation of family role inequality, the de-identification of external characteristics based on social constructions, the deconstruction of gender-associated toys, the expansion of cultural constructions.

5. Discussion and conclusion

Preschool children's wordless narratives confirm previous findings regarding both the development of visual literacy in this age and its implications in the ability to comprehend the visual features, cues and codes when learning visual concepts and metalanguage (Arizpe, Noble, & Styles, 2023), and to generate notable narrative structures, like the three-act structure exploiting the wordless picturebook' s conventions for conveying their own versions of the notion of belonging (Kalaitzi & Panos, 2019).

Comic-strip cartoon conventions presented in 'Clown' pictorial devices (Hopper Swain, 2014), were identified in all six children's wordless narratives. Similarly to the 'Clown's non-verbalised expression of emotions, children employed the smiling mouth suggested by an upward curved line and the mouth conveying sadness by a line curving down, to express their own protagonists' range of readily recognizable moods and mental states. Three out of six children also employed the action dots that accompany balloons picturing their protagonists' thoughts usually to elaborate and emphasize the second act of confrontation in their narratives, confirming Prior, Willson, and Martinez's (2012) findings that children-readers pay attention to images that convey such kind of information of feelings and actions.

The diversity in which preschoolers framed the notion of belonging proves that, as Mohd Arif and Hashim (2008) and Mantei and Kervin (2014) noted, the reading of a wordless picturebook is an open-ended process where viewers read stories by bringing their background experiences and personal

histories to bear on the visual images they encounter within the text. ‘Clown’ leaves indeed wide-open space for interpreting the notion of belonging. The last picture in ‘Clown’ gives complexity, consistency continuity and as a complex page is completely facilitated with detail (Rizqiyani & Azizah, 2019) while conveying the story’s moral. The notion of belonging in ‘Clown’ is restored through what could be implied as the reader’s last looking-from-the-door-lock glance of a united happy family of which the clown is finally a member. Correspondingly, the notion of belonging in children’s wordless narratives is identified through the third act of resolution, where in every case they portrayed a glance of their characters belonging in a group or feeling integrated despite their diverse characteristics and behaviours.

The combined use of three-act narrative structure and comic-strip cartoon conventions functioning as a framework (Crawford & Hade, 2000), enabled preschool children to exploit comprehending gaps conventions, embed implied and omitted information (Arizpe, 2013), serving indeterminacy while conveying their own understanding of abstracted notions through visual codes (Zhang, Xue, & Lysaker, 2022) and to build construction of their own pictorial narratives, confirming Jalongo et al. (2002), Isbell et al. (2004) and Lysaker and Hopper (2015), by making inferences about the events taking place, creating non-verbal dialogue and following narrative action.

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SELF-EFFICACY AND MOTOR PERFORMANCE: THE IMPACT OF MOTOR-EXPRESSIVE ACTIVITIES IN PRIMARY SCHOOL

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Abstract

The recent scientific contributions of neuro-pedagogy map learning processes in the light of a multi-perspective vision that, recognising the existence of a circular dialogue between cognitive, experiential and bodily narrative dimensions (Damasio, 1995; Gallese et al., 2006; Glenberg, 2008; Barsalou, 2010; Caruana & Borghi, 2016), return centrality to the body in action in terms of increasing perceived self-efficacy and intrinsic motivation (Brambilla et al., 2010; Biddle et al., 2019; Errisuriz et al., 2018). The need to acquire a holistic view of the educational process in the context of Physical Educational practices and the search for methodological practices and variants that can become the crossroads of interdisciplinary dialogues (Colella et al., 2020), meet the assumption that the sense of self-efficacy influences both motivation and behaviour, as well as the ability to cope with challenges and to adopt proactive attitudes (Bandura, 1997; Schunk & Pajares, 2009). This study investigates, with reference to age group, gender and learning context (school/dance), the relationship between self-efficacy and motor performance in developmental age. The aim is to consider how and according to which theoretical and practical assumptions motor-expressive activities can fit into first-cycle schools, in order to effectively act in the horizontal and vertical curriculum, by enhancing the development of fields of experience and competences. The study involved a convenience sample of 248 children between the ages of 8 and 10, (M=75; F=174), selected by non-probabilistic sampling. The first group was provided with experiential paths of expressive movement and yoga, and a second group was offered traditional Physical Education practices. The results, investigated through the administration of the self-report PSP_C (Children's Self-Efficacy Scale) (Colella et al., 2008), show that a correct disposition of the body's musculoskeletal structures in relation to the force of gravity and the efficient and enunciative movements enabled by the prompting of the proprioceptive mechanisms of the body scheme in stasis and dynamics, promoted an increase in perceived self-efficacy in the group that practiced motor/expressive activities. This confirms that self-efficacy develops through direct experience and meaningful learning and could be a determining factor for personal growth and general well-being (Zimmerman, Cleary 2006). The educational approach declined in movement-expressive practices (Pallonetto, 2023), experiential anatomy (Olsen, Tolja, 1994), ideokinesis (Bernard et al. 2021), yoga (Bazzano et al. 2018) and educational dance (Palumbo, 2024), implemented the dimension of feeling and body awareness by opening the channels of somatic memory and sense-motor intelligence.

Keywords: *Motor education, primary school, expressive movement, dance, yoga.*

1. Introduction

The important dialogue between neuroscience and pedagogy has provided the educational community with new insights into psycho-corporeal (Damasio, 1995; Gallese et al, 2006; Glenberg, 2002; Barsalou, 2008; Caruana & Borghi, 2016) and bio-psycho-social (Nicolodi, 2015). This has led to the recognition of the body not only in terms of movement and action, but also in terms of inter-body relations, as a multidimensional entity. This multidimensionality encompasses communicative, expressive, relational and self-knowledge functions. In fact, the contributions of the neuroscientific literature describe the existence of a syncretism between cerebral, mental and motor activity (Caruana & Borghi, 2016), framing the child's development through a global perspective lens that integrates the different areas of development. This perspective reflects the application of simplexity (Berthoz, 2011; Sibilio, 2015) to the educational phenomenon. It shifts the system’s locus of control toward action, understood as an embodied and situated

form of cognition. The perception and representation of the self, in fact, derive from the construction of the mental representation that the individuals make of themself and the evaluation that they make, not only of their own actions, but also in relation to their environment and others (Bandura,1997). This perspective highlights the need to examine the multiple implications and effects on educational practices in which the body and the body in action represent a central tool for promoting integral personality developmen. In particular, it contributes to increase perceived self-efficacy and intrinsic motivation (Brambilla et al., 2010; Biddle et al., 2019; Errisuriz et al., 2018). By moving beyond the outdated notion of corporeality as a fragmented, secondary, or purely training-oriented element, motor-expressive activities seek to foster a cross-disciplinary educational approach. This approach encourages the expression of personal creativity, the development of active listening, trust, empathy, and communication skills. Furthermore, it promotes the exploration and definition of one's identity and role within a group, while fostering collaboration toward a shared goal. Given that regular engagement in motor activities plays a crucial role in both a child's psychophysical development (Strong, 2005) and the adoption of physically active lifestyles that are more likely to persist into adulthood (Telama et al., 2005), this study aims to examine the relationship between motor-expressive activities, conveyed by executive variants that recruit both quali-quantitative and spatio-temporal movement variables, and perceived self-efficacy.

2. Method and results

2.1. Objective

This study examines the role of various motor experiences, motor skills, and self-perception of abilities by comparing mean scores. The objective is to analyze differences in the effects of motor-expressive activities versus traditional motor education on children's self-efficacy perceptions during motor performances.

2.2. Sample

The present study involved a convenience sample of 248 children aged between 7 and 10 years (table 2), (M=75; F=174) (table 1), attending a primary school in the province of Salerno, in an urban context with a medium socio-economic level, selected by means of non-probabilistic sampling. Participants were divided into an experimental group and a control group. The experimental group (n=112) engaged in experiential and laboratory pathways of motor-expressive activities, including movement-expressive practices (Pallonetto, 2023), experiential anatomy (Olsen & Tolja, 1994), ideokinesis (Bernard et al., 2021), yoga (Bazzano et al., 2018) and educational dance (Palumbo, 2024). These activities were designed and conducted by a specialist. The control group (n.=136) followed a traditional Motor Education practices, proposed by the same expert. The activities, for both groups, were conducted once per week, with each session lasting 45 minutes, over a one month period.

Table 1. Gender.

		Frequency	***%***
	F	174	70.0
	M	75	30.0
	Total	248	100,0

Table 2. Age.

		Frequency	***%***
	7	31	14,2
	8	73	29,4
	9	72	29,0
	10	68	27,4
	Total	248	100

2.3. Instruments

The results were investigated through the administration of the self-report PSP_C (Child Self-Efficacy Scale), (Colella et al., 2008). The PSP_C is a psychometric instrument designed to measure self-efficacy in children in developmental age that emphasises the importance of personal beliefs in regulating behaviour and managing challenges. The scale consists of an self-report questionnaire with straightforward interpretation, which allows children to respond authentically and immediately to the questions in it, which are related to the perception of their own abilities. The PSP_C assesses three key dimensions of self-efficacy: autonomy in movement, specifically the perception of one's ability to move independently and safely; motor skills, referring to confidence in one's ability to perform physical activities and sports; and endurance and fatigue management, namely the perceived ability to sustain physical effort during movement. The questionnaire consists of six items addressing strength, speed and coordination skills with a scale of values for answers from 1 to 4 points. The children are asked to express a self-perception score corresponding to their perception during play or physical education activities.

2.4. Results

The aim of the data analysis conducted in this study was to explore the relationship between participation in motor activities and perceived self-efficacy, considering different motor activity experiences (motor-expressive activities and traditional physical education). In order to better understand this connection, the data were analysed by calculating means and standard deviations, while the ANOVA test was performed to assess the significance of differences between the examined groups (table 3). The research activity was conducted through an action-research model integrating both qualitative and quantitative approaches. The qualitative methodology involved observing students directly involved in the activity, in order to explore the subjective perception and emotional impact of the proposed bodily practices. In parallel, the quantitative approach allowed the collection and analysis of numerical data regarding the relationship between participation in motor activities and perceived self-efficacy, accounting the different types of motor practice. The results revealed that partecipants engaged in motor-expressive activities show higher mean values in self-efficacy variables compared to those who practise traditional physical education: the mean value of the 'self-efficacy_tot' variable is significantly higher for participants engaged motor-expressive activities (M=19.11, SD=2.07) compared to those who do not (M=16.20, SD=2.61). Specifically, it emerges that the practice of motor-expressive activities shows particularly high values of perceived self-efficacy, suggesting a potential contribution of this discipline to the development of confidence in one's motor skills (M=19.11, SD=2.11) compared to those who do not practice such activities (M=18.74, SD=1.92). The analysis of variance (ANOVA) highlights statistically significant differences between the groups across all the examined variables ($p < 0.001$), suggesting that participation in motor-expressive activities significantly affects the perception of one's motor skills. For instance, regarding the variable 'I1_speed', the difference between the groups is significant ($F = 30.646$, $p < 0.001$), further supporting the impact of motor-expressive activities on speed perception. The data analysis shows that children engaged in motor-expressive activities achieve higher mean scores across all assessed variables. In particular, motor-expressive activities seem to foster higher levels of self-efficacy and coordination than traditional sports. Finally, the analysis supports the hypothesis that the observed differences are not random, but rather attributable to the influence of motor-expressive activities, thus confirming their significant role in the development of motor skills and competences.

Table 3. Descriptive statistics.

		N	Weigthed average	Standard Deviation	Error std.
I1_speed	no	75	2,71	,731	,084
	Motor-expressiv	131	3,14	,523	,046
	traditional	42	3,24	,532	,082
	Total	248	3,02	,629	,040
I2_coordination	no	75	2,57	,597	,069
	Motor--expressi	131	3,08	,535	,047
	traditional	42	3,05	,439	,068
	Total	248	2,92	,585	,037
I3_force	no	75	2,71	,610	,070
	Motor-express	131	3,15	,482	,042
	traditional	42	3,05	,439	,068
	Total	248	3,00	,551	,035

I4_speed	no	75	2,79	,622	,072
	Motor-express	131	3,26	,505	,044
	traditional	42	3,19	,455	,070
	Total	248	3,10	,574	,036
I5_coordination	no	75	2,63	,785	,091
	Motor--express	131	3,18	,688	,060
	traditional	42	2,98	,563	,087
	Totale	248	2,98	,739	,047
I6_speed	no	75	2,80	,717	,083
	Motor-express	131	3,31	,570	,050
	traditional	42	3,24	,576	,089
	Total	248	3,15	,657	,042
selfefficacy_tot	no	75	16,20	2,615	,302
	Motor-esxpressi	131	19,11	2,118	,185
	Traditional	42	18,74	1,926	,297
	Total	248	18,17	2,595	,165

3. Conclusions

Self-perceptions and beliefs about one's own abilities, which arise from motor performance, are shaped and refined over the course of a lifetime, as influenced by age, gender, experiences, interpersonal relationships, and physical and psychological changes. This attributes a crucial role to the quality of physical activities performed, as these can contribute decisively not only to the formation of a positive self-image by enhancing individual self-esteem but also to the development of perceived physical self-efficacy. The present study seems to outline a methodological framework in which motor-expressive activities contribute to promoting a proper alignment of the musculoskeletal system in relation to gravitational forces. By stimulating the proprioceptive mechanisms of the body schema in both static and dynamic conditions, these activities facilitate efficient and expressive movements and may enhance perceived self-efficacy. Within the structured motor-expressive environment, children free to express and experience themselves in a protected and non-judgmental setting, were guided by a skilled facilitator who served as both a reference point and a reflective model (Minghelli & Palumbo, 2024). This experience fostered a deeper sense of embodiment and body awareness by activating somatic memory and sensorimotor intelligence. This result, although partial and requiring further validation, appears to support the idea that motor activities, when fostering discovery, sensory openness, and the integration of thought, body, and emotion (Marchesano et al., 2025), lead to an increase in perceived self-efficacy. When cultivated through direct and meaningful movement experiences (Whitehead, 2013), perceived self-efficacy emerges as a key factor in personal growth and overall well-being (Zimmerman & Cleary, 2006).

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THE ROLE OF STEM IN DATA-DRIVEN LEARNING IN THE SOCIAL SCIENCES

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Abstract

The digital age has precipitated profound changes in all aspects of human life, with education being no exception. Contemporary learning is characterised by increased interactivity, collaboration and a focus on the student as the central element of the educational process. Within a comprehensive educational framework, STEM plays a pivotal role in cultivating a foundation of theoretical and applied knowledge. The objective of the present study was to analyse the implementation of an educational approach based on Science, Technology, Engineering, and Mathematics (STEM) concepts for teaching in the Social Sciences (STSS) through data-driven learning (DLL). The focus was on the development of disciplinary content and science skills as outlined in the curricula of the degree programmes that are part of the STSS. The present study entailed a thorough review of the curricula of the Social Sciences (SS) degrees programmes, with the objective of ascertaining the proportion of STEM subjects included in the curricula. The data collection technique employed involved the retrieval of curricula, with the objective of conducting a comparative study and determining the impact of STEM on the education and outcomes of STEM students. The findings provide an overview of teachers' knowledge of STEM, as well as the development of students' scientific skills through the empowerment of ABD techniques.

Keywords: *Data-driven learning, STEM, creativity, science skill.*

1. Introduction

Nowadays, learning has become more interactive, collaborative, and student-centered. Through a comprehensive education, STEM plays an important role in the formation of the background of theoretical and applied knowledge and data-based learning.

Within the STEM model, several researchers have identified the following challenges: 1) The demand for proposals based on new theoretical-methodological precepts based on coexistence with student data (real or everyday situations (Murillo, 2013); 2) The appropriate combination of a greater solidity of STEM knowledge with the pedagogical theories and specific methodologies of the Social Sciences (SS) (Uzurriaga, 2013); 3) The construction of authentic situations of the Stem-everyday binomial (Rodríguez, 2013), to promote a better predisposition and motivation of students, as well as a greater appreciation for the usefulness and value of STEM content.

These challenges mean the need for a change of course around curricular design in the different degrees of the university education system, in order to influence the use of STEM methodology, which entails some difficulties, due to the fact that, in general, the curriculum is usually closed and inflexible (García & García, 2020).

However, it is possible to observe subjects that promote the integration of multidisciplinary contents: such as Basic Statistics, Multivariate Statistics, Experimentation and Simulation and Modelling of the Reality in which the students' activity takes place. In addition, it includes a training path related to digital technologies in which the study of software for the study of STEM content such as R, ChatGPT (among others) and applications related to the coexistence of data is incorporated.

This work includes, in addition to the introduction, a second section on the problem statement, a third section on the review of the state of the question and a fourth section on methodological discussion and evidence. The fifth section includes an analysis of the evidence related to the inclusion of STEM content in the curricula, to finally point out the limitations and conclusions.

2. Statement of the problem

In an increasingly technological and digital society, the verification of certain shortcomings in the STEM education of university students is one of the problems faced by the higher education system. The relevance of this problem is based on the fact that STEM education has become a fundamental pillar in the training of university students, as it prepares them for the knowledge society.

It is an educational approach that integrates four pillars: Science, Technology, Engineering and Mathematics, focused on learning based on the handling and management of large amounts of data, aimed at generating questions and questioning in the student, encouraging their creativity and allowing them to develop essential skills for the 21st century, such as critical thinking, problem-solving and digital skills.

STEM education improves the development of skills and knowledge through the integration of STEM subjects into the curricula of bachelor's and master's degrees and the development of teaching strategies based on the examination, design, analysis and interpretation of the data with which it coexists.

3. State of the art

In the digital age, the concept of education has evolved significantly thanks to the integration of Information and Communication Technologies (ICT), Learning and Knowledge Technologies (TAC) and Technologies for Empowerment and Participation (TEP). From this perspective, STEM education as a learning tool in a world that coexists with data has the task of preparing students to face the academic and labor challenges of the digital age.

By STEM education we mean that which promotes the integration and development of scientific-technical subjects in a single interdisciplinary framework with a didactic approach that guarantees the transversality of the teaching-learning process through science, technology, engineering and mathematics (Science, Technology, Engineering and Mathematics).

STEM training explores how communication and learning technologies redefine teaching and learning methods, becoming an essential requirement in contemporary education. The detailed exploration of STEM content in curricula allows the relevance of these contents to be evaluated in the generation of analytical, filtering and discrimination competencies of data and information and encourage active participation in student learning.

It is about understanding the impact of STEM on the educational context and on the skills of handling new technologies and how its content can be used to enrich the learning experience.

STEM education ensures that the use of "Learning and Knowledge" technologies improves and optimizes teaching and learning processes in the higher education space. That is, it develops competencies aimed at facilitating the acquisition of knowledge, skills and competencies, using digital resources such as simulations, collaborative learning platforms and interactive multimedia resources and, more recently, intelligent tutors.

STEM content makes it possible to incorporate new knowledge, skills and competencies into the students' background knowledge, through the creation of more participatory and motivating learning environments, which stimulate the generation of questions and questions, as well as the necessary motivation for the academic and professional technological empowerment of students.

In the 21st century, the teaching of STEM content represents a fundamental change in the way the teaching-learning process is conceived, pointing towards a more interactive model based on the extraction of information from the coexistence with data, and prepares students not only to overcome academic challenges, but also to thrive in a digital world.

Bybee (2013) conceives STEM as a concept that can be defined at different levels, so that we can talk about an approach, model, initiative, educational groups, policies, programs and even teaching practices of a STEM nature. This flexibility is not exempt from some criticisms, however, precisely because the use of the term has been applied with some freedom to different areas, in this sense Bybee (2013) points out that in order to be able to speak of a STEM approach or strategy, it is necessary to include some characteristics, such as the integration of knowledge, competencies and skills in the solution of a problem-situation or in the analysis of large volumes of data.

Other authors, such as García Cartagena et al. (2017, 19), mention that STEM education, within the context of integrated sciences, is understood as an approach to the teaching of science, technology, engineering and mathematics, in an interdisciplinary way, where the rigor of scientific knowledge is developed through immersive didactic activities applied to the real world.

This type of learning, which is generated under this approach, is present within all disciplines of the Social Sciences, and has been considered by various authors (Mansilla, 2010; Martin-Páez et al., 2019) as interdisciplinary learning that, in terms of Tomalá-Vera (2024), involves a process in which students

understand and assimilate different knowledge and ways of thinking from various disciplines that are integrated to achieve a new background of concepts, processes, skills, and attitudes.

That is, it would not only be about knowing or representing data, but also about testing hypotheses, also about arguing, discussing, proposing ideas, or conducting experiments. These last actions have also been identified as a fundamental part of STEM teaching.

From this perspective, learning should provide opportunities for students to develop reasoning, inquiry, argumentation, and reflection skills (Barrera et al., 2021; García & García, 2020). Moreover, this STEM approach can contribute to responding to current economic and social challenges, specifically by identifying the needs of jobs and professions to adjust new skills to job requirements, emphasizing current technological and environmental challenges.

Hence, the construction of formalized knowledge includes activities such as solving problems, inquiring, experimenting, obtaining answers, making demonstrations, posing new questions, among others. This type of procedure also includes errors, difficulties, reframing of questions, etc. The question then arises as to why not transfer these principles to teaching-learning in the SS.

This conception of education makes it possible to identify the need for learning that takes into account the formalization, with a solid theoretical basis, of the interdisciplinary or multidimensional knowledge of SS students.

4. Methodology and empirical evidence

In this research, we carried out a review of the curricula of SS degrees to determine the proportion of STEM subjects included in these plans. The data collection technique used was the recovery of the curricula to carry out a comparison between grades and establish the impact of STEM on the training and results of SS students. The findings offer an overview of teachers' knowledge of STEM, as well as the development of scientific skills in students through the empowerment of ABD techniques (see Table 1).

A first result shows that there are some extreme outlier degrees such as Law whose study plan does not include any ECTS STEM credits and Applied Statistics whose study plan includes 85% of credits related to STEM knowledge.

We also observe that the range of variation of STEM knowledge fluctuates between 5% and 25%, which implies a relatively low level of credits taught of STEM knowledge in the Social Sciences. Among the degrees with the lowest proportion of STEM knowledge are: Tourism, Social Work, International Relations, Journalism, Pedagogy, Management and Public Administration, Social Education, Criminology, Political Science and Social and Cultural Anthropology.

While 10% of the Bachelor's Degrees that teach the most STEM knowledge are made up of the Bachelor's Degrees: Business Administration, Finance, Banking and Insurance and Information and Documentation.

In general, it is possible to conclude that there is a clear deficit in the STEM training of Social Sciences students, with the exception of certain Bachelor's degrees focused on Statistics and Data Science.

*Table 1. Proportion of ECTS Credits of STEM Knowledge in the Bachelor's Degrees in Social Sciences (SS).**

Proportion of ECTS Credits of STEM Knowledge in the Bachelor's Degrees in Social Sciences (SS)*		
Bachelor's Degrees in Social Sciences	ECTS credits	% of total credits
Business Administration	60	25,0
Social and Cultural Anthropology	18	7,5
Applied Data Science	150	62,5
Political science	18	7,5
Commerce	42	17,5
Audiovisual Communication	30	12,5
Criminology	12	5,0
Business Administration UCM - HWR, Berlin	47	19,6
Bachelor's Degree in Fashion Design and Bachelor's Degree in Commerce UPM-UCM	30	12,5

Bachelor's Degrees in Social Sciences	ECTS credits	% of total credits
Economy	42	17,5
Community education	12	5,0
Applied Statistics	204	85,0
Finance, Banking & Insurance	60	25,0
Geography and Spatial Planning	36	15,0
Management and Public Administration	12	5,0
Information and Documentation	60	25,0
Pedagogy	18	7,5
Journalism	18	7,5
Advertising & Public Relations	24	10,0
International relations	12	5,0
Labor Relations and Human Resources	6	2,5
Sociology	36	15,0
Social work	12	5
Tourism	18	7,5
* Public universities in Spain offer similar degrees with similar plans of studies		

5. Limitations

Authors such as Bogdan and García (2021, 70) comment that one of the limitations related to the conceptualization of STEM as a curricular integration of four disciplines is the lack of greater empirical support to support the didactic effectiveness of this educational approach. Also the limited sample used, given that the universities that offer Bachelor's Degrees include private universities, which are not part of this pilot sample.

6. Conclusions

The STEM approach has become increasingly important in the international educational field, because it has characteristics that make it possible to integrate different elements of the four components that make it up into a learning task for the classroom.

In relation to the STEM knowledge taught in the different Bachelor's Degrees in Social Sciences, there is a clear deficit in their curricula. In general, the range of STEM credits taught in most Bachelor's Degrees fluctuates between 5% and 25%.

There is a wide dispersion between the different degrees in the inclusion of STEM knowledge in the curricula of the different degrees offered in the Social Sciences, with the exception of the degrees in Applied Statistics and Data Science, which are focused on data-based learning and the use of technological tools.

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SATISFACTION LEVEL OF PORTUGUESE PUBLIC PRIMARY AND SECONDARY SCHOOL TEACHERS WITH TEACHING PERFORMANCE EVALUATION PROCESS

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Abstract

The Teacher Performance Evaluation (TPE) has raised controversial issues, leading to changes in the evaluation models implemented in Portugal. Nevertheless, it seems consensual that it should be part of the teachers' professional development process to improve the quality of all educational activity. In this context, the main purpose of this study is to assess the satisfaction level of Portuguese public primary and secondary school teachers considering the TPE process. The study is based on a qualitative and quantitative methodology considering the literature review and the statistical analysis of the applied survey. The results show that teachers agree with the existence of a TPE model, but there satisfaction degree is negative since the professors consider the referred model as an excessively bureaucratic and inflexible process; unfairly due to allocation of quotas; causing strong pressure for assessment to be summative rather than formative in nature; leading all these problems to a climate of demotivation and mistrust among teachers which, consequently, translates into a more individualistic and uncooperative work. It was also evident that the implementation of TPE models must actively involve teachers and promote the teaching activity, in order to promote a collaborative culture, providing effective opportunities for development and professional satisfaction, with an impact on the quality of the educational action and on the improvement of schools as well as the service they provide to the communities in which they operate.

Keywords: *Education, public administration, teacher performance evaluation, satisfaction.*

1. Introduction

The Teacher Performance Evaluation (TPE) raises a wide range of theoretical and practical issues related to its implementation, and it is a difficult process to conceive and put into practice (Fernandes, 2008). In Portugal's case, it is almost an external imposition, a consequence of the systematic feedback that the Ministry of Education has received.

It comes in a scenario of profound social transformation that is having repercussions on the school context, forcing deep reflection on the educational, organisational and pedagogical framework. In this context, particular reference is made to the OECD and its various reports on the state of education in Portugal, as well as the PISA programme (Programme for International Student Assessment), promoted by the OECD since 2000, whose main purpose is to carry out an international assessment of students' learning in order to evaluate their skills and knowledge and thus provide countries with credible indicators of the success or failure of the educational policies promoted (Queiroga, 2015).

In this context and considering the central role that teachers play in the education system, specifically for its evolution and improvement and, consequently, for students' success, TPE, based on the analysis of a set of control indicators related to the quality of teaching services, has assumed particular relevance in recent decades (Queiroga, 2015). As well as their continuous training and development, with a view to improving the quality, efficiency and effectiveness of education and the school (Alonzo, Labad, Bejano, & Guerra 2021; Georgia, 2019; Marques, 2017; Mandinach & Gummer, 2016).

Nevertheless, as Silva, Machado and Leite (2014) highlight, although TPE is recognised by the teachers themselves as a necessity, this recognition disappears when it comes to developing and implementing a system that operationalises this assessment. This is because developing teacher appraisal systems that are geared towards professional development and improving practices, while at the same time monitoring activity, accountability and career management, i.e. trying to reconcile the formative function

of appraisal with the accountability function, is not an easy endeavour (Day, 1993; Avalos & Assael, 2006; Formosinho & Machado, 2010; Stronge, 2010). Therefore, considering teacher performance evaluation from a formative perspective requires the development of supervision processes, whether developed by peers or non-teaching professionals, a self-evaluation dimension and the creation of collaborative learning environments in schools. TPE would thus emerge as an instrument that facilitates teacher individual development (Wei, Chow, Huang, Huang & Cheng, 2023) and, consequently, as a driver of organisational development (Afonso, 2016; Silva et al, 2014).

However, developing and implementing a TPE system based on this logic of conciliation and valuing teachers has proved to be a very complex process. Although the appraisal process should be ethically irreproachable, treating each and every appraisee fairly, studies carried out over the last few decades have shown that this is not the case in Portugal. On the contrary, it has contributed to teachers perceiving it as a mere value judgement and not as a tool for professional development and teaching practices improvement (Queiroga, 2015), although there seems to be a consensus that it should be part of teachers' professional development process in order to improve the quality of all educational activity (Serrano, 2015).

According to Afonso (2016), as a result of political and social pressures and the transformations that have occurred in society, TPE has been used as an instrument of control and accountability, in a logic of administrative management of the teaching career and has proved to be a detrimental factor for the school climate and interpersonal relations, leading to superficial understandings and reducing performance evaluation to a purely technical instrument. Vaz (2019) reinforces this position by stating, still for the Portuguese case, that TPE has emerged more in connection with the rationalisation and management of the education system's resources and legitimised by the necessary promotion of teaching quality, rather than out of perceived need or desire for teachers' professional development. The same author concludes from his study that teachers are unfavourably disposed towards the possibility of TPE having a transformative effect on teacher practice in order to improve student learning or contribute to teacher professional development.

Even so, Afonso (2016), states that from his study it is possible to identify some positive aspects of the TPE in Portugal, namely reflection on performance appraisal, teamwork and raising awareness of the need for performance appraisal. For his part, Vaz (2019) also identifies a favourable opinion on the teachers' part in terms of accepting the presence of external and internal evaluators as a guarantee of fairness and impartiality, as well as the desire to have evaluators from the same scientific area as the teacher being evaluated, with recognised experience and professional competence and with specific training in supervision or evaluation. The data also pointed to a lack of appreciation for the participation of partners from the educational community in the evaluation process. Gamero (2018) in this regard, concludes that there is a certain ambiguity on the part of teachers in some central aspects of TPE, since, on the one hand, teachers agree with the influence of TPE on learning, highlighting indicators such as reflection, cooperation and promotion of teacher training and, on the other hand, they disagree when considering indicators such as bureaucracy, reduction of useful working time, lack of motivation, lack of knowledge sharing, bad environment and conflict of interests. This duality of perceptions on the part of teachers in relation to the TPE process was also confirmed by Serrano (2015), when he stated that teachers agree with the existence of a TPE, provided that it is fair and impartial and that it contributes to improving the conditions that determine the teaching-learning process. They also consider that evaluation should be done by the director and by colleagues from the same school, as long as they receive the needed training. However, their perception of the teaching performance assessment model is that it does not promote educational development and quality in the school, nor does it improve the teaching-learning process, but rather contributes to discontent and conflict between teachers.

From the various studies presented, we can conclude that the TPE process in Portugal is considered to be too bureaucratic and inflexible because it uses an excessive number of standardised registration instruments, making it a consumer of time and resources, which instead of improving the quality of teaching, generates conflicts and mistrust (Matos, 2014; Soares, 2013). This results in a negative conception of the TPE process as a consequence of the routinisation of professional practices, the lack of coordination between teachers, the bureaucratisation of change and the demotivation of teachers (Martins, Candeias, & Costa, 2010; Gonçalves, 2023). Based on this framework, we decided to evaluate the satisfaction level of public primary and secondary school teachers with the TPE process in Portugal.

Based on the above theoretical framework and the consequent definition of the general objective, this article is structured in four sections. The first is an introductory section with a theoretical framework and identification of the problem; the second section deals with the design and objectives of the study, and the results analysis and discussion and conclusions are presented in the third and fourth sections.

2. Design, objectives, hypotheses and methods

This study is based on qualitative and quantitative methodology using various data collection methods, which will be described in the following sub-sections.

2.1. Objectives

The main purpose of this study is to evaluate the satisfaction level of public primary and secondary school teachers with the TPE process. In order to achieve the general objective, i.e., to verify teachers' satisfaction with the appraisal process, four specific objectives were defined:

1. To understand to what extent the current TPE model contributes to teachers' personal and professional development;
2. To identify the main strengths and weaknesses of the appraisal process;
3. To analyse supervision practices in TPE;
4. To understand to what extent there should be a new appraisal model or what restructuring should be considered and implemented in the current system.

2.2. Hypotheses

Based on the literature review and the defined objectives, we have formulated the following hypotheses:

- Hypothesis H1: ADD is an important tool for teachers' professional and personal development;
- Hypothesis H2: The current SADD negatively affects school climate;
- Hypothesis H3: The current SADD negatively affects the relationship between teachers;
- Hypothesis H4: A negative perception by teachers of the ADD process negatively affects teachers' level of satisfaction and motivation.

2.3. Methods

This study was based on a qualitative and quantitative methodology using various data collection methods. The qualitative methods used were: document analysis; analysis of the open-ended questions in the questionnaire; research into online databases; articles; newspaper reports. The quantitative data collection method consisted of analysing the closed questions in the questionnaire. The questionnaire is structured in three main parts: Part I - Sociodemographic information; Part II - Teachers' appraisal of the current ADD regime and, Part III - Prospects for a new ADD model. The questionnaire consists of twelve questions, the vast majority of which are closed-ended and uses a list scale and two five-point Likert scales. Our sample consists of 198 questionnaires completed using *Google Forms*.

3. Results analysis and discussion

3.1. Socio-demographic characterization

The socio-demographic respondents' characterization is as shown in Table 1.

Table 1. Characterisation of respondents.

Variables	***Categories***	***%***	***Frequency***
Gender	Male	24,24	*48*
	Female	75,76	150
Age group (years)	Mean		52
	Age range		28-66
	20-30	1,01	2
	31-40	4,04	8
	41-50	33,33	66
	51-60	54,04	107
	Over 60s	7,58	15
Length of service (years)	Years of service range		3-45
	Less than 10 years	4,04	8
	11-15	4,04	8
	16-20	8,59	17
	21-25	19,70	39
	26-30	33,33	66
	31-35	22,73	45
	Over 35	7,58	15
Academic degree	Bachelor's degree	1,52	3
	Degree	74,24	147
	Master's degree	22,22	44
	Doctorate	2,02	4

Regarding the respondent's characterization, we found that women are more representative, with 75.76% of respondents being female and 24.24% male. They are aged between 28 and 66, with the vast majority of teachers in the 51-60 age group. The average age is 52. This confirms the scenario of a high number of retirements in the near future. As for years of service, they range from 3 to 45 years, with the majority in the 26-30 years range, totalling 56%, with an average of approximately 27 years. When we characterised the sample, we saw that the vast majority of respondents (74.24%) had a bachelor's degree, 22.22% a master's degree, 2.02% a doctorate and 1.52% a bachelor's degree. We also found that the respondents consider *evaluation to be important*, above all, for career progression (21.17%) and for promoting professional development (12.55%). Identifying training needs in order to improve the quality of teaching (11.03%) and recognising professional merit (10.39%) are very closely related. These 4 factors account for 55% of the respondents' answers.

From the average responses to each question, we can verify regarding to *supervisory practices*, that it is very common for the evaluator to be concerned about complying with legislation, with an average of 4.05 responses. On the other hand, the majority of respondents say that the least positive aspect of TPE supervision practice is the fact that the evaluator doesn't provide feedback on weaknesses, with an average of 2.85 responses.

Regarding the *main strengths and limitations of the TPE process* the teachers taking part in the study recognise few positive aspects in the current TPE model. Nevertheless, they identify training and the fact that the assessment is carried out by an external assessor as strengths of the model. Concerning the negative aspects of TPE, the agreement among respondents stands out, considering that the model does not translate into a fundamental requirement for the quality of education, not contributing to the improvement of school results or student learning or even to improving teachers' knowledge. In this regard, we can see that one of the most negative aspects lies in the existence of quotas. According to respondents, this condition gives the model a reductive and completely maladjusted character, creating a feeling of injustice. In what concerns the *contributions of the TPE process,* teachers do not recognize major contributions from the model. There is indeed an agreement regarding the development of negative feelings (discomfort, distrust, insecurity, lack of motivation, stress and a competitive atmosphere among colleagues) with an average of 4.36 responses.

4. Conclusions and hypotheses confirmation

The significance level (p-value) is $\alpha=0.05$.

From the chi-square test (χ^2) we can conclude that TPE process does not promote professional or personal development of teachers, implications only in terms of career progression, not confirming *H1*. We can also observe that the TPE model is pointed out and perceived by the vast majority of teachers as being negative. Thus, the respondents argue that the current model has caused, to a significant extent, the degradation of personal and professional relationships between teachers, generating tensions that have destabilized and penalized the school climate. Hypotheses *H2* and *H3* were therefore not confirmed. On the contrary, *H4* was confirmed, since a negative perception of teachers regarding TPE corresponds to a significant level of dissatisfaction and demotivation among teachers.

The results allow us to highlight that teachers agree with the existence of a TPE model, but do not identify with the current model and point out some gaps in the process and final results, which are not always considered fair. Teachers look at assessment as a means of advancing their careers. Therefore, they continue to consider the current model as unfair and incoherent, due to the quota granting system, which makes the transparency and fairness of the process unfeasible, generating feelings of instability and rivalry in the school and among the teaching staff.

The limitations of the ADD model also include the likelihood of inflation in assessments, largely due to the lack of definition of an evaluator profile with adequate training, which undermines the credibility of the assessment process. Furthermore, the quantification of the evaluation has a negative impact on the school environment and the excessive bureaucracy of the process.

The conclusions drawn are in accordance with the literature review carried out. We can therefore reinforce that a quality TPE model must be based on a climate of trust where teachers receive feedback on their work, have confidence in those who evaluate them, recognizing their skills, and feel that TPE effectively contributes to improving their performance. It also allows teachers to view their colleagues as potential partners and professional colleagues and not as direct competitors. Develop the feeling that the whole school is involved in a culture of mutual understanding and respect, feeling that TPE is, above all, a means for professional development and organizational improvement and not just for grading teachers.

4.1. Limitations

The main limitation of our study lies in the low response rate, which implies a weak generalization of the data.

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INNOVATIVE USE OF ARTIFICIAL INTELLIGENCE IN A MATERIALS SCIENCE SUBJECT FOR ANALYZING RESULTS

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Abstract

Artificial intelligence (AI) is gaining increasing interest over the years, and it is one of the most useful tools to be used in education, either in primary and secondary education or in university. AI is a very powerful tool to show students how to be more independent and make them main characters of their own learning. In this study, AI is used in a subject called Structures and Characterization Techniques from the masters' degree Engineering, Processing and Characterization of Materials from Universitat Politècnica de València (UPV). The main aim of this study is using AI models, such as ChatGPT or DeepSeek to help students analyse results obtained in the aforementioned subject. In this subject, different polymeric materials are characterized and their properties are evaluated. However, some properties, such as chemical bonds present in those materials are normally quite difficult to evaluate and understand by students. These chemical bonds are characterized by Fourier Transformed Infrared Spectroscopy (FTIR), which gives a spectra with different peaks associated with the chemical interactions in the molecules of the analyzed materials. The students use AI models for assisting them in analyzing these FTIR spectra. Moreover, the analysis made by students is compared with a traditional FTIR analysis. Results show that, in general, the effectiveness of AI models is superior and easier for students to use. This is corroborated by surveys made to students at the end of the subject.

Keywords: *AI models, FTIR, characterization, materials.*

1. Introduction

Artificial Intelligence (AI) is increasingly being recognized as a transformative force in education, offering novel ways to engage students, personalize learning, and improve educational outcomes across all levels—from primary to higher education. In university settings in particular, AI is not only enhancing pedagogical practices but also enabling students to take a more active and independent role in their learning processes. The use of AI in this context aligns well with the evolving educational paradigm that values critical thinking, autonomy, and the ability to engage with complex, interdisciplinary problems (White, 2020).

One of the most promising applications of AI in higher education lies in its ability to support students in analyzing and interpreting complex data (Pierdicca and Paolanti, 2022). This is particularly relevant in scientific and technical disciplines where understanding nuanced experimental results is a critical skill. In the master's program Engineering, Processing and Characterization of Materials at Universitat Politècnica de València (UPV), AI models such as ChatGPT and DeepSeek have been integrated into the curriculum of the subject Structures and Characterization Techniques. Here, AI is used as a pedagogical aid to assist students in interpreting experimental data—specifically the characterization of polymeric materials through techniques like Fourier Transform Infrared Spectroscopy (FTIR).

FTIR spectroscopy is a common method for identifying chemical bonds in polymeric materials by analyzing the peaks in the infrared spectrum (Ismail et al., 1997). However, understanding and interpreting these spectra can be particularly challenging for students due to the complexity of chemical interactions and the subtle differences in peak patterns. By incorporating AI tools into the learning process, students are given the ability to receive real-time assistance in analyzing FTIR data and understanding the molecular structures of the materials they study. This use of AI transforms what can often be an abstract and difficult subject into a more accessible and interactive learning experience.

Notably, the AI-supported approach is not meant to replace traditional methods but to complement and enhance them. In the UPV case study, students are meant to obtain FTIR spectra from two different polymers, high density polyethylene (HDPE) and polylactic acid (PLA), analyze both spectra by the traditional methodology and by AI-supported methodology, and are encouraged to compare their AI-assisted analyses with traditional FTIR interpretation techniques based on literature. In addition, feedback is collected from the students through surveys, relating to the comfortability of obtaining complex data using AI databases, in this case ChatGPT.

This study is meant to underscore the growing potential of AI to support higher education, particularly in technical disciplines where data interpretation plays a central role. As AI tools become more sophisticated and accessible, their integration into university curricula can foster deeper engagement, independent learning, and improved academic performance. However, successful implementation also requires thoughtful integration, faculty training, and an emphasis on ethical and critical use of these technologies.

2. Objectives

The objective of this study is to explore the effectiveness of integrating artificial intelligence tools, specifically ChatGPT and DeepSeek, into the Structures and Characterization Techniques course within the master's degree in Engineering, Processing and Characterization of Materials at Universitat Politècnica de València. The focus is on evaluating how these AI models support students in interpreting complex data, particularly Fourier Transform Infrared Spectroscopy (FTIR) spectra used to characterize polymeric materials. By comparing AI-assisted analyses with traditional methods and gathering student feedback, the study aims to assess the impact of AI on learning outcomes, student autonomy, and overall engagement.

3. Methods

In this study, a class of 15 students in the subject of Structures and Characterization Techniques in the master's degree in Engineering, Processing and Characterization of Materials was taken as a sample. One of the aspects of the work in this subject is analyzing the FTIR spectra of several polymers, in this case: high density polyethylene (HDPE) and polylactic acid (PLA). The analysis is carried out using a Bruker S.A Vector 22 (Madrid, Spain) coupled to a PIKE MIRacle single reflection diamond ATR accessory (Madison, Wisconsin, USA). 20 scans were taken and averaged for each measurement, between 4000 and 600 cm^{-1}. Once the spectra of both polymers was obtained, students were asked to evaluate them using IA models (ChatGPT or DeepSeek) and searching in scientific literature. Afterwards, surveys were conducted in order to assess the comfortability of students towards this new approach to evaluate more abstract and complex data such as FTIR spectra.

4. Discussion

4.1. FTIR analysis

The main scientific data obtained by students in this study was that of FTIR spectra from HDPE and PLA polymers. Figure 1 shows the spectra of both polymers made by the students. FTIR is one of the most difficult characterization techniques for students to evaluate and comprehend. Moreover, the traditional approach of analyzing it through literature is rather time consuming and not the most attractive activity for students, as it will be discussed in the following section.

Table 1 gathers an FTIR analysis made by a student of both spectra presented in Figure 1. This analysis has been done with and without the help of AI models. As it can be observed, the AI analysis fully comprehends all the wavenumber range taken in the spectra, selecting the most important peaks and bands and associating them to the corresponding chemical bond present in the polymer. Moreover, it gives certain details that add more accuracy to the evaluation and help to better understand the nature of the polymer. On the other hand, the analysis done without AI models was correct up to a point, but was missing some important details and some of the most important bands in the spectra.

Figure 1. FTIR spectra of high density polyethylene (HDPE) and polylactic acid (PLA).

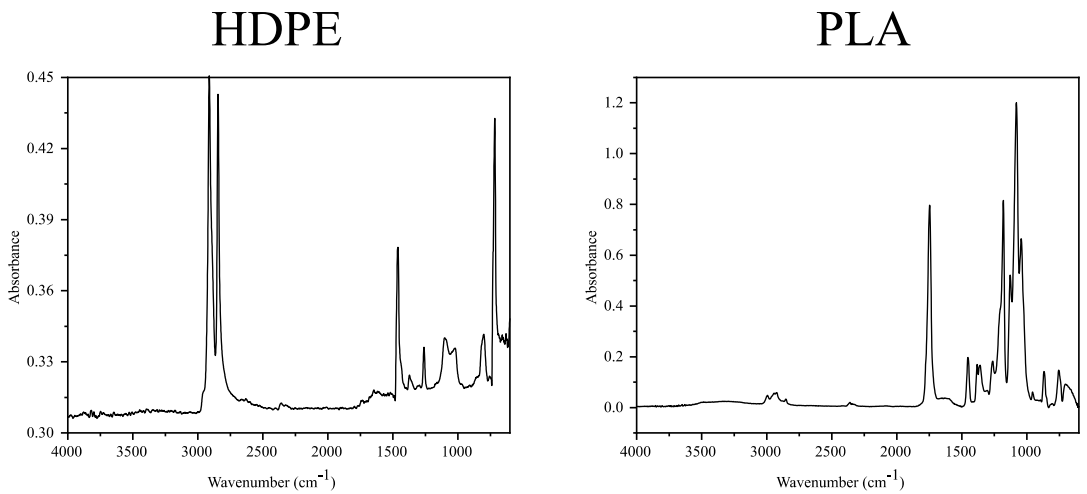

Table 1. Evaluation of the FTIR spectra made by a student based on ChatGPT AI model.

Wavenumber (cm^{-1})	**HDPE functional groups (AI analysis)**	**HDPE functional groups (traditional analysis)**	**Wavenumber (cm^{-1})**	**PLA functional groups (AI analysis)**	**PLA functional groups (traditional analysis)**
2950	Asymmetric CH_2 stretching	CH_2 – asymmetric stretching	2995-2945	C-H stretching (weak to moderate signaling corresponding to methyl and methine stretches.	C-H stretching
2915	Asymmetric CH_2 stretching	CH_2 – asymmetric stretching	1750	Strong C=O stretching. Signature peak of the ester group in PLA	C=O stretching
1472	CH_2 bending		1455	CH_3 bending (deformation)	CH_3 bending
1462	CH_3 bending	CH_3 bending	1360	CH bending	CH bending
1375	CH_3 symmetric bending	-	1180-1080	C-O-C stretching. Presence of multiple strong peaks that indicate symmetric and asymmetric stretching of the typical ester linkage of PLA.	C-O-C stretching
730 - 720	Rocking vibration of $(CH_2)_n$ sequences – particular characteristic of long alkyl chains, typical of PE	Rocking vibration of $-CH_2-$	870-750	C-COO out of plane bending. Less intensity but it can appear depending on the crystallinity and structure of PLA.	-

4.2. Students' feedback

In the final session of the subject, a satisfaction survey was conducted in all students in order to receive feedback from them about the use of AI. This was very interesting for us, as FTIR is a complex technique that every year gives rise a lot of doubts and misunderstandings about how to analyze the obtained results and how to interpret them. Table 2 shows the answers to 10 questions to which the students responded yes, no or left it blank. In general, it can be seen that the feedback was positive, as it was expected. It was observed that students found it a lot easier to analyze FTIR by using ChatGPT or DeepSeek than by the traditional method of consulting literature. Moreover, it was less time consuming and as described by some students, not so "boring". In addition, we knew that after making the analysis of the

FTIR spectra as it was required, some student further investigated about the polymers they had just analyzed, searching for their origin, applications and looking for more details about their chemical structure. This survey reflects that the use of AI is perfect for making it easier and more constructive for students to analyze complex data in the laboratory, and that it even motivates them to investigate further than what it was required.

Table 2. Answers of the students to the satisfaction survey conducted at the end of the subject.

Question	**Number of students that answered**		
	Yes	**No**	**Blank**
1. Have you ever received AI teaching methodologies in any other subject before?	1	14	0
2. Would you include AI teaching in other subjects?	13	2	0
3. Would you maintain this methodology for the next year?	13	1	1
4. Have you enjoyed using AI more than consulting literature?	10	3	2
5. Do you consider it has been easier to analyze FTIR by AI than by consulting literature?	14	0	1
6. Do you consider that your results have been better due to the use of AI models?	15	0	0
7. Do you think that the results obtained through literature have been more complete than by AI?	0	15	0
8. When you conducted the FTIR analysis by AI, did you find it more time consuming than the traditional analysis?	1	14	0
9. Did you explore further about the FTIR analysis than what it was initially required in the subject through AI?	9	3	3
10. Are you satisfied with the AI methodology used in the laboratory practices of the subject?	14	0	0

5. Conclusions

This work has proven that AI methodologies can be effectively used in practical laboratory sessions of Materials based subjects. In spite of the fact that the approach taken in this study is simple, it has considerably improved both the results of the students and their attitude towards the subject and the FTIR technique. In previous years, FTIR was seen as very complex and abstract by students, which made them dislike this part of the subject. However, this year, the use of AI has improved the concern of the students for this technique, has made them better understand it, and has also encouraged them to further investigate about the insights of FTIR and the results it provides. It has also been demonstrated the potential of AI for analyzing complex data with more ease, which can also be transferred to other different complex methodologies and even in other subjects. We plan on developing more complex approaches using AI in future years both in this subject and in other materials-based subjects.

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DIGITAL CHILDREN'S LITERATURE ANTHOLOGIES: ENGAGING NEW LITERACIES WITH TEACHER CANDIDATES IN AN INTRODUCTORY COURSE

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Abstract

Literacy teacher education has become increasingly complex given the rapid pace of technological advances and the fluidity of what counts as literacy today. In addition to having to learn how to teach traditional print literacies, teacher candidates need to develop understandings of digital and critical literacies so they can prepare their students to negotiate life, citizenship, and work in our globally networked societies. How can we prepare teacher candidates to confidently negotiate their roles as literacy educators in this ever-shifting context? This paper reports on my approach, as a literacies professor, to the initiation of new teachers into the rich, but overwhelming, field of literacies education. In an introductory literacies course, upper-elementary-level student teachers complete a single major literacies assignment -- the curation of a digital literature anthology, intended for use during practicum. The assignment requires new teachers to integrate multiple interconnected strands of literacies theory and practice. Through the lens of New Literacies Theory, student teachers engage numerous relevant areas of literacies teaching and learning. Their own learning process involves working in-between quality children's literature, social justice themes, student needs and interests, curriculum expectations, print-based literacies, and multimodal texts. The challenging experience of curating the various components of a digital literature anthology when they are in their first semester of the Teacher Education Program, allows teacher candidates to gain a quick appreciation for the nature of literacies today. They recognize the need to adopt professional dispositions open to change and complexity. Through my description of this work with new teachers, I hope to open up critical conversations on the complexities of literacies teacher education in our times.

Keywords: *New literacies, children's literature, teacher education, language arts.*

1. Introduction

Given rapid technological developments and ever-expanding understandings of what constitutes literacy in the digital era (Cope & Kalantzis, 2003; Duke & Cartwright, 2021; Dwyer, 2016; Fei, Weimin, Nguyen, 2022; Turner, Eisenstock, Hicks, Jolls, O'Byrne, Paciga, Price-Dennis, Schira Hagerman, 2025; Vasquez, Janks, Comber, 2019; Watt, 2019; 2023), literacy teacher educators grapple with how best to prepare teacher candidates for the elementary classroom. In addition to learning how to teach traditional print-based reading and writing, beginning teachers need to keep in mind that each time a new technology is introduced, new literacies are required (Leu, Kinzer, Coiro, Castek, Henry, 2018). This is an ongoing challenge, as educators are responsible for ensuring students develop the literacies needed to thrive in their everyday lives as students, as citizens in a democratic society, and in their future careers. Adapting to a rapidly shifting field can be especially overwhelming for professors and new teachers trying to situate their practice within this literacies ecosystem. How can we prepare elementary level teacher candidates to feel confident in their roles as literacy educators in this ever-shifting context of proliferating literacies? In this paper, I discuss how I respond to this challenge in the context of an introductory literacies course in elementary-level Teacher Education.

2. Teaching & learning context

I am a literacies professor in the Faculty of Education, at a large Canadian University. The Junior level (Grades 4 to 6) *Language Arts* course described in this paper is offered during the first semester of a two-year Teacher Education Program, in the province of Ontario. This is the only *Language Arts* course students take at the Junior level. They also take an introductory literacies course at the Intermediate level

(Grades 7 and 8). The Junior level *Language Arts* course discussed here takes place 3 hours per week, over a 12-week period. The Ontario Language Curriculum (2023) consists of 4 strands. These include:

Strand A: Literacy Connections & Applications – The focus on connections and applications, permits students to transfer skills and draw on knowledge from the other strands, from other subject areas, and from wider contexts

Strand B: Foundations of Language

Strand C: Comprehension: Understanding and Responding to Texts

Strand D: Composition: Expressing Ideas and Creating Texts

Our program offers an optional technologies course, but no course in Children's Literature. Given the limited literacies course offerings, it is important students receive a comprehensive introduction to literacies teaching and learning in their Junior level *Language Arts* course.

3. The issues

In addition to limited literacies course offerings in our program and a new Language Curriculum (2023) with a strong focus on *The Science of Reading* (Duke & Cartwright, 2021), the field of literacies education has become increasingly complex with the advance of new technologies. Students need a solid grounding in both traditional print-based, and digital literacies teaching and learning, in spite of time and program constraints. My past research inquires into the out-of-school video making and sharing practices of three female, Somali Canadian YouTubers, and it is important to bring such new literacies into the classroom (Watt, Abdulqadir, Siyad, Hujaleh, 2018; Watt, 2019, 2023). Knowing that teacher attitudes impact what and how they teach, how do we help new teachers appreciate the complex nature of literacies today?

4. New literacies theory

Proponents of new and multiliteracies studies regard literacy as a collection of emerging practices for communicating in diverse and multiple social and cultural contexts (Cope & Kalantzis, 2000; Lankshear & Knobel, 2011; New London Group, 1996). With regards to the issue of how to assist new teachers grasp the complex array of literacies relevant for education today, New Literacies Theory (Leu et al., 2013, 2018) provides a helpful framing. It has been proposed as an umbrella term that brings together diverse areas of research, theory, and practice within the ever-expanding field of literacies education. Alongside traditional print text, New Literacies Theory and pedagogies embrace different modes of meaning making (i.e., multimodal)—including visual, audio, spatial, and gestural (Kress, 2010). This broadened notion of literacy accounts for the expanded role digital technologies play in everyday life, including increased contact with difference both online and face-to-face. Multiliteracies pedagogies in teacher education has always been based on principles of social justice and equity, and critical literacies are also an important component of New Literacies theory and practice.

To promote a love of reading with their own students, teacher candidates are asked to reflect on what literacies are *for* (Willinsky, 2001). Literacies should be viewed not only as activities students *do* at school. Being literate informs and enriches our lives, whether we are reading the meanings others produce, or are communicating our own meanings. These key ideas ground candidates in the relevance of the literacies work they do with students. For similar reasons, literacies programs should be constructed around quality children's texts, which can be used to engage literacies development, cross-curricular content, and social justice themes.

5. The assignment

Students take my introductory Language Arts course in their first semester in the program. With so much new content, it is a challenging period in the program. When I assign the digital literature anthology, most question their ability to pull so many elements together at such an early stage in their learning. Most understand literacies within the traditional confines of print-based literacy, and one of my main goals is to expand this assumption. I purposely want the literature anthology assignment to feel like "too much" to force students to grapple with the complexity of our field. Six weeks later, when students share their anthologies with classmates, their sense of accomplishment, pride, and enthusiasm attest to the relevance and power of this assignment. After doing this for more than a decade, with 90 students each fall, this is always the highlight of the semester for everyone.

Students know one of the main goals of this assignment is to have them design learning experiences that bring together a number of components of the Ontario Language Curriculum (2023), including many kinds of literacies. By applying curriculum expectations to this meaningful teaching and

learning context, they gain hands-on experience applying curriculum and theory to practice within the meaningful context of children's literature.

The literature anthology is to be designed as an educator resource which includes 3 titles that are related around a social justice theme. Students may choose a theme they already feel strongly about teaching, or they may select a topic they want to learn more about. For example, collections written by Indigenous authors are often chosen by students who may not have been exposed to these perspectives in their own schooling. These collections are meant to be used during their first teaching practicum. Students must introduce the collection and explain how the titles are examples of quality children's literature, appropriate and relevant for students at the junior level. For each title students provide a summary, keywords, explicit links to the theme, brief suggestions for use in the classroom, and curriculum connections. They need to make links to all 4 strands of the Language Curriculum (2023) in the collection, including activities that engage reading, writing, word knowledge, listening, speaking, media/visual literacy, media production, and The Arts Curriculum (2009), which includes Drama, Fine Arts, Dance, and Music. To accomplish these goals, teacher candidates learn how to integrate curriculum expectations to create holistic and meaningful literacies learning opportunities for their students.

These literature anthologies are published as digital flyers, which are posted on our class website. Teacher candidates thus learn the importance of collaboration through sharing their work with colleagues. The ability to share with an authentic audience underlines the value of digital authorship and multiplies the number of children's literature titles and ideas for teaching each student in the course has access to for their own learning and growth. Even students without much knowledge of children's literature leave the course with a solid sense of what is available. With 40 students in each class, and 3 titles per anthology, teacher candidates have ready access to 120 titles and suggested peer-created activities. Each anthology is an exemplar of literacies curriculum design. Through sharing their work, they have multiple examples of how curriculum, theory, pedagogy, and quality children's literature can be used in the classroom to engage New Literacies learning and social justice themes.

6. Engaging the messiness of literacies teaching & learning

Teacher candidates find the task of designing a digital literature anthology challenging, but ultimately the project is enjoyable, practical, and rewarding. Sharing work with the professor and sharing it with classmates are completely different experiences, that impact content and design decisions. Publishing the collection as a digital flyer provides experience designing a digital text. Students experience the power of multimodal meaning making. They see how images, external links, video, sound recordings, as well as font, colour, and headings support meanings in the written text. Having peers as an authentic audience for their work also highlights how digital publishing can deepen engagement and learning, while improving student writing. The need for correct spelling and editing skills becomes apparent. Creating an anthology your peers might want to use in their own classroom, is also highly motivating. They also experience the uncertainty that comes with sharing their work publicly, another important lesson for educators.

Traditional print-based literacy pedagogies are taken up in the suggested activities that accompany each title. Students are required to include the full range of literacy skills in the activities, including reading, writing, vocabulary learning, speaking, listening, and digital literacy. They are also encouraged to include multimodal activities such as video making, podcasting, or art making. The open-ended nature of this assignment inspires teacher candidate creativity. As they involve themselves in the multifaceted work of putting together their literature anthology -- that includes the higher purpose of bringing social justice themes to elementary students -- they take ownership of their work and gain confidence as literacy educators. Themes engaged by teacher candidates through their chosen texts include anti-racisms, immigrant experiences, poverty, war, LGBTQ+ identities, eco-justice, disabilities, neurodivergent learners, gender, and Indigenous perspectives, to name a few. Immersed in the messiness of teaching and learning New Literacies through quality children's literature, teachers candidates gain a quick appreciation of the enormous potential of literacies today, with all they have to offer.

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EMPOWERING MENTAL HEALTH LITERACY AMONG VOCATIONAL EDUCATION AND TRAINING-TEACHING STUDENTS IN GERMANY

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Abstract

Over the past few years, a constant deterioration in the mental health of students in Germany can be observed. Among other things, this can be traced back to increasing pressure and exhaustion caused by reform processes in the higher education system itself, as well as an increase in external stressors, such as social and political crises. In addition, potential discrimination based on socio-structural characteristics (e.g., gender, sexuality) within the university can have an individual impact on (mental) health equity. This is particularly important for students on vocational teacher training courses, as they are a very heterogeneous academic group that differs significantly from average cohorts in such aspects as age, care responsibilities, occupational experience and academic background. Also, with regard to their future field of employment, prospective teachers have a distinct requirement for high mental health literacy (MHL). As teachers, they are exposed to an environment in which the stress and burnout rate of employees is significantly higher than average (especially considering the drastic increase in the teacher shortage in Germany). Yet the potential can also be emphasized, as teachers can serve as multipliers for the transfer of MHL through their dual role as both learners and teachers. In order to promote the individual MHL of this specific target group, it is crucial to create a study environment that takes their mental health into account and also supports the explicit development of competence. Continuous consideration of the students' perspective is essential for both. Therefore, in context of a research project, students are actively involved in a participatory research design in the curricular and structural design of health-promoting framework conditions and formats within the university. The first approach is based on the curricular integration of MHL-promoting content or the participatory development of advice, information and support formats. Moreover, a setting approach is used to interlink the behavioral and relational levels, so that the awareness of lecturers can also be raised and course-specific individualization or flexibilization achieved. In the long term, the needs and results are to be consolidated and represented in student health management within the university structures and to anchor the curricular offerings on the topic of MHL in the form of a micro degree in the university curriculum.

Keywords: *Health promotion, mental health literacy, participation, teacher training, vocational education and training.*

1. Introduction: The invisible problem

The shortage of teachers is a growing problem in Germany. As the Stifterverband's "Lehrkräftetrichter" (2021) illustrates, out of 50,000 first-year students, including cross- and side entry students, just 35,000 make their way into the classroom. This leads to an expected deficit of approximately 49,000 qualified teachers by 2035, with a large amount of these falling to vocational schools. At the same time, the development of (mental) health among teachers is also alarming. One in three teachers feels overworked. Significant proportions of employees in the education sector are subjectively suffering from chronic stress and mental health problems, and a comparison of occupational groups also demonstrates that employees in the education sector experience particularly high levels of stress (Blossfeld et al., 2014). This negative trend can already be observed during their academic career, as the overall mental health of students has steadily deteriorated in recent years. In addition to all this, it can be observed that around 9 out of 10 people (86.1 %) show low MHL (Kolpatzik, Fretian, Bollweg, & Okan, 2024). Despite the high and increasing prevalence of chronic diseases (especially among young people) and the existing data on general health literacy, this approach tends to remain neglected (ibid). As such, MHL focuses on knowledge and attitudes towards mental health, help-seeking behavior and experiences with mental illness and its treatment (Jorm, 2012). Given this, it can be concluded that the promotion of mental health among teachers must

begin as early as the academic phase in order to accompany students through the vulnerable period of their studies and reduce the likelihood of dropping out. By addressing MHL in the setting of the university, it is also possible to strive for a combination of behavioral and situational change.

2. The rise in student mental health challenges

The increase in mental health issues among students in Germany has become a growing concern for educators, policymakers, and healthcare providers (TK, 2008). In recent years, the number of students reporting symptoms of anxiety, depression, and other mental health disorders has increased significantly, reflecting a broader trend observed across many* countries worldwide. Several factors contribute to this rise, including social, global and economic challenges (p.e. COVID-19, the global climate crisis or the Middle East conflict), and the impact of digital technology and social media (Banek, Gillen, Michele, & Steuber, 2025). Beyond this, however, in particular the academic pressure remains one of the most significant sources of stress for students. This is particularly evident in a comparison with non-students of the same age, as the risk of developing mental health problems among university members almost doubled between 2013 and 2021, whereas it only increased by 2 percent among the overall population (TK, 2023). This can be caused by various reasons, such as exam stress, additional burdens due to care work and part-time jobs, financial worries or excessive workloads. In addition to the increasing stress and risk of illness, the likelihood of poor subjective well-being, sleep disorders, nutritional deficiencies, lack of exercise or substance abuse also increases (Dadaczynski, Helmchen, Sendatzki, & Rathmann, 2023). Besides this, other correlations exist between the stress that students experience during their academic careers and other factors such as their social background, low social support, a chronic illness, gender, migration background or financial worries (Sendaatzki & Rathmann, 2022; TK, 2023) It is therefore crucial to provide students with the knowledge and skills to manage their mental health and take care of it independently. Likewise, the university must provide structures that enable this. One promising approach is to empower MHL which is defined as knowledge and beliefs regarding mental disorders that promote their recognition, management or prevention. This includes knowledge of prevention of mental disorders, ability to recognise when a disorder is developing, an understanding of help-seeking options and available treatments, effective self-help strategies for milder problems and first aid skills to support others who are developing a mental disorder or experiencing a mental health crisis. (Cairns, Rosetto 2019; Jorm, 2012) Higher MHL is associated with better scores in the areas of knowledge, beliefs and attitudes towards mental health, as well as a lower tendency towards stigmatizing attitudes towards people with mental illness. Furthermore, people with higher MHL have a better state of well-being and are also more willing to seek professional help in the case of personal mental health problems (Kolpatzik, Fretian, Bollweg, & Okan, 2024). Looking at the group of students studying to become vocational teachers, it becomes clear at this point how these discrimination factors are also reflected in academic structures. In the following, the extent to which vocational education teaching (VET) students, as a vulnerable group, suffer from mental stress in particular and can benefit from the promotion of their own mental health skills will be emphasized. Secondly, the relevance of the topic for the target group will be examined from a prospective angle, focusing on their function as teachers. Here, not only the relevance of internal mental health is central, but also the potential to strengthen the mental health literacy of students at an early stage.

3. Mental health as a blind spot in vocational teacher training

Considering the ongoing precarious situation of teachers, which is linked to the shortage of teaching staff and a general decline in health (reflected, for example, in the prevalence of burnout and increasing mental conditions such as depression, the urgency of strengthening the MHL of student teachers is increasing (Banek, Gillen, Michele, & Steuber, 2025). VET students and early career teachers in Germany report high levels of psychological stress that stem from excessive workload, inadequate support, and challenges in maintaining work-life balance (Kärner, Bottling, Friederichs, & Sembill, 2021). This can among other things be traced back to the fact that VET students are an extremely heterogeneous group, whose needs and requirements must be considered differently from those of ‘the average student’. A more differentiated look at this group reveals that many students are ‘newcomers to education’ who have not yet had any contact with university structures as part of their family background. Furthermore, around 40 % of VET students already have occupational experience at the beginning of their studies (Gillen, Michele, Schäfers, Steuber, & Wende, 2021). On the one hand, this leads to an above-average starting age of 22 and the possibility of being able to return to their occupational qualifications at any time, which increases the

* In this context, it is important to mention that around 500 individual diagnoses are summarized under the term ‘mental disorders’, of which anxiety disorders, depression, psychosomatic disorders and addictions are the most prevalent (Blossfeld et al., 2014).

likelihood of dropping out (fallback option) (ibid.). They are therefore a group whose educational biographies are subject to the consequences of various health-related dimensions of inequality. The need for a high level of MHL is also increasingly apparent from the perspective of their later job requirements. In everyday school life, for example, teachers spend long periods of time interacting with students who are in a vulnerable phase of their lives in terms of mental health, as mental illness is likely to manifest at this age (Kirchhoff, Fretian, & Bruland, 2023). At the same time, almost eight out of ten trainees in Germany have only a low level of mental health literacy (Kolpatzik, Fretian, Bollweg, & Okan, 2024). Addressing and strengthening mental health and corresponding resources among young people not only fosters individual well-being but also opens up opportunities for teachers to actively engage in the planning and implementation of preventive and supportive measures within the school context. These approaches can be embedded within the framework of school health promotion and prevention, highlighting the role of teachers as key agents in fostering a health-promoting school environment. In this context, health literacy is increasingly recognized – by the WHO and the National Action Plan on Health Literacy and Schools as an essential educational objective, encompassing not only the transmission of knowledge, but also the development of competencies and attitudes that enable individuals to promote, maintain and improve health within everyday educational settings (Kirchhoff, Fretian, & Bruland, 2023).

4. Projekt “Mindful Campus (MinCa) – Strengthening Mental Health Literacy Among Students”

Based on this clearly outlined and emerging issue, universities are faced with a clear obligation: to take the mental health of students and its promotion seriously and to take responsibility as an institution of health promotion. This requires approaches that anchor target group-specific needs at all levels of the higher education system in a structured and coordinated manner.

How this can be operationalized through a participatory research approach is discussed in the following section by the Mindful Campus (MinCa) research project. The principal aim of the project is to develop a participatory concept and strategy to establish a Student Health Management (SHM) to promote health literacy among students across curricular and structural university settings. The initial focus of the project is on VET-Students due to the multiple stresses that have already been highlighted. The project is based on a salutogenetic understanding of health, whereby health is understood as a continuum that is detached from the normative concept of ‘being healthy’ and includes physical, psychological and social factors as conditions of origin and development factors for the individual state of health (Antonovsky 1991). In this context, the promotion of health literacy has a particular significance, as it allows people to develop constructive coping mechanisms to manage stress and regulate their own health. The promotion of health literacy includes an individual's cognitive, social and motivational abilities and skills that help him or her to gain access to health-related information and to understand and use it in such a way that it contributes to disease management, disease prevention and/or health promotion (Sørensen et al., 2012).

4.1. Principle 1: Setting approach

In addition to strengthening students' individual mental health, it is also necessary for universities as educational institutions to become aware of their responsibility for developing a health-promoting environment, to recognize the above-mentioned effects of crises and disadvantages within their organizational structures and to take them into account by designing their university culture in a responsive manner (TK, 2020). The setting approach focuses on promoting health literacy in people's actual living environment and therefore addresses both the framework conditions and personal behavior. Given this background, the university is understood as a socio-spatial system in which health-promoting measures and processes can be implemented in both working and learning contexts. Also, the amendment of the Prevention Act in 2015 adopts this approach and emphasizes the relevance of specific measures and structural development in the university context. The setting approach is considered one of the core strategies of health promotion and networking can be its most important development tool’ at universities (TK, 2020). MinCa adapts this concept by operating on two different levels. The structural level is addressed by establishing a SHM to contribute to the long-term improvement of health-promoting university structures. This includes the formation of a steering group for the coordination, consolidation and further development of (mental) health literacy within the university. One of the main priorities is cross-institutional interlinking and the prevention of duplicate structures and programs. In addition, MinCa also addresses the specific promotion of individual MHL at the behavioral level. This is achieved by first distinguishing between the need for prevention and intervention programmes and the theoretical qualification, focusing initially on the target group of VET students. The knowledge transfer and aims to promote both the students' own MHL and the transferability to the VET- school context. This involves the participatory development of seminar content, learning opportunities and exchange formats on topics related to MHL.

4.2. Principle 2: Partizipation

Participation is understood as the individual or collective involvement of individuals in health-related decisions for their lives in the narrower sense (Wihofszky, Hartung, & Narimani, 2020). As part of project planning, a participatory approach enables an increase in effectiveness and acceptance and requires more flexibility in all project phases. To achieve this, MinCa follows Wrigth's (2020) stages of participation in health promotion over the entire duration. The aim is to involve target groups as much as possible in the stages of 'participation' and to formalize their involvement in decision-making as co-researchers (Wright, 2020). In the case of MinCa, this is evident right from the planning (e.g. through exploratory workshops to identify topics and coordinate the project framework) and the permanent institutionalization of a steering group with student participation. During the data collection and evaluation phase, students research assistants are also involved, for example by collaboratively revising the recruitment and advertising materials developing and testing semi-structured interview guidelines. Using this method, a permanent accompanying evaluation is taking place, in which ten interviews have been conducted with students so far. An expansion to include PhD students and study program coordinators is currently being planned. In direct linkage with the curricular level, students are also being included as co-researchers in a pilot course on participatory knowledge transfer with a focus on mental health in higher education structures since the summer semester of 2025. In addition, professional trainings on Mental Health First Aid are organized which target all hierarchical levels of the university involving students as well as lecturers, professors and administrative staff in order to sensitize for the subject.

5. Conclusion

The persistent shortage of qualified teachers in Germany constitutes not only a structural challenge for the education system but also a significant concern from a public health and social development perspective (Blossfeld et al., 2014). Addressing this multifaceted issue requires more than policy interventions aimed solely at increasing recruitment figures; it necessitates a comprehensive strategy that targets the underlying determinants of teacher attrition – among which mental health plays a pivotal role. Emerging evidence indicates that student teachers, particularly those in VET programs, are exposed to substantial psychological stressors during their academic training. These stressors, if unaddressed, contribute to elevated dropout rates and early career exits, thereby exacerbating the existing personnel crisis in education. Consequently, the promotion of MHL must be recognized as a critical component in the development of sustainable teacher education pathways (Kirchhoff, Fretian, & Bruland, 2023). By equipping prospective teachers with the knowledge, attitudes, and competencies necessary to manage their own mental health and support others, MHL not only promotes individual resilience, but also helps teachers to address additional key challenges in dealing with their students and to ensure a healthy school. Through its dual emphasis on a setting-based approach and participatory research design, MinCa situates the promotion of MHL within both structural and curricular dimensions of the university environment. This integrated approach ensures that health-promoting measures are co-developed with students, thus enhancing their relevance, responsiveness, and sustainability. By institutionalizing MHL as part of student health management and embedding it within the academic curriculum, MinCa contributes to the creation of a university culture that actively supports the well-being of future educators. Ultimately, promoting MHL in VET students is not just a secondary aspect of teacher education, but a central cross-sectional task with the potential to mitigate systemic challenges such as teacher shortages. It underscores the notion that the psychological well-being of student teachers is a prerequisite for their professional effectiveness, long-term engagement, and the overall quality of education. Therefore, MinCa provides a model for how higher education institutions can take a proactive and collaborative role in promoting health equity and occupational well-being in the higher education sector through participatory research approaches.

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PHYSICAL EDUCATION AND PERSONALIZED LEARNING IN LINE WITH EUROPEAN UNION AND NATIONAL STANDARDS

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Abstract

Physical education represents a central discipline for promoting the psychophysical well-being of adolescents, in a context characterized by a growing incidence of sedentary lifestyles. This trend, associated with a reduction in regular physical activity, has negative effects on the physical, emotional, and social development of students, making targeted educational intervention urgent (Shao T. & Zhou X., 2023). However, the heterogeneity of motor skills and sports experiences, determined by individual, social, and cultural factors, represents a significant challenge for teachers, who must design activities that are both inclusive and compliant with national curriculum objectives. The present study aims to analyze innovative teaching strategies that promote motivation and active participation in heterogeneous educational contexts, with a focus on adolescence. Approaches such as the differentiation of motor activities based on individual needs, the use of diversified workstations, peer collaboration, and the valorization of students' personal inclinations and preferences will be explored. These strategies aim to create a flexible and stimulating learning environment, where each student can feel welcomed and supported in their growth journey. Through a systematic review of scientific literature, the work intends to provide a structured theoretical framework that highlights the effectiveness of inclusive teaching interventions in improving not only motor skills but also aspects related to intrinsic motivation, perceived self-efficacy, and social cooperation. Previous studies have shown that the personalization of learning paths in physical education, associated with collaborative practices, promotes emotional involvement and reduces the sense of inadequacy in students who are less skilled from a motor point of view (Bailey et al., 2019). Therefore, the aim is to construct and provide operational indications for educators, to balance the need to personalize learning-teaching processes (Bruner, J. S. 2002) with the achievement of the expected training standards. Particular attention will be paid to the role of the teacher as a facilitator of active, inclusive learning oriented towards the valorization of diversity. In this way, physical education can become a key tool to respond to the pedagogical challenges posed by today's society, promoting holistic well-being and the social integration of adolescents in diverse educational contexts.

Keywords: *Physical education, secondary school education, motor skills, sedentary lifestyle, personalization.*

1. Introduction

The scientific literature highlights how widespread in today's socio-cultural scenario is a significant tendency to adopt a sedentary lifestyle (Martins et al., 2020), which produces negative effects on the physical, emotional and social development of students, making a targeted educational intervention urgent (Shao T. & Zhou X., 2023). In this sense, physical education is a central discipline for the promotion of adolescents' psychological and physical well-being. However, the classroom context presents considerable internal heterogeneity. Students' prior and developing skills can be significantly influenced by the performance of extracurricular activities, resulting in the presence of significant inter-individual variability (April Yesaya Sipayung & Aliman, 2024). This heterogeneity must be integrated with the structuring of a learning context, often de-structured, which requires careful management of spaces, according to safety, interaction between students and the objectives of the intervention. These two specificities attributable to the discipline represent a significant challenge for teachers, who are called upon to design activities that are both inclusive and consistent with the objectives of the national curriculum. As with other disciplines, physical education, too, cannot be separated from the institutional regulatory framework that defines its objectives, content and implementation methods. Internationally, there is substantial alignment regarding the learning objectives to be pursued; however, the number of hours per week devoted to the discipline varies significantly in the different countries of the European Union

(European Commission, 2013). This study focuses on the methodological and didactic strategies implemented in the field of applied exercise science for adolescents in the international context.

2. Aim

This study aims to analyse innovative teaching strategies that foster motivation and active participation in heterogeneous educational contexts, with a focus on adolescents. Through a systematic review of the scientific literature, the work aims to provide a structured theoretical framework that highlights the effectiveness of inclusive teaching interventions in improving not only motor skills, but also aspects related to intrinsic motivation, perceived self-efficacy and social cooperation.

3. Methods and tools

To outline a structured theoretical framework useful to support teachers in the design of innovative, effective physical education consistent with the needs and challenges of the contemporary school system, the systematic review work took into consideration studies on effective methodological approaches in secondary education. To support the argumentation, recent empirical data concerning the involvement of student emotionality, the influence of gender stereotypes, and proposed methods are described.

4. Databases and research criteria

The literature search was conducted on several databases (Google Scholar, PubMed, EBSCO, Scopus, MDPI), and considered studies published from 2017 to January 2025. The main search criteria used are: *Physical education in high schools, Physical education and gender, Didactic approach in physical education.* Both argumentative and experimental articles were considered.

5. Results

A total of 25 articles were selected. They are listed below complete with title and citation. Further information, complete with DOIs, will be given in the bibliography.

Table 1. Articles examined.

Citation	Title
April Yesaya Sipayung & Aliman, 2024	How Does Fitness Level Affect Physical Education, Sports, And Health Student Learning Achievement
Ben Dyson et al., 2024	Students' Perspectives of Social and Emotional Learning in a High School Physical Education Program
Cassandra Sparks et al., 2017	An intervention to improve teachers' interpersonally involving instructional practices in high school physical education: Implications for student relatedness support and in-class experiences
Cristiana Bessa et al., 2021	Sport Education and Traditional Teaching: Influence on Students' Empowerment and Self-Confidence in High School Physical Education Classes
Demian Bazyliuk & L. P. Dolzhenko, 2024	Gender approach in physical culture classes of high school students
Elisa Huéscar Hernández et al., 2019	Motivational Profiles of High School Physical Education Students: The Role of Controlling Teacher Behavior.
Hans van der Mars et al., 2018	Physical Education Meets Teacher Evaluation: Supporting Physical Educators in Formal Assessment of Student Learning Outcomes
Iván López Fernández et al., 2021	High School Physical Education Teachers' Perceptions of Blended Learning One Year after the Onset of the COVID-19 Pandemic
James Darwin N Lagman & Richard John W Hernandez, 2024	Assessing the Impact of Remote Learning on Learning Competencies of Senior High School Students in the Health Optimizing Physical Education (HOPE) Program
Jia Sun et al., 2024	A Study on the Implementation of the Student-Centered Teaching Model in Junior High School Physical Education Classes in Beijing
Jomar S. Tianio & Jefferson Moreno De Castro, 2024	Innovative Improvement in the Physical Education Learning Experience: A Study at Dela Paz National High School Philippines
Juan Antonio Moreno-Murcia et al., 2018;	Perceptions of Controlling Teaching Behaviors and the Effects on the Motivation and Behavior of High School Physical Education Students.

Kelly L. Simonton et al., 2021	Caring Climate, Emotions, and Engagement in High School Physical Education
Ken Murfay et al., 2024	Supporting Students' Physical Activity Self-Efficacy within High School Physical Education
Ken R. Lodewyk & Lodewyk, 2018	Associations between trait personality, anxiety, self-efficacy and intentions to exercise by gender in high school physical education
Matt Alexander Taylor & Kevin John MacLeod, 2024	Fostering Competence and Autonomy in High School Physical Education Classes: An Exploration of Intricate Relationships
Nicholas Washburn, 2023	Enhancing the Legitimacy of High School Physical Education
Nick Faulds & Zack Beddoes, 2023	Perceptions of Universally Designed Adventure Education in High School Physical Education
Olivia J. Gillispie et al., 2023	Selecting Content to Teach in High School Physical Education
V. Bilyk et al., 2024	Using methods of self-regulation of stressful states as a means of increasing psycho-emotional stability of high school pupils in the process of physical education
Wyndell A. Casquejo et al., 2023	Appropriateness of assessment modes in senior high school physical education learning standards
Yang Gu Lee, 2024	Interrelationships among Perceptions of Physical Self-Concepts in High School Students Participating in Physical Education Classes
Yuling Pan et al., 2019	Comparison of Learning Effects of Merging TPSR Respectively with Sport Education and Traditional Teaching Model in High School Physical Education Classes
Yuxiao Deng, 2023	Influence of Gender Stereotype on Participation in Physical Education Class of High School Students
Zhanna Domina, 2024	Modern approaches to increase the efficiency of physical education of high school students

6. Discussion

The literature on motor sciences in schools is rich in evidence that focuses attention on improving the discipline's didactic proposal. In particular, the inclusion criteria have led to the identification of different focuses that concern, on the one hand, the relationship between psychophysical characteristics and ... and, on the other, the issues of didactic design. Studies that consider the processes that regulate the relationship between psychophysical transformations in adolescence and participation in motor activities highlight the role of the correct implementation of practices in promoting the overcoming of gender stereotypes (Demian Bazyliuk & L. P. Dolzhenko, 2024). Conversely, in the absence of proper declination of interventions, gender stereotypes appear to significantly influence student engagement and risk compromising participation in activities (Yuxiao Deng, 2023). An experimental study that investigated the effectiveness of a programme of Yoga, Tai chi and Qigong as tools for promoting the psycho-emotional resilience of Ukrainian students, highlighted how much the emotional components, the student's perception of himself and his role in the community are influenced by the quality of participation (V. Bilyk et al., 2024). Even in the context of studies that more closely investigate the topic of instructional design, the involvement of the student's emotional sphere together with his or her proactivity are often at the centre of the methodological debate that compares traditional approaches, full of standardised tests and tabular evaluations, and more innovative methods, such as games and the personalisation of activities (Cristiana Bessa et al., 2021; Feiqun Fan et al., 2024; Yuling Pan et al., 2019). In particular, according to studies, the former seems to inspire more confidence in teachers due to their formal correctness in measuring quantitative motor skills (Jia Sun et al., 2024); whereas, the latter are more useful for developing 'soft' skills such as cooperation and intrinsic motivation (Yuling Pan et al., 2019), which are rarely covered by traditional methods. The centrality of the student in an inclusive school implies increasing attention to context-dependent variables. In this sense, the use of alternative methodologies seems to allow for a more effective removal of architectural, emotional and cognitive barriers, often related to the more subtle and subjective aspects of the educational experience (Ken R. Lodewyk & Lodewyk, 2018). The referenced studies present numerous insights and empirical evidence that underline the risk of neglecting these dynamics. At the same time, they invite reflection whereby alternative, ad-hoc structured teaching methodologies run the risk of being valid only in specific contexts, and of not being usable in different institutional and cultural contexts (Jia Sun et al., 2024; Zhanna Domina, 2024).

7. Conclusion

In today's school context, in which the student is at the centre of teaching and teaching aims to be increasingly inclusive and customisable, it is essential that every teaching proposal, right from the planning

stage, considers the risks and criticalities of the methodologies applied. The framework outlined seems to highlight how the student's globality is involved in the discipline of Motor Sciences, highlighting how educational success is influenced by the harmonious integration of its different dimensions. This review suggests the importance of adopting mixed teaching approaches, balancing strategies indicated as 'traditional' for the development and measurement of performance skills with more flexible and customisable methodologies aimed at the growth of soft skills. While the former guarantee solidity in the evaluation of the learning process, the latter favour the development of personal and social skills, which are less easily quantifiable with objective instruments. In order to decline effectively in the respective national contexts, this study can constitute an initial epistemological basis, to be supplemented with further complementary studies, which through the use of quantitative and qualitative survey strategies investigate the opinions of teachers in relation to the different implementation methodologies, with the aim of understanding how it is possible to integrate traditional and innovative approaches, which are effectively inclusive and sustainable, both in normative and didactic terms.

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EXPLORING THE ROLE OF ARTIFICIAL INTELLIGENCE IN TECHNICAL DEGREES: INSIGHTS FROM BUILDING MATERIALS SUBJECTS

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Abstract

The incorporation of Artificial Intelligence (AI) in education has gained significant attention, particularly for its potential to assist in the learning process. This paper explores how AI tools were used in the course "Building Materials II", within the Building Engineering program of Polytechnic University of Madrid (Spain), focusing specifically on the topic of cement. In this exercise, students were tasked with creating their own summaries of the topic and then comparing their work to summaries generated by AI. The objective of this activity was to evaluate how AI could assist students in understanding complex, technical content. The students used AI to generate summaries, which they then compared to their own. This comparison allowed us to identify both the strengths and the limitations of using AI in this context. While AI was able to generate summaries quickly and in a coherent format, it sometimes fell short in capturing the level of detail required for a subject as specialized as building materials. Certain aspects of the topic, particularly more technical or industry-specific details, were not fully addressed by AI. Additionally, the exercise prompted students to reflect on the differences between their own summaries and those produced by AI. This critical analysis allowed them to better understand the role of AI as a tool in academic and professional settings, as well as the importance of developing their own skills in research and technical writing. The students also gained insights into the limitations of relying solely on AI for technical subjects, where in-depth knowledge and expertise are essential. The findings from this study emphasize several limitations of AI in technical education. AI often simplifies complex topics, sometimes failing to include all the relevant technical details. Its content is also dependent on available data, which may not always be the most up-to-date, and AI lacks the ability to integrate personal experience or provide insights from the professional world. Despite these drawbacks, AI can be a valuable supplementary tool, offering students quick access to information and aiding in the learning process. In conclusion, while AI offers promising benefits in technical education, its limitations must be acknowledged. Educators should combine AI tools with traditional teaching methods to ensure students develop a comprehensive understanding of the material, encouraging critical thinking and in-depth learning.

Keywords: *Artificial Intelligence (AI), higher education, technical subjects, building materials, student learning.*

1. Introduction

The rapid advancement and increasing ubiquity of Artificial Intelligence (AI) are transforming various sectors, and education is no exception (Popenici & Kerr, 2017). From personalized learning platforms to automated grading systems, AI offers unprecedented opportunities to enhance teaching and learning processes. One particularly promising application lies in the domain of text summarization. The ability of AI algorithms to condense large volumes of information into concise and informative summaries holds significant potential for both educators and students in navigating the ever-expanding landscape of academic and professional knowledge.

In the field of construction materials education, students are often faced with extensive technical reports, research papers, industry standards, and regulatory documents (Smith & Jones, 2020). Comprehending and extracting key information from these sources can be time-consuming and challenging, potentially hindering deeper engagement with the subject matter. AI-powered summarization tools offer a potential solution by automating the process of identifying and synthesizing crucial information, thereby freeing up students' time for critical analysis, problem-solving, and creative application of knowledge (Johnson et al., 2021).

Several approaches to AI summarization have emerged in recent years. Extractive summarization techniques identify and select key sentences directly from the original text, while abstractive methods generate novel summaries by understanding the underlying meaning and rephrasing it in a concise manner (Nallapati et al., 2017). Recent advancements in deep learning, particularly transformer-based models like BERT (Devlin et al., 2019) and GPT (Brown et al., 2020), have significantly improved the quality and coherence of abstractive summaries, making them increasingly viable for educational applications.

The integration of AI summarization tools into construction materials education could offer numerous benefits. Students could quickly grasp the core concepts of complex materials science topics, efficiently review literature for research projects, and stay abreast of the latest advancements in the field. Educators, on the other hand, could leverage these tools to streamline the preparation of learning materials, identify key takeaways from student assignments, and potentially personalize learning pathways by providing summaries tailored to individual student needs (Hwang et al., 2020).

However, the successful adoption of AI summarization in this specific educational context hinges on several factors. Understanding the perceptions of both students and educators towards these technologies is crucial. Concerns about the accuracy and reliability of AI-generated summaries, the potential for over-reliance and the erosion of critical reading skills, and the ethical implications of using such tools need to be addressed (Floridi et al., 2018). Furthermore, the actual use patterns and the perceived utility of these tools in specific learning activities within construction materials education remain largely unexplored.

Artificial Intelligence (AI) has increasingly been adopted in educational settings to assist in content creation, summarization, and concept organization. Particularly in technical subjects like Construction Materials, AI tools may help students synthesize complex content more effectively. This study aims to evaluate how students perceive the utility and challenges of using AI for these purposes, using data from a structured survey.

2. Methodology

The research was conducted during the first semester of the 2024/2025 academic year in the construction materials course of the bachelor's degree in Building Construction at the Polytechnic University of Madrid. Specifically, the research consisted of two main sections.

First, the student was given an activity and a deadline to complete it. The instructions given to the students are shown below:

- ACTIVITY: Comparison of self-made summaries/outlines versus artificial intelligence (AI)
- SUBMISSION INSTRUCTIONS: Submit a single document in PDF format that includes: 1) the outline/summary of the cement topic that you made yourself (by hand or computer), 2) the outline/summary of the cement topic made with AI (e.g., GPT), and 3) Summary and conclusions of the activity carried out, explaining the methodology, technology used, power, reliability, and degree of usefulness of the AI, ... 4) Fill out the following survey - form at the end of the activity.
- RECOMMENDATIONS FOR USE OF AI: Give specific instructions such as "specify sections of the summary" "approximate length", etc.
- MAXIMUM LENGTH (APPROXIMATE): 3 pages (6 sides) + 3 pages (6 sides) + 1 page (1 side) for the summary and conclusions.
- DEADLINE: 2 weeks after the end of the chapter.

In second place, a survey was carried out of students enrolled in the Construction Materials II course. It included both quantitative and open-ended questions concerning their experiences with AI-based tools. Variables such as time invested, number of prompts, language used, and satisfaction levels were analyzed descriptively. Qualitative responses were also translated and thematically categorized. The questions included in the survey are shown below:

- Was the expected result achieved?
- How many commands did you have to give to obtain an acceptable result?
- Did you enter the commands in English or Spanish?
- How much time did you spend (in minutes) completing the AI portion of the activity?
- Which phrase was key to achieving the expected result?

- In what aspect or content of the topic do you find the AI most difficult?
- Do you consider the use of AI to be approved in solving this type of exercise?

3. Results and discussion

The survey collected responses from 234 students. Among them, 160 (68%) reported achieving the expected result using AI tools. A majority of students (68%) required fewer than 15 prompts to reach a satisfactory outcome, and most used Spanish to interact with the AI.

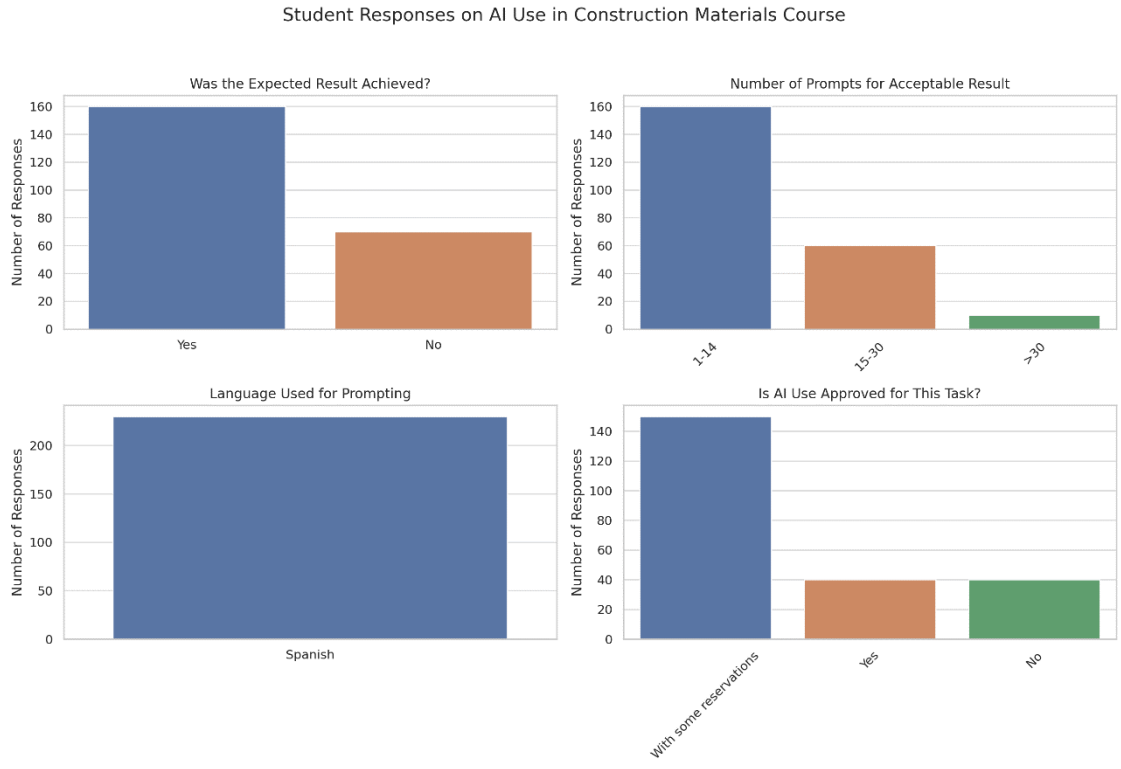
Statistical tests were performed to explore associations among variables:

- A chi-square test showed a statistically significant relationship between achieving the expected result and the number of prompts required ($\chi^2 = 7.79$, $p = 0.0053$). Students who achieved satisfactory results tended to need fewer interactions.
- Another chi-square test revealed a strong association between obtaining the expected result and approving the use of AI ($\chi^2 = 45.64$, $p < 0.00001$), suggesting that perceived success strongly influences acceptance.
- A Spearman correlation between the number of prompts and approval rating could not be calculated due to categorical limitations.

These findings support the hypothesis that user experience and effectiveness are closely tied to students' acceptance of AI as an educational tool. They also indicate that better outcomes correlate with reduced interaction effort, which highlights the importance of providing clear examples and prompt guidance when integrating AI into educational practice.

The following figure summarizes key quantitative findings.

Figure 1. Survey results.



4. Conclusions

The findings of this study reveal a generally positive reception among students regarding the use of AI tools for academic purposes in technical subjects. Most students achieved the expected outcomes efficiently and found the interaction intuitive. However, the effectiveness of AI tools is closely tied to user guidance, clarity of task instructions, and student familiarity with prompt design.

Educators integrating AI into their teaching strategies should consider providing specific prompt templates, training sessions, and ongoing support to enhance student experience. Furthermore, clear expectations and examples of correct usage can reduce cognitive load and foster greater confidence and approval of AI tools.

This research is limited to a specific course and academic context at a single university, which may affect the generalizability of the findings. Additionally, the survey data are self-reported, which may introduce response bias. The analysis was limited to descriptive statistics and basic non-parametric tests due to the categorical nature of the variables. Future studies with a mixed-methods approach could offer more comprehensive insights.

Future research should explore the long-term effects of AI tool usage on learning outcomes and knowledge retention. Comparative studies across different subjects and institutions could broaden the understanding of AI's role in education. Moreover, developing rubrics for evaluating AI-generated content and integrating feedback mechanisms within AI tools could further enhance their pedagogical value.

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THROUGH A CHILD'S EYES: LITERATURE AS A BRIDGE TO UNDERSTANDING POST-TRAUMA

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Abstract

Children's literature serves as a crucial medium for helping young readers make sense of complex emotional and social realities. Traditionally, early childhood literature has steered clear of themes related to war trauma, particularly post-traumatic stress disorder (PTSD). However, recent socio-political events have catalyzed a shift in Israeli children's literature, resulting in the emergence of narratives that engage with the psychological aftermath of war within the family unit. This study examines a selection of contemporary Hebrew picture books that depict fathers returning from combat with PTSD, exploring how these texts introduce young children to the emotional and behavioral transformations experienced by their caregivers. Through literary analysis, the study identifies a shared six-stage narrative structure across these books, mapping the progression from pre-war stability to post-war familial adjustment. Key motifs such as emotional distance, behavioral changes, and the child's perspective on parental trauma are explored, highlighting how these narratives provide a framework for early emotional literacy. The findings suggest that these books function not only as therapeutic tools for young readers but also as educational instruments that foster emotional resilience, empathy, and intergenerational dialogue. By integrating contemporary trauma discourse into early childhood literature, these texts challenge conventional boundaries of children's storytelling while offering educators and parents new pathways for discussing difficult topics with young learners. The study concludes that literature can serve as a safe space for children to process and articulate emotions related to familial trauma, reinforcing its role in social-emotional learning and trauma-informed education.

Keywords: *Early childhood education, children's literature, social-emotional learning, trauma-informed pedagogy, Post-Traumatic Stress Disorder (PTSD).*

1. Introduction

Children's literature has long functioned as a space where emotional, social, and cognitive development begins to take shape. While war and conflict have been mainstays in Israeli cultural production, early childhood literature traditionally skirted direct engagement with the psychological consequences of combat. This changed markedly following the Iron Swords War (October 2023), when the traumatic impact of war entered the civilian sphere with unprecedented intensity. In response, a wave of Hebrew picture books emerged, portraying children navigating life with a post-traumatized parent—usually a father, who returned from combat with Post Traumatic Stress Disorder (PTSD)[*]. These texts offer a new literary framework for understanding familial trauma, childhood emotional literacy, and the evolving discourse on masculinity and caregiving in Israeli society.

On October 7, 2023, Hamas and Islamic Jihad launched a surprise assault on Israeli communities near Gaza, resulting in the murder of 1,163 civilians—including 38 children—and the abduction of 255 individuals, among them 42 children[†]. The war that followed, known as the Iron Swords War, exacted a heavy psychological toll. More than 6,400 applications for psychiatric disability were filed by soldiers

[*] The DSM-5 diagnostic criteria for PTSD: Exposure to actual or threatened death, serious injury, or sexual violence; Presence of one (or more) intrusion symptoms associated with the traumatic event(s), beginning after the traumatic event(s) occurred; Persistent avoidance of stimuli associated with the traumatic event(s), beginning after the traumatic event(s) occurred; Negative alterations in cognitions and mood associated with the traumatic event(s), beginning or worsening after the traumatic event(s) occurred; Marked alterations in arousal and reactivity associated with the traumatic event(s), beginning or worsening after the traumatic event(s) occurred; Duration of the disturbance is more than 1 month The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning; The disturbance is not attributable to the physiological effects of a substance or another medical condition. See: American Psychiatric Association 2013, 271-272.

[†] The Institute for National Security Studies, "Iron Swords – A real-time updated situational assessment."

within the first 14 months, nearly half by reservists[‡]. These figures reflect not only the trauma experienced in combat zones, but also the emotional aftermath reverberating through homes, families, and the youngest members of Israeli society.

To fully appreciate the emergence of post-trauma narratives in contemporary Israeli children's literature, it is essential to understand the cultural backdrop against which these stories are told. For decades, the foundational ethos of Israeli society celebrated the image of the fearless, self-sacrificing soldier. Rooted in early Zionist ideals, this figure was emotionally stoic and physically resilient, embodying the collective imperative to defend the land at all costs. Within this framework, psychological suffering was rarely acknowledged, and trauma—particularly post-trauma—was stigmatized or silenced altogether[§].

This silence began to crack following the Yom Kippur War (1973), when public disillusionment and high casualty rates prompted a cultural shift toward recognizing the individual costs of war. Subsequent conflicts, including the First Lebanon War (1982) and the Second Intifada (2000–2005), further destabilized the myth of the unbreakable fighter. Mental health services for veterans expanded, and PTSD was officially recognized as a legitimate outcome of combat stress. Still, these shifts were slow to permeate early childhood literature, which remained cautious in its portrayal of vulnerability and psychological rupture.

The Iron Swords War (2023–2025) marked a turning point. The war's unprecedented psychological toll on both soldiers and civilians, combined with widespread media coverage and national trauma, catalyzed an urgent need for new emotional tools—especially for children[**]. Literature stepped into this space, offering not only stories, but symbols, metaphors, and emotional scripts for families grappling with invisible wounds.

The recent wave of PTSD-themed picture books reflects a profound transformation: from a culture that once suppressed emotional pain to one that increasingly values emotional transparency, intergenerational dialogue, and collective healing. These stories do not reject heroism—they redefine it. In their pages, strength is measured not by silence, but by the willingness to speak, to feel, and to stay connected despite the scars of war.

2. Post-Trauma as a narrative framework

This study analyzes the six picture books for early childhood (ages 4-7) published between late 2023 and early 2025: *Papa Tank*; *Posti and Me*; *What Happened to Or's Dad?*; *Where Did Dad's Laughter Go?*; *Daddy Postamaty* and *Menahem's Secret Soldier*.

Despite their stylistic differences, these works share a five-stage narrative arc that maps the emotional transformation of the family following a father's return from war with PTSD. This structure serves both literary and pedagogical purposes: it renders trauma comprehensible for young readers and models emotional adaptation for families experiencing similar realities. Each stage contributes to a gradual unfolding of psychological insight and emotional literacy through metaphor, imagery, and dialogue. By drawing on metaphors, symbolic visuals, and empathetic dialogue, these stories translate adult psychological experiences into child-accessible terms. The five-stage narrative structure is as follows:

(1) *Pre-war stability: The idealized father figure*: Each story begins with a depiction of a harmonious family life, emphasizing the father's emotional availability, competence, and warmth. This phase is crucial in establishing the father as a nurturing and engaged figure—often portrayed as a hero in the child's eyes. For instance, in *Or's Dad*, the father is remembered for telling bedtime stories and laughing during playtime. In *Daddy Postamaty*, the father is described as "superhuman" capable of superhuman feats like removing lice without causing pain, eating spicy food "without steam coming out of his mouth," and inventing endlessly long stories over a cup of coffee. This idyllic beginning not only sets the emotional tone for the rupture that follows, but also anchors the child's deep longing for the "before" version of the parent.

(2) *Post-return disruption: Emotional withdrawal and change*: The father's return marks a sudden shift in tone. He is physically present but emotionally inaccessible. The texts illustrate this change through sensory cues—raised voices, blank stares, avoidance of touch, and hypersensitivity to noise. In *Papa Tank*, a playful invitation from the child triggers an outburst of anger. In *Posti and Me*, the child describes the father's emotional absence by referring to an invisible companion named "Posti" who "takes over" her father. The metaphor externalizes the trauma, allowing the

[‡] Peleg-Gabai 2025, pp. 3.
[§] Somer & Bleich, 2005.
[**] Between October 7, 2023, and May 2005, approximately 143,000 civilians were evacuated from the Gaza Strip, and 68,500 residents were displaced from northern Israel. Over 35,500 rockets, missiles, and UAVs were launched at Israeli territory, triggering more than 36,143 alerts that forced civilians into shelters. In that same period, 8,670 terrorist attacks were recorded. This accumulation of data testifies to the magnitude of national trauma—whether direct, indirect, secondary, or reactivated—experienced by millions of Israeli citizens.

child (and reader) to understand the father's behavior as the result of an inner struggle rather than rejection or indifference.

(3) *The child's confusion: Emotional disorientation and self-Blame*: Unable to make sense of the father's altered behavior, the child begins to feel confused, anxious, and at times responsible. The invisible nature of PTSD exacerbates this confusion—there is no visible injury to explain the pain. In *Where Did Dad's Laughter Go?*, Nir, the child protagonist, questions why his father no longer smiles or celebrates with him. In *Or's Dad*, the child asks, "How can he be hurt if he didn't lose a leg or a finger?" This phase captures the destabilizing effect of trauma on a child's worldview and the challenge of maintaining attachment in the face of incomprehensible change.

(4) *A search for understanding: Inquiry, imagination, and dialogue*: Driven by confusion and concern, the child embarks on a quest to understand the transformation. This journey may involve asking questions, seeking explanations from other family members, or retreating into imaginative reinterpretations of reality. In *Papa Tank*, Yuval processes his father's anger through a dream in which a threatening tank appears in the family kitchen. The tank eventually transforms into "Papa Tank," a softened version that joins the family on a beach outing. Similarly, in *Menahem's Secret Soldier*, a traumatic encounter between a preschool child and a war-affected neighbor is reframed by the teacher into a story about "Menahem's secret soldier," enabling the child to approach the frightening experience through the lens of narrative and empathy. This stage reflects the child's efforts to build a new framework for understanding the altered familial world his active role in constructing meaning—a developmental task that literature helps scaffold through symbolic language and emotional metaphors.

(5) *Emotional reconnection: Mutual recognition and integration*: In the final stage, emotional breakthroughs occur. The father articulates his pain, often using metaphors that align with the child's earlier attempts at understanding. The child, in turn, offers empathy and reaffirmation of love. In *Papa Tank*, the father says, "Sometimes I feel like a tank with sharp edges," echoing the child's metaphor and transforming it into a shared emotional language. In *Where Did Dad's Laughter Go?*, the father and child find moments of connection despite ongoing challenges. These resolutions are not conclusive "happy endings" but open-ended moments of recognition and growth, where trauma becomes a visible, speakable presence within the family—not a rupture, but a reality to be integrated.

This five-stage model mirrors real psychological processes of trauma adaptation: from shock and disruption to emotional meaning-making and partial healing. By presenting trauma not as an abrupt rupture but as a process, these books offer children not only validation but hope—anchoring pain in relationship, memory in imagination, and suffering in shared narrative.

3. Family at the heart of healing: Navigating trauma together

Across the examined picture books, fathers return from war not as triumphant heroes, but as emotionally distant figures struggling to reconnect with their children. They are often depicted as withdrawn, irritable, and overwhelmed by everyday stimuli—startled by noise, disturbed by light, or unable to participate in family life. This emotional detachment is not portrayed as rejection, but as the visible effect of invisible wounds.

Many of these fathers express an internal conflict: a longing to fulfill their parental role, coupled with a deep sense of inadequacy. In *Daddy Postamaty*, the father likens his emotions to a volcano erupting inside him. In *Papa Tank*, the father acknowledges, "Sometimes I really do feel like a tank—with sharp edges that can hurt." These metaphors help children understand that the father's behavior is not rooted in anger or disinterest, but in pain and self-protection. This tension between the father's past identity and his current fragility shapes a fractured sense of self. Yet, even in moments of withdrawal, the fathers express a desire to return—to themselves and to their families. These admissions become turning points, allowing children to see their parents not as frightening strangers, but as wounded loved ones striving for connection. Through this lens, emotional vulnerability becomes a pathway to relational repair.

The children in these books are not passive observers but active interpreters of their environment. Their perspective drives the emotional narrative, reflecting confusion, guilt, and resilience. In *Where Did Dad's Laughter Go?*, Nir's efforts to reawaken his father's joy reveal both emotional loss and persistent love. In *Daddy Postamaty*, Yair embarks on a metaphorical journey to understand his father's "invisible wounds," guided by questions, memories, and conversations with family members. These child protagonists perform a mediating role between silence and dialogue. Their emotional labor—asking, imagining, translating—creates a space for healing and reflection, both within the narrative and for the young readers themselves.

A prominent feature across the books is the role of the mother as emotional anchor and interpreter. She often bridges the gap between the traumatized father and the confused child, offering explanations that protect the child's sense of security while validating the father's struggle. In *Or's Dad*, the mother explains the concept of a "wound in the heart," helping the child reframe fear as empathy. In *Daddy Postamaty*, she gently encourages the father to reflect on his reactions, modeling emotional intelligence and co-regulation.

Through these portrayals, the books construct an interdependent family model, where healing is shared and communication is central. They emphasize the mother's dual role as stabilizer and translator, carrying both the emotional and practical burdens of maintaining familial cohesion in the aftermath of trauma.

4. From silence to dialogue: Pedagogical and therapeutic potential

These picture books reject silence as a viable coping strategy. Instead, they promote gradual, developmentally appropriate dialogue. Emotional expression is scaffolded through metaphors, narrative resolution, and therapeutic language. For instance, in *Menachem's Secret Soldier*, the community's recognition of a war-affected neighbor fosters empathy and reintegration, suggesting that healing is not solely a private endeavor but a collective responsibility. The use of imagination—such as tanks that turn gentle or invisible wounds that speak—provides children with psychological distance to engage emotionally without being overwhelmed. Furthermore, the normalization of therapy in couple of the books destigmatizes mental health care and models help-seeking behavior.

Perhaps most striking is the challenge these texts pose to traditional models of Israeli masculinity. Lidor Leibovitz, the author of *Posti and Me* and a veteran with PTSD, recounts his own experience after the birth of his daughter[††]: "The first three months after Noga was born brought me to the edge […] It felt like an out-of-body experience […] I didn't recognize myself. The container was full." Even routine events—such as a birthday party at kindergarten—become overwhelming, prompting the father's withdrawal from social life.

The archetype of the emotionally silent, heroic fighter is gradually replaced by a figure capable of expressing pain, seeking help, and maintaining relationships. Trauma is not framed as failure, but as part of the emotional cost of war. "This is the story of many families," asserts Leibovitch[‡‡], "It is the story of the costs of living in Israel, of serving in the military, of protecting the country—and of being wounded in the process. This is what the price of military service looks like." In *Papa Tank*, for instance, the father's confession of feeling like a "sharp-edged tank" is met with empathy, not rejection. His emotional openness is positioned as a new form of courage.

This reframing allows children to hold multiple truths: to be scared and loving, to feel grief and pride. The books thus function as cultural interventions, expanding the possibilities for emotional expression and masculine identity in a society deeply shaped by military service.

5. Conclusion

The emergence of PTSD-themed picture books in Israel following the Iron Swords War represents a watershed moment in children's literature. These texts do more than narrate trauma—they mediate it. By foregrounding the child's perspective, acknowledging familial rupture, and promoting relational repair, they offer a blueprint for emotional resilience in the face of psychological disruption.

Beyond their literary merit, these books serve vital pedagogical and therapeutic functions. They equip educators, parents, and children with language, imagery, and empathy to address the emotional legacies of conflict. Most importantly, they affirm that healing begins not in silence, but in story.

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GROWTH MINDSET INTERVENTIONS TO ENHANCE PHONICS LEARNING IN EARLY YEARS EDUCATION: AN EXPLORATORY STUDY

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Abstract

This study explores the efficacy of a growth mindset intervention in early years education, aiming to assess its impact on phonics learning. Using an interpretative ethnographic approach, the researcher worked with twelve learners to gain an understanding of their experiences participating in the intervention. This study gathered qualitative data through art-based approaches, focus groups, and participant observation to assess the effectiveness of the intervention and gain insights into learners' perceptions, attitudes, and experiences. Firstly, this study explored the impact that the growth mindset intervention had on achievement in phonics learning focusing on specific groups of learners including low-achieving, middle-achieving and high-achieving cohorts to determine if a growth mindset intervention benefits all groups or only some. It presented a significant finding in relation to the impact of achievement in phonics learning following a growth mindset intervention on the group of learners with Special Educational Needs (SEN). Secondly, the results of this study highlighted many other benefits to learning including the areas of "learning how to learn", increased effort, motivation, resilience in response to challenges and mistakes and learner autonomy. It also provided useful insights into the importance of establishing the correct learning environment in order to help learners adopt a growth mindset effectively. This study seeks to contribute valuable insights and evidence-based recommendations for educators, policymakers and stakeholders, in the hope that readers will view the implementation of growth mindset interventions as a fundamental approach in early years education, ultimately leading to more supportive and conducive early learning environments.

Keywords: *Growth mindset, intervention, cohorts, learning environment, autonomy.*

1. Introduction

This research, based on Carol Dweck's (2006) theory that intelligence can be developed through effort and perseverance, investigates how fostering a growth mindset influences achievement in and attitudes towards phonics learning in young learners. The researcher's own interest in growth mindsets began during the completion of a capstone project at St. Mary's University College, Belfast. Dweck's ideas, supported by figures like Bill Gates, have gained global relevance across the education and business sectors, with the Organisation for Economic Cooperation and Development (OECD) highlighting the importance of mindsets in PISA reports.

Despite its popularity, misconceptions remain, especially in early childhood contexts, covering ages 0–5 years old. Studies by Gunderson et al. (2017) and Pomerantz & Saxon (2001) show young learners are especially receptive to mindset interventions, though research in this area remains limited. Phonics, a core element of early literacy, provides a clear framework to explore the impact of such interventions. Terminology within this study, such as referring to students as "learners" and using "low-achieving" instead of "low-ability," aligns with the growth mindset philosophy, emphasising potential and effort over fixed traits.

The study aims to address two primary research questions:

- To what extent does a growth mindset intervention enhance achievement in phonics learning within early years education?
- To what extent does a growth mindset intervention enhance attitudes towards phonics learning within early years education?

2. Literature review

This review examines the conceptual foundations of growth mindset theory, emphasising its relevance in early childhood education. Originating from Carol Dweck's work, the theory posits that abilities can be developed through effort and perseverance. Hong et al. (1999) suggested that fostering a growth mindset in young learners enhances engagement and well-being. While extensively studied in older learners, research on its application in early years is limited. Research suggests that mindset may also be shaped by past academic experiences, reinforcing the importance of early intervention (Limeri et al., 2020).

2.1. The benefits of growth mindset interventions

Growth mindset interventions are structured activities aimed at encouraging learners to believe their abilities can develop through effort (Limeri et al., 2020). While outcomes vary, well-designed interventions can foster positive learning dispositions. However, Sisk et al. (2018) cautions that educators need to ensure to tailor interventions to the developmental stage of learners.

Studies show a positive link between growth mindsets and academic performance (Reardon, 2011). Interventions help learners maximise opportunities by influencing beliefs about intelligence (Yeager & Dweck, 2012). Growth mindset interventions appear particularly beneficial for low-achieving learners (Paunesku et al., 2015), though even high-achievers have demonstrated gains, such as increased enrolment in advanced maths courses (Zhu et al., 2019).

Learners with growth mindsets show greater perseverance and motivation (Blackwell et al., 2007; Yeager & Walton, 2011). They view effort as a path to improvement, in contrast to fixed mindset learners who may interpret effort as a sign of inadequacy (Dweck, 2016).

Growth mindset interventions promote metacognition, helping learners understand and regulate their own learning processes (Hattie, 2009). Highlighting the brain's malleability encourages learners to view intelligence as adaptable (Yeager et al., 2016). This approach supports the development of resilience (Duckworth et al., 2007) as learners with such mindsets are more likely to persist through setbacks, interpret failure constructively, and adopt adaptive strategies (Haimovitz & Dweck, 2017). Conversely, fixed mindset learners often avoid challenge to preserve the appearance of intelligence (Mueller & Dweck, 1998).

The classroom environment and educators' own mindsets significantly influence the success of interventions (Rattan et al., 2012). While most teachers recognise the value of growth mindsets, many feel ill-equipped to foster them (Education Week Research Centre, 2016). Dweck (2016) warns against superficial application, so-called "false growth mindsets", which has been suggested to mislead learners. Praising effort over innate ability is crucial (Mueller & Dweck, 1998), and subtle shifts in language, such as using "not yet," can reinforce growth-oriented beliefs (Dweck, 2014). Educators' understanding of cognitive science also plays a vital role (Ricci, 2013).

Despite the literature suggesting these many benefits of a growth mindset intervention, successful implementation demands time, training, and curriculum alignment (OECD, 2019).

2.2. Phonics

Phonics instruction is a cornerstone of early literacy, enabling children to decode words by recognising sound-letter relationships. Systematic approaches, introduce learners to phonemic patterns through structured progression.

The literature indicates that integrating growth mindset interventions in early education can positively influence learners' attitudes including resilience, motivation and love of learning, and, to some extent, their academic performance. This study aims to explore how such interventions affect achievement in and attitudes towards phonics learning among early years learners. By examining both performance metrics and learner dispositions, the research seeks to provide a comprehensive understanding of the interplay between mindset and early phonics development.

3. Methodology

3.1. Research paradigm

An ethnographic approach was chosen to gain an in-depth understanding of how growth mindset interventions affect phonics learning. Ethnography captures everyday practices and beliefs, providing a holistic view of participants' experiences. This method is flexible and allows for rich, contextual insights, despite challenges such as researcher bias.

3.2. Methods chosen

The study will use art-based approaches, focus groups, and participant observation to collect qualitative data. Triangulation ensures robust data by cross-verifying findings. Art-based methods, such as

drawing, will allow young participants to express their thoughts on growth mindset, fostering engagement and emotional intelligence. These methods have some limitations, such as subjectivity in interpretation and time constraints. Focus groups will help interpret art-based data, allowing participants to discuss their thoughts in depth. While useful for gathering diverse insights, focus groups can be affected by personality dynamics and social desirability bias. Participant observation offers a nuanced understanding of how growth mindset interventions are integrated into daily routines. This method allows for direct observation of interactions but requires balancing insider and outsider perspectives to avoid bias.

3.3. Research context and participants

This study employs opportunistic sampling to select a research site based on participant availability and accessibility, facilitating efficient data collection in a small-scale setting. While this approach offers practical advantages, it may introduce bias and limit generalisability due to the non-random selection of participants.

The participant group comprises twelve early years learners, balanced by gender and achievement levels in phonics. Purposive sampling ensures representation across low, middle, and high achievers, based on recent formative assessments. Participants were assessed on their ability to blend and segment ten words, aligning with previously studied sounds. Efforts were made to include all learners, with additional lessons provided to those absent, ensuring equitable participation and reliable data collection.

3.4. Data collection procedures

In terms of the growth mindset intervention, a series of five lessons, inspired by Muncaster & Clarke (2016) and Dweck (2006), will introduce concepts including brain plasticity and the value of effort. The intervention comprises examples of famous failures to illustrate growth through persistence. Participants will engage in two art-based activities to express their feelings about learning and growth mindsets through drawings. Initial activities will familiarise them with art-based methods before focusing on mindset-related themes. Following the art activities, structured focus groups will facilitate discussions, guided by prepared schedules to ensure balanced participation. The researcher will act as a facilitator, using familiar language and allowing adequate time for responses. The researcher will observe and document classroom interactions, noting observations, conversations, and reflections. These notes will be reviewed to interpret and inform the study's findings.

3.5. Data analysis procedures

Data analysis will follow an ethnographic approach, beginning with immersion in collected materials (notes, recordings, drawings). The researcher will apply coding to identify recurring themes, conduct thematic analysis to interpret these patterns, and use constant comparison to refine categories. Triangulation will compare data from various methods to enhance credibility. Findings will be synthesised into a comprehensive narrative, incorporating direct quotes and contextual details to provide a rich understanding of the phenomena.

3.6. Ethical considerations

Ethical clearance will be obtained, adhering to BERA (2004) and institutional guidelines. Informed consent will be sought from participants and guardians, emphasising voluntary participation and the right to withdraw. Confidentiality will be maintained through fictitious names and de-identification. Continuous reflexivity will be practiced to acknowledge and mitigate researcher bias, ensuring ethical integrity throughout the study.

4. Results

This ethnographic study investigated the impact of a growth mindset intervention on achievement in and attitudes towards phonics learning among early years learners. The findings are organised into main themes, addressing two research questions. While these themes are presented separately, they are interconnected, as achievement and attitudes often influence each other.

The intervention led to notable improvements in phonics achievement across different learner groups. Low-achieving learners showed significant progress, with three out of four learners increasing their scores. Middle-achieving learners demonstrated moderate gains, while high-achieving learners also experienced improvements, although to a lesser extent. For instance, a low-achieving learner, improved from 1/10 to 5/10, and a middle-achieving learner, increased from 3/10 to 6/10. The study also highlighted the role of Special Educational Needs (SEN) in influencing outcomes. Learners with SEN, including concentration issues and English as an Additional Language (EAL) challenges, often showed limited improvement. For example, a high-achieving learner with concentration difficulties, did not demonstrate

significant progress. Similarly, an EAL learner, faced barriers in phonics achievement despite a positive shift in attitude.

Attitudinal shifts were observed post-intervention. Learners began to view learning as a process of growth, expressing "I think I could not read words but now I can try really hard and my brain grows very big." These changes were accompanied by increased effort and motivation in phonics tasks. For instance, a low-achieving learner, transitioned from a fixed mindset to a growth mindset, demonstrating increased willingness to tackle phonics tasks. Similarly, some high-achieving learners, who initially lacked confidence, showed improved resilience and engagement with challenging tasks.

The intervention also positively influenced learners' perceptions of mistakes. Learners shifted from viewing mistakes negatively to seeing them as integral to the learning process. This change in attitude was supported by educators providing constructive feedback, emphasising effort over innate intelligence. Such feedback reinforced the growth mindset, fostering a supportive learning environment.

Furthermore, the intervention promoted learner autonomy. As learners internalised growth mindset principles, they became more self-directed, taking ownership of their learning and demonstrating increased independence. This shift was evident in learners, who, with growing confidence, began to approach tasks proactively.

In conclusion, the growth mindset intervention positively impacted both phonics achievement and learner attitudes, with variations influenced by individual learner profiles and SEN considerations. It effectively cultivated resilience, autonomy, and positive attitudes towards learning. These outcomes underscore the importance of fostering a growth mindset to enhance learners' academic and personal development.

5. Discussions and conclusions

This study examined the effects of a growth mindset intervention on phonics learning among early years learners. Results indicated that low-achieving learners made notable progress, while high-achieving learners exhibited increased confidence and resilience. However, learners with Special Educational Needs (SEN) showed limited improvement, suggesting the necessity for additional support tailored to their individual needs.

The intervention also fostered greater effort, motivation, and enthusiasm, promoting learner autonomy and resilience in the face of challenges. These findings align with existing literature, which highlights the benefits of growth mindset approaches in enhancing learners' attitudes and engagement.

Despite positive outcomes, the study faced limitations, including a small sample size and potential confounding factors. Future research should explore the scalability and long-term effects of such interventions, particularly for SEN learners. Overall, the study underscores the value of integrating growth mindset principles into early years education to support diverse learners' development.

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HEALTH 4.0 PARADIGM LEARNING USING HEALTHTEK VIRTUAL CAMPUS

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Abstract

The HealthTEK project is an open-access virtual training platform designed to provide education on the fundamental concepts of biomedical engineering. The initial focus of the project is to introduce students to the convergence between emerging technologies and the healthcare sector through the exploration of the key principles defining Health 4.0. The first unit of the project, titled *Unit 1: Health 4.0*, focuses on the Industry 4.0 paradigm as applied to healthcare and quality of life, covering a range of topics that provide students with a comprehensive understanding of digital transformation in the healthcare sector. This unit is organized into four core modules, each addressing a key topic within this context. The first module introduces the basic concepts of Health 4.0, providing a solid foundation on the advanced technologies that are reshaping healthcare. The second module focuses on inclusive and user-centered design approaches, particularly the "Design for All" models, which aim to ensure that 4.0 technological solutions are accessible and effective for all individuals, regardless of their characteristics and capabilities. This module emphasizes the importance of creating products and services that are inclusive, efficient, and tailored to the needs of users. The third module explores the most commonly used validation methods for assessing the effectiveness of technological solutions in healthcare. Through this module, students gain a detailed understanding of the validation processes required to ensure the safety, reliability, and effectiveness of technological innovations in the healthcare field. The fourth module focuses on the social impact generated by these technological solutions, analyzing how technology in the healthcare sector can improve the quality of life for patients, as well as raise new ethical, social, and economic challenges. At the conclusion, the unit includes a chapter presenting several case studies. From a methodological perspective, the course integrates a variety of interactive pedagogical resources, such as multimedia presentations, explanatory videos, case studies, recommended readings, and interactive quizzes, designed to assess student progress and ensure the acquisition of key knowledge. All content is structured within a gamification-based learning strategy. This approach promotes autonomous, personalized, and flexible learning, optimizing the educational experience and ensuring that students develop a comprehensive understanding of the fundamental concepts related to Health 4.0 and biomedical engineering.

Keywords: *eLearning, Health 4.0, biomedical engineering, asynchronous online teaching, gamification.*

1. Introduction

Education and research have long revolved on health, but the incorporation of digital technologies (Tang et al, 2021; Millar et al., 2023; Kumar et al., 2021) in the last several decades has really shifted the focus. Here, for the last three years, work has been steadily progressing on the HealthTEK: Technology for Healthcare education utilizing smart Gamification project.

By delving into the fundamental ideas that make up Health 4.0 (Mateus-Coelho, Cruz-Cunha, & Ávila, 2021), the initiative aims to familiarize students with the growing relationship between healthcare and new technology (Mateus-Coelho, Cruz-Cunha, & Ávila, 2021). Unit 1: Health 4.0 investigates the digital revolution of the healthcare business through the lens of business 4.0 (Bause et al., 2019), providing students with a comprehensive understanding of cutting-edge technologies and their impact on quality of life. This unit is organized into four modules that cover essential aspects of the subject. First, the fundamental foundations of Health 4.0 will be presented, establishing a solid foundation in the technological innovations that are revolutionizing the healthcare sector. Next, inclusive and user-centered design will be analyzed, highlighting the "Design for All" approach, which aims to ensure that technological solutions are accessible and effective for all people, regardless of their abilities. It then examines the

primary validation methods used to evaluate the safety, reliability, and efficacy of various healthcare technologies included in Health 4.0 paradigm. Finally, the societal effect of digitalization in healthcare will be studied, taking into consideration that health 4.0 paradigm is considered as a synonym of "Digital health". The lesson finishes with case studies of computer games for health (Garett, & Young, 2019; Krishnamurthy et al., 2022) that demonstrate the actual application of these principles in a variety of situations, giving students context and a better understanding of what they've learned.

The course includes a virtual approach (Kumar et al., 2021; Leadbeater et al., 2021; Masters et al., 2023) including a range of interactive pedagogical tools, such as multimedia presentations, explanatory videos, case studies, recommended readings, and interactive quizzes, all designed to track student progress and ensure critical knowledge acquisition. All content is grouped around a gamification-based learning approach. This strategy promotes independent, customized, and flexible learning, therefore improving the educational experience and ensuring that students have a solid understanding of the core concepts of Health 4.0 and biomedical engineering.

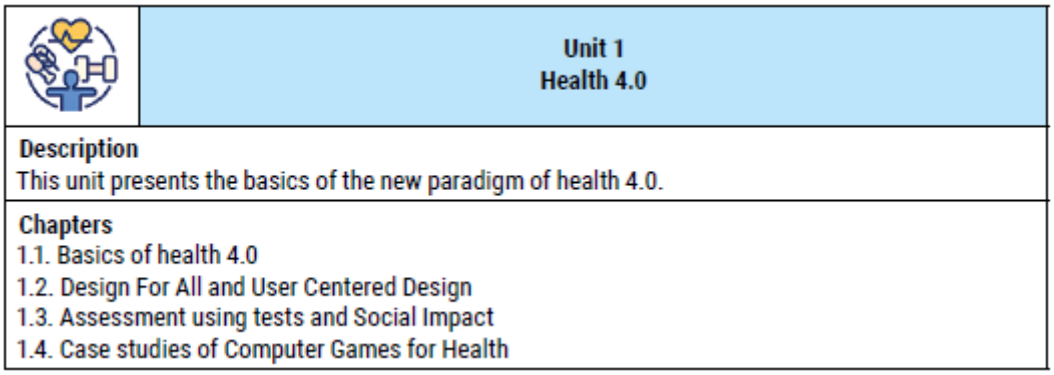
Unit 1: Health 4.0's content and techniques were evaluated in several European educational institutions, including the University of Deusto (Spain), the ESTIA Institute of Technology (France), Francisco de Vitoria University (Spain), and Bialystok University of Technology (Poland). Student satisfaction was assessed both objectively and subjectively, providing useful information for improving the teaching process and learning experience.

2. Methodology and proposed design

A series of stages has been proposed to facilitate access to and interaction within the platform. The main steps that users must follow to access HealthTEK and make the most of the educational experience are detailed below:

1. **Registration on the Moodle platform that hosts HealthTEK**: The first stage consists of creating an account on the Moodle platform, which is the system that hosts the HealthTEK educational tool. This registration is essential to guarantee that users can access the available content and resources in a secure and personalized way, creating a unique profile that will allow them to interact with the material effectively.
2. **Access to the unit**: Once registered on the platform, users will be able to access the specific learning unit within HealthTEK. This phase involves navigating the platform, where participants will be able to view and begin exploring the Health 4th training unit, which includes documents, videos and gamified learning activities. It is a crucial step in familiarizing themselves with the structure and content of the course or training they have enrolled in.
3. **Assessment of learning outcomes based on gamified activities**: After interacting with the Health 4.0 learning unit, participants will be assessed through gamified activities. This approach aims not only to measure the knowledge acquired, but also to motivate users through game dynamics. The activities are designed to offer continuous and fun evaluation, allowing users to reflect on their progress and performance while learning in an active and interactive way.
   The following figures show the content that students will learn in the Health 4.0 unit.

Figure 1. Content of the Health 4.o unit in HealthTEK learning platform.



Throughout the Health 4.0 unit, a diverse set of content will be presented that will allow students to gain a comprehensive understanding of the key topics within this field. First, the most basic concepts of Health 4.0 will be addressed, offering a detailed introduction to this innovative approach and its application in the field of digital health. Next, two fundamental concepts will be explored: Design For All and User Centered Design, which are essential approaches for the development of accessible technological solutions focused on user needs. These approaches will ensure that students understand the importance of designing products and services that are inclusive, usable and effective for everyone, regardless of their abilities or characteristics. Thirdly, we will discuss how to use standardized tests during evaluations, which will allow students to become familiar with the tools and methodologies that can be used to objectively measure the effectiveness and impact of interventions in the Health 4.0 field. Finally, case studies will be presented that use video games and similar technologies as tools for evaluation and learning, demonstrating how games can be used to analyze and improve the user experience in healthcare contexts.

3. Results

During the learning process, students will be involved in the execution of various fun activities designed to reinforce their understanding and skills in the topics being taught. These activities, which have a dynamic and entertaining approach, are structured in such a way that students can actively participate while reinforcing the knowledge they have acquired. Below are some examples of these fun activities, which are detailed in the following figure, to illustrate how they are integrated into learning. These activities not only seek to teach effectively, but also to provide a fun experience that fosters students' motivation and interest in their educational process.

Figure 2. Range of recreational activities for gamified learning.

To effectively evaluate the usability and accessibility of the contents of the Health 4.0 unit, the SUS (System Usability Scale) and USE (Usefulness, Satisfaction, and Ease of Use) tests were administered to assess how engaging is the environment (Bucholz, 2020). These tests were used to obtain an accurate measurement of the user experience, thus allowing us to know their perception of the usability and usefulness of the educational unit. Through these questionnaires, valuable information has been gathered about users' opinions and suggestions, which has been crucial in identifying areas for improvement. In this way, the feedback received has been carefully considered, with the aim of adjusting and optimizing the content of the unit, guaranteeing a more satisfactory and effective experience for future students.

4. Conclusions

The growing integration of digital technologies in healthcare education and research has redefined the way these fields are approached. In this context, the HealthTEK project: Technology for Healthcare Education Utilizing Smart Gamification has worked for the past three years to develop innovative approaches. Unit: Health 4.0 has shown to be an effective tool for introducing students to the convergence of technology and healthcare with promising results aligned to the new role of technology in medical sciences (Rahman, & Rahman, 2021; Syokumawena, & Jaya, 2022). The knowledge includes the provision of a systematic knowledge through a Health 4.0 unit that covers everything from technological principles to social and ethical implications.

The incorporation of interactive pedagogical strategies and a gamification-based approach has enabled more autonomous, flexible, and personalized learning, facilitating the acquisition of fundamental knowledge in Health 4.0 such as the integration of internet of things, virtual and augmented reality, artificial intelligence, biosignal processing or 3D manufacturing among others applied to health and wellbeing. Furthermore, evaluations of content and technique at several European universities have provided valuable information for the continued improvement of the teaching process. The findings describe a pleasurable and effective educational experience, underlining the importance of continuing to research and improve training in technology applied to the health profession.

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PERCEPTIONS OF FUTURE KINDERGARTEN TEACHERS ON THE USE OF EMBODIED LEARNING WHEN APPROACHING WORKS OF ART IN PRESCHOOL EDUCATION

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Abstract

The purpose of this study is to explore the perceptions of future kindergarten teachers on the use of embodied learning in the preschool classroom with an emphasis on movement that comes from exposure to works of art in museums or in the classroom. For this purpose, we used a google forms questionnaire with open-ended and closed-ended questions administered to 45 undergraduate students in the Department of Preschool Education at the University of Crete. Specifically, we asked for their views on their previous experiences with museums and on the application of movement when approaching works of art. According to the respondents, museums are mainly seen as places of art and exhibits, while they point out that they lack educational museum learning activities. They also agree, with the educational practice of visiting a cultural site or using works of art in the kindergarten classroom. The implementation of embodied learning to approach works of art is supported by the participants. They believe that movement contributes to the sensory experience of exhibits and works of art, to the approach of difficult concepts and to a better understanding and retention of knowledge through experience, body and senses. Furthermore, they point out that works of art can act as a stimulus for children's motor activation and that movement and the experiences associated with it play an important role in the expression of emotions, development and learning. Finally, participants express their desire for workshops on how to approach works of art through embodied learning in their university curriculum.

Keywords: *Museum experiences, embodied learning, motor experiences, early childhood, higher education.*

1. Introduction

Despite the insistence on traditional mind-centered teaching methods, which separate the body from the mind and have the learner sitting in a chair in a classroom, listening and writing, it is now increasingly recognized that movement and the experiences associated with it play an important role in the learning process (Macrine & Fugate, 2022; Wilson, & Foglia, 2015). The theory of embodied learning has been developed, rooted in the theory of phenomenology by Martin Heidegger and Maurice Merleau-Ponty, according to which, the physiology of the human body and the experiences the individual has in the environment with their body determine the way they think (Vasilaki, 2023; Kai-Kee, et al., 2020). Our body and its sensorimotor skills are a point of orientation in the environment and therefore a key reference point for our learning, developmental and cognitive experiences (Pourkos, 2015). During the preschool age, motor and perceptual experiences form the basis of a young child's education. Activities, as well as educational environments that involve movement and engage students to move in defined ways, enhance learning (Kosmas & Zaphiris, 2018). In addition, embodied educational interventions and interactions make knowledge accessible to all students, offering them more opportunities for active participation (Macrine & Fugate, 2022; Macedonia, 2019; Kosmas & Zaphiris, 2018; Foglia & Wilson, 2013). Embodied knowledge seems to be influenced by the activity of the body as the triptych of perception-cognition-action is closely linked (Barsalou, 2010). By changing the traditional ways of teaching and learning, embodied learning uses the body, the senses, the mind and the environment (Shapiro & Stolz, 2019; Paniagua & Istance, 2018).

Non-traditional learning environments such as museums function as places of diversity and holistic sensory and cognitive experiences, where learning is achieved through processes that activate both body and mind. In particular, post-humanist theories point to the importance of sensory experiences, movement, somatic memory and the need to take into account, during the museum experience, the dynamic role played

not only by the objects, but also by the actual space and time of the museum (Hackett, Holmes & Macrae, 2020). At the same time, “body-based pedagogy” in museums is taking shape, which puts visual perception in the background and focuses on approaching museum exhibits with all of the senses, the mind and the body, and encourages somatic interpretations (Christofalou, 2022). In fact, studies show that embodied learning assists in approaching difficult concepts in education (Papadopoulos & Mamali, 2021; Smyrnaiou, et al, 2016).

However, in the field of teacher education, existing research emphasizes mainly the cognitive and scholarly aspects of embodiment. We have therefore identified a research gap between teaching and sensory, body experiences (Hilde & Ørbæk, 2024). Furthermore, a shortage has been identified in courses on how to utilize art and museum experiences through embodied learning in the museum and in the classroom by both future and practicing teachers (Dimitriadi & Malafantis, 2022; Doxanaki & Linardakis, 2022; Oikonomidis & Trouli, 2022; Trouli, 2023; Sotiropoulou-Zormpala, Trouli & Linardakis, 2015; Sotiropoulou-Zormpala, Trouli, & Linardakis, M. (2010).

Seeking to fill the aforementioned gap, in recent years, in the Psychomotor and Museum Education courses of the University of Crete, we use techniques of embodied learning, such as sensorimotor activities, gestures, free movement expression activities and playful body movements, emotional involvement activities, and role playing, in order to approach knowledge, often using works of art as a tool.

2. Research aims and questions

In this context, we decided to investigate the perceptions of a group of students from the Department of Preschool Education on the implementation of embodied learning through the approach of works of art in museums or in the kindergarten classroom. The research questions involve exploring the participants' prior experiences and perceptions of museums, as well as the application of movement when approaching works of art.

3. Method

3.1. Research design

For the needs of the research, a questionnaire was designed in google forms with 8 open-ended and 19 closed-ended questions on a Likert scale. Mixed methodology was applied for data analysis, particularly, descriptive-thematic analysis of the participants' reasoning (Tsiolis, 2018), and descriptive statistical analysis using the statistical package SPSS22 (Chalikias, Lalou, & Manolesou, 2015). The students' responses to the open-ended questions were recorded and sorted into categories; the number and percentages received by each response category are listed below. For those questions where responses were given on a five-point Likert scale (1=strongly disagree, 2=disagree, 3=don't know, 4=agree, 5=strongly agree), the means and standard deviations of the participants' responses are provided.

3.2. Research sample

The sample of the survey consisted of 45 students (43 women and 2 men, aged 20-22 years old), a ratio that reflects the actual representation in Preschool Education Departments in Greece. The participants were in their last two years of studies at the Department of Preschool Education of the University of Crete during the academic year 2024-25.

4. Results

4.1. Perceptions of future teachers on museums

In relation to the first research question, in order to explore the respondents' perceptions of museums, they were asked to write down three words that came to their minds when they heard the word museum, three things they liked about museums and three things they thought were missing from museums. They were also asked to answer what preschoolers gain from visiting a museum or using works of art in the kindergarten classroom.

In their attempt to capture the notion of "museum," students use the words statues (N=21, 46.7%), history (N=15, 33.3%), art (N=14, 31.1%), paintings (N=12, 26.7%), exhibits (N=12, 26.7%), culture (N=9, 20%), and guided tours (N=8, 17.8%). Students perceive museums as places of: art and exhibits (objects, sculptures, paintings, jewelry, frescos, pottery, tombs, photographs) (N=34, 75.6%), information, exploration, discovery, and learning (activities, educational events, guided tours, teaching materials, etc.) (N=19, 42.2%), calm, harmony, and relaxation (N=6, 13.3%), as well as observation of the evolution and usefulness of objects and their influence until today (N=6, 13.3%).

According to the students, significant deficiencies in museums are observed in the following areas: museum education (museum educational activities for everyone, experiential activities, interactivity, interactive exhibits, transmission of knowledge, hands-on interaction with the exhibits, guides, games, entertainment, audio tours) (N=26, 57.8%), access (physical, cognitive, free entrance, cheaper tickets, funding, accessible for people with disabilities) (N=11, 24.4%), organisation (site and visitor management, more staff, better promotion and information, spaces for children) (N=11, 24.4%), as well as exhibition and collections (lack of technology, presentations, and music) (N=11, 24.4%).

The students' answers regarding the individual questions about the educational practice of visiting a cultural site and the use of works of art in the kindergarten classroom ranged between "agree" and "strongly agree". In particular, they consider that this practice enriches children's stimuli and experiences (mean=4.5, sd=0.76), helps children acquire knowledge (mean=4.48, sd=0.63), supports their sensory development (mean=4, sd=0.91), the development of their cultural awareness (mean=4.51, sd=0.79), the development of their empathy (mean=4.24, sd=0.96), their social development (mean=4.2, sd=0.82), their language development (mean=4.1, sd=0.91), the development of their body expression (mean=3.96, sd=1.19), the development of their civic awareness (mean=4,1, sd=0,89), the development of their environmental awareness (mean=3.96, sd=1.11), and lastly, the development of their non-verbal expression (mean=3.84, sd=1.39).

4.2. Perceptions of future teachers on the application of movement when approaching works of art

In order to explore the perceptions of the research participants about the application of movement when approaching works of art, we asked them what they think about the implementation of embodied learning in museums or kindergartens, whether movement can contribute to the sensory experience of works of art, whether we can approach difficult concepts through movement, whether works of art can serve as motivation for the motor activation of children, and lastly, how does movement and the experiences associated with it benefit preschool children?

The implementation of embodied learning in museums or in approaching works of art in the kindergarten classroom finds the students of our sample "in agreement" (mean=4.4, sd=0.75). In particular, they believe that embodied learning can contribute to a better understanding and retention of knowledge (N=17, 37.8%), enhance interactivity and interest among children and adults (N=4, 8.8%), promote well-being (N=3, 6.7%) and creativity (N=3, 6.7%).

Regarding the contribution of movement to the sensory experience of exhibits and works of art, students seem to "agree" (mean=4.31, sd=0.95). In fact, they consider that: movement contributes to better understanding and retention of knowledge through experience, the body, and the senses (N=17, 35.8%), it increases emotional engagement and understanding of emotions (N=4, 8.9%), enhances representation of exhibits through the body, and the development of creativity (N=4, 8.9%), and strengthens memory (N=2, 4.4%).

The students also "agree" that through the movement and sensory experience of the exhibits we can approach difficult concepts, such as the refugee issue (mean=4.02, sd=1.14) and point out that empathy is enhanced and we achieve awareness and understanding of a difficult situation (N=17, 37.8%), they also consider movement a good approach for difficult issues (N=13, 28.9%) and that it increases emotional engagement and understanding of emotions (N=3, 6.7%).

The view that works of art can act as motivation for the motor activation of children is "agreed" by the students (mean=4.33, sd=0.79), as 35.7% (N=16) believe that works of art are a source of inspiration for motor-physical representation and expression, however, they point out that an appropriate educational approach (N= 11, 24.4%) and suitable works of art (N=2, 4.4%) are required.

Lastly, the students in the sample "agree" that movement, and the experiences associated with it, play an important role in the processes of: emotional expression (mean=4.40, sd=1.14), physical and motor development (mean=4.22, sd=1.06), social development (mean=4.24, sd=1.09) and education and learning (mean=4.22, sd=1.06). In fact, in an open-ended question, when asked to indicate what else they consider important for approaching works of art through embodied learning, the students in the sample indicated their desire for the implementation of relevant workshops as part of their university curriculum for the purpose of: acquiring skills to apply embodied learning (N= 16, 35.6%), acquiring and enhancing new skills (N= 7, 15.6%), acquiring knowledge in a different way (N= 6, 13.3%) and gaining hands-on experience (N= 4, 8.9%).

5. Discussion

The students' previous experiences of museums confirm previous studies (Trouli, 2023; Dimitriadi & Malafantis, 2022; Oikonomidis & Trouli, 2022) where the notion of museum is mainly associated with

statues, history and art. The students in the sample perceive museums mainly as places of art and exhibits, which can be explained, as in Greece, archaeological and historical museums are predominant (Doxanaki & Linardakis, 2022).

Even though the respondents perceive museums as places of learning, exploration and discovery, they point out that there are deficiencies when it comes to museum education and access (Trouli, 2023). Previous studies confirm the views of the students in the sample on the educational practice of visiting a cultural site or the use of works of art in the kindergarten classroom (Trouli, 2023; Dimitriadi & Malafantis, 2022; Oikonomidis & Trouli, 2022). In particular, the students responded that this educational practice enriches children's stimuli and experiences, helps children in acquiring knowledge, supports their sensory development, the development of their cultural awareness, the development of their language skills, their empathy, their social development, their civic and social awareness, as well as their physical/nonverbal expression.

The implementation of embodied learning in museums or in the approach of works of art in the kindergarten classroom through the sensory experience of exhibits and works of art, which essentially function as a motivation for the motor activation of children, is "agreed" by the students in the sample. They believe that, embodied learning can mainly contribute to a better understanding and retention of knowledge, to approach difficult concepts through experiencing the body and senses, confirming the literature on the importance of embodied learning to approach knowledge (Foglia & Wilson, 2013; Kosmas & Zaphiris, 2018). In addition, they point out that works of art can act as a stimulus for children's motor activation and that movement and the experiences associated with it play an important role in the expression of emotions, development and learning.

In order to achieve the above, they express their desire for the implementation of relevant workshops within their university curriculum in order to develop new skills in the implementation of embodied learning and to gain knowledge and experiences in an experiential way.

6. Conclusions

In kindergarten, the implementation of embodied learning is essential, as children conceptualize their experiences to a greater extent through their movement, senses and mind (Macrine & Fugate, 2022; Macedonia, 2019; Kosmas & Zaphiris, 2018; Foglia & Wilson, 2013). Unfortunately, later on, as we grow older, due to the prevalence of traditional teaching models that separate the body from the mind, opportunities to perceive and understand knowledge and the environment through the body are lost. Our research shows that students, the future teachers, understand the value of embodied learning, identifying its benefits and pointing out the need to strengthen university curricula with experiential courses and workshops.

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REMOTE LEARNING IN VIRTUAL BIOLOGY EDUCATION: SCIENCE PROCESS SKILLS ACQUISITION IN MICROSCOPY

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Abstract

Teaching and learning in the 21st century have increasingly been transformed to accommodate remote learners who are not limited by time and geographic location. In biology education, one of the challenges of remote learning is the acquisition of science process skills that are related to the subject. This research reports on the use of virtual laboratories in complementing students' microscopy skills through an inquiry-based learning approach. 98 first-year students were conveniently sampled to participate in the research following an embedded mixed-method approach. For the quantitative aspect of the study, a quasi-experimental design in which no control groups were used was employed. A pre- and post-test of students' science process skills acquisition in microscopy was conducted, followed by a desktop analysis of students' perceptions of their virtual microscopy learning experiences captured on discussion boards. The results from the analysis of test scores showed no significant differences in students' content knowledge of the subject. However, the paired sample T-test revealed a significant positive shift in the mean science process skill scores obtained post-intervention. Content analysis of recorded experiences on Blackboard discussion boards indicated three main themes, which showed that virtual laboratories played a significant role in extending remote science learning. Based on these findings, it was concluded that while virtual laboratories may not significantly affect biology content knowledge acquisition in the short term, they clearly enhance the development of certain basic and integrated science process skills among remote students. These findings underscore the potential of virtual tools to bridge the practical skill gap often associated with online science education. A key challenge that students highlighted was the difficulty in replicating the hands-on experience of traditional microscopy, prompting the need for innovative virtual designs that are closer to real experiences. Based on the findings, virtual laboratory learning is recommended for remote learning settings where a level of skill mastery is required. Future studies could employ control groups in order to establish stronger causal relationships. The implications of the study are linked to the value that virtual laboratories can add to remote biology education by potentially increasing students' access to learning opportunities regardless of their physical location and time.

Keywords: *Remote learning, science process skills, virtual laboratories, virtual microscopy (VM).*

1. Introduction and background to the study

One of the key laboratory tools in modern biology laboratories is the Microscope, which enables students to participate in inquiry in biology and related fields. Microscopy, defined as the scientific technique of using microscopes to observe and analyse specimens that are too small to be seen with the naked eye, allows students to magnify and resolve the fine details of biological specimens at both the cellular and molecular levels (Murphy & Davidson, 2012). With the use of a microscope, students can examine the properties, composition or even behaviour of different specimens, in turn building their science process skills for inquiry-based learning in biology. There are different types of microscopes that serve this purpose, including optical, electron, light (simple and compound) and the subfields of microscopy covered by these broad domains (Herodotou et al., 2025).

Traditional microscopy, while effective, presents challenges such as high costs, maintenance, and limited access to equipment in resource-constrained settings (Whalley et al., 2020). On the other hand, Virtual microscopy (VM), which uses digital slides viewed through a computer interface, has become a worthy complementary tool in science education. VM allows students to interact with high-resolution images of specimens, annotate observations, and collaborate remotely, potentially enhancing science process skills, accessibility to microscopy and unlimited engagement (Dee, 2009; Dickerson & Kubasko, 2007).

Science process skills (SPS), as defined by Padilla (1990), encompass the basic and integrated skills that scientists use to explore natural phenomena. These skills are crucial for transforming abstract scientific concepts into a clear, concrete understanding, particularly during scientific investigations. By mastering SPS, students can better grasp the principles of science (in this case, biology) through active participation in investigations that involve observation, experimentation, and inference. However, the development of SPS, particularly in biology, is often hindered by the limited availability of resources necessary for traditional laboratory-based experiences. VM offers a platform to bridge this gap by simulating real-world biology investigations, enabling students to practice SPS in a controlled, repeatable environment (Maity et al., 2023). Despite its potential, the effectiveness of VM in cultivating SPS remains underexplored, particularly in diverse educational contexts.

This study, therefore, investigates how virtual laboratories can be used in complementing traditional microscopy skills through an inquiry-based approach, with the main goal of developing their SPS. The study also addresses gaps in the literature regarding the pedagogical affordances of VM, its impact on student learning outcomes (in this case, the acquisition of SPS). The findings from this study could explicate approaches that can be employed for teaching microscopy in remote settings.

1.1. Research gaps

Since the 2020 pandemic, the need for educators to future-proof teaching has become increasingly important. Virtual microscopy (VM) is one way in which educators could enable remote learning as a complementary strategy when access to traditional laboratory facilities is limited. However, while VM has been praised for increasing access to microscopy (Maity et al., 2023), few studies have systematically evaluated its role in developing SPS. Existing research, like Paxinou et al. (2022), often focuses on cognitive and procedural skills associated with VM, but little attention is given to the SPS that could be attained in the requisite procedures. Furthermore, there is limited evidence on how VM performs across different educational contexts outside of the medical field and where access to technology and prior exposure to inquiry-based learning may vary. This study seeks to address these gaps by addressing the following objectives:

- To examine the extent to which VM enhances SPS,
- To evaluate the perspectives of students on their use of VM in remote settings and
- To report on the optimal instructional strategies for integrating VM into science curricula.

2. Literature review

Literature underscores the potential of VM to transform science education. In the study by Dee (2009), the researcher posited that VM enables students to explore digital slides at their own pace, fostering self-directed learning and critical observation skills. The systematic review by Maity et al. (2023) has several researchers reporting that VM improves access to rare or fragile specimens, democratizing microscopy education. However, challenges include the need for educators to be adequately trained and for all students to have the relevant devices and connectivity to tap into VM's benefits (Penn & Ramnarain, 2019).

Regarding SPS, Bybee (2011) emphasises that skills like hypothesising and data analysis are best developed through active engagement in authentic scientific tasks. VM supports such tasks by allowing students to manipulate variables (e.g., magnification) and record observations systematically (Herodotou et al., 2020). More research in the domain of remote and virtual learning suggests that virtual tools become pedagogically effective when they are used in complement with traditional tools using inquiry-based learning approaches (Braun & Kearns, 2008; Penn & Mavuru, 2020). Mixed-methods approaches, combining VM with traditional microscopy and inquiry-based learning, have shown promise in enhancing SPS but require further exploration.

2.1. Theoretical lens

Theoretically speaking, the study is guided by a multi-theoretical framework which combines Mayer's theory of multimedia learning (Mayer, 2009) and the active learning theory as suggested by Bonwell and Eison (1991). Multimedia learning optimises information delivery, ensuring cognitive load is managed through the thoughtful use of words, sound and images. On the other hand, active learning shifts learners from passive recipients to engaged participants through interactive tasks, problem-solving, and critical reflection. This combination of hands-on interactivity and multiple representations enhances virtual learning environments: multimedia presents content clearly, while active strategies ensure deeper processing and knowledge construction. The result of the merger is a dynamic virtual experience that truly empowers learners to develop a comprehensive understanding and lasting skill acquisition.

The literature also highlights contextual factors that tend to affect science learners. In resource-limited settings, VM can reduce costs associated with physical microscopes and laboratories, but digital literacy and access to reliable internet remain barriers that should be addressed (Herodotou et al., 2020). Moreover, cultural attitudes toward technology-mediated learning influence student engagement to a great extent and should always be considered.

3. Methodology

This study employed an embedded mixed-methods research design to investigate VM's impact on SPS acquisition. A quasi-experimental approach was preferred as it catered for the shortcomings of ethical issues that are related to controlled experiments in social science settings. 98 first-year undergraduate students (72 females and 26 males) in an intermediate phase teacher education programme were purposively selected to participate in a pre-science process skills test adapted from the intervention and the post-test. An integrated SPS pre- and post-tests, adapted from Mokhaba (2009), were piloted with a non-participating group of students and then administered. The SPS test measures skills such as *observation, hypothesis formulation, classification, stating operational definitions, Graphing and interpretation, experimentation and data analysis*. Scores of pre- and post-tests were analysed using paired t-tests to determine significant differences before and after the intervention with VM. The intervention carried out utilised the freely available "virtual microscope" (https://www.ncbionetwork.org/educational-resources/elearning/virtual-microscope) developed by ncbionetwork on an open license to use by educators and students.

Follow-up qualitative thematic content analysis of the discussion forum feed of all participants was conducted to establish perspectives of students on VM's usability in remote settings, engagement, and alignment with SPS. During the intervention, an inquiry-based approach to learning was employed, where participants needed to compare virtually observed biological specimens and the actual specimens. Observations of use and interviews were also conducted but are not reported within the scope of this proceeding. Thematic analysis, guided by Braun and Clarke's (2006) framework, identifies recurring patterns in the qualitative data. The mixed-methods approach triangulates findings, ensuring a comprehensive understanding of VM's effectiveness.

4. Findings

Quantitative results indicate that the VM group showed significant improvement in SPS scores ($p < 0.05$), between pre- and post-SPS tests, particularly in observation, classification, operationally defining and data analysis components of the test. However, no significant differences were found in graphing, hypothesising and experimenting skills, suggesting that VM may require additional scaffolding to support higher-order thinking. A paired samples t-test was conducted to evaluate the effectiveness of the virtual microscopy intervention on students' science process skills. The results revealed a statistically significant increase in post-test scores ($M = 18.35$, $SD = 2.78$) compared to pre-test scores ($M = 15.32$, $SD = 2.73$), $t(97) = 18.58$, $p < .001$. This finding suggests that the intervention had a meaningful and positive impact on students' performance in certain aspects of the science process skills test.

Qualitative findings, as captured on discussion boards, revealed three key themes that suggested the following: 1. that students valued the interactive features in the virtual microscopy lab, such as adjusting the optical lenses, handling equipment, adding oil and annotation tools, which enhanced their engagement and precision when observing specimens. 2. The remote affordance of VM granted the freedom to revisit difficult aspects over and over again, even in the comfort of students' homes, and lastly, 3. Students agreed that VM was an important prerequisite for preparing for traditional instruction. The lab assistants also noted that the use of the discussion board forum for sharing experiences was a worthy tool in facilitating collaborative learning remotely, as students could share screenshots of their experiences in real time. Figure 1 below shows a sample of discussion board images.

Figure 1. Sample discussion board threads.

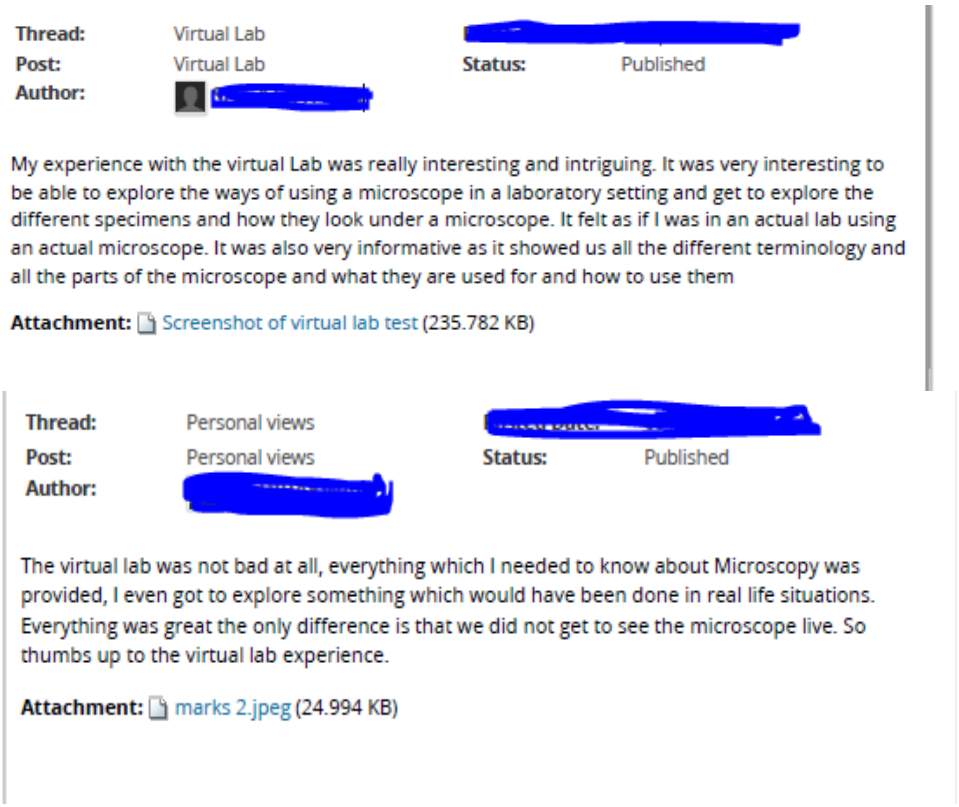

Figure 1 shows some excerpts of students' discussion board feeds as extracted from Blackboard. All permissions and ethics dimensions were followed. A key challenge identified by students was the need for hands-on experience to be added to the virtual aspect. Other challenges that were easy to resolve included a few technical glitches and connectivity issues.

5. Discussion

The findings align with Dee's (2009) assertion that VM promotes self-paced and autonomous learning, as participant students demonstrated stronger observation and analysis skills after engaging on their own with the virtual microscope. Profound gains like trial and error, unlimited access and the levels of interactivity with the virtual tool concur with the findings of other studies (Herodotou et al., 2020; 2025; Maity et al., 2023). Some of the challenges, like the lack of authentic experiences, echo Penn and Mavuru's (2020) observation that technology must be paired with explicit pedagogical strategies and traditional experiences for maximum benefit. Mixed-methods instruction, combining VM with inquiry-based activities, appears to maximise the learning outcomes in this particular intervention study.

It was also worth noting from the findings that virtual tools will always need to be complemented with actual traditional experiences, especially when it comes to the acquisition of science process skills. Contextual factors, such as the availability of digital tools and strong internet, significantly influence VM's effectiveness and may affect scalability in resource-constrained settings, corroborating Maity et al. (2023). The study highlights the need for teacher training to integrate VM effectively into remote and blended education settings as part of equipping students with innovative ways of learning in the digital age.

6. Recommendations and conclusions

Virtual microscopy holds a significant promise for enhancing science process skills, offering an accessible and engaging platform for scientific inquiry. This study demonstrates that VM improves observation, classification, operational definition, and data analysis skills significantly, though its impact on hypothesising requires further pedagogical support. By addressing contextual barriers and integrating VM into mixed-methods instruction, educators can maximise its potential for students' learning. These findings contribute to the growing body of evidence on technology-enhanced science education, offering actionable insights for practitioners and policymakers. Based on the findings, virtual laboratory learning

with VM is recommended for remote learning settings where a certain level of skill mastery is required. Future studies could employ control groups in order to establish stronger causal relationships, as this was the main limitation of this study. The implications of the study are linked to the value that virtual laboratories can add to remote biology education by potentially increasing students' access to learning opportunities regardless of their physical location and time.

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WORKSHOPS

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THE 5 CS FRAMEWORK FOR EFFECTIVE ASSESSMENT COMMUNICATION IN HIGHER EDUCATION

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Abstract

Purpose: Higher education students experience elevated levels of anxiety in relation to summative assessment (Walsh, 2021; Knight and Walsh, 2023). This can be exacerbated by ineffective communication of assessment requirements and expectations. However, developing clear, accessible and inclusive assignment briefs is challenging.
Background: Drawing on best practice and emergent research, this practical, hands-on workshop will share a recently developed framework to support the development of effective assignment briefs as part of inclusive assessment practices. By the end of the workshop, participants will be able to: identify the characteristics of effective assessment communication; apply a critical framework to an assignment brief to identify potential communication issues; and, use a framework to develop a communicatively effective assignment task.
Key points: The *5 Cs Framework* requires assignment briefs to be *clear, consistent, concise* and *comprehensive*. It is also important to design opportunities for students and staff to engage in *conversation* around the brief. This promotes critical engagement with disciplinary, academic and institutional norms at a level appropriate to their needs and supports the internalisation of valued tacit knowledge.
Procedure: Following a brief presentation and rationale for the *5 Cs Framework*, participants will engage with and critique an example brief and then develop their own assignment briefs. Participants are encouraged to bring their own assignment briefs for review and development. Workshop activities will involve a mix of individual and paired/group work with opportunities for questions and discussion.
Participants: This workshop is relevant to all higher educational professionals involved in assessment processes.

Keywords: *Communication, assignment brief, inclusive assessment, 5 Cs Framework, higher education.*

1. Introduction

Assessment is central and unavoidable within higher education (Boud, 1995), with challenges for both students and educators (Boud, 2006). Students experience elevated levels of anxiety in relation to summative assessment, which can be exacerbated by ineffective communication of assessment requirements and expectations in assignment briefs (Walsh, 2021; Knight & Walsh, 2023). At the same time, developing clear, accessible, and inclusive assignment briefs is challenging. Embedded within their own disciplinary and professional communities, educators may have different understandings of what can be tacitly assumed and what should be made explicit in their communications with students (Williams, 2005; Collier & Morgan, 2008). Their own knowledge of rhetorical practices within their disciplines may also be largely tacit and under explored (McGrath, Negretti & Nicholls, 2019). The aim of the *5 Cs Framework* is to provide educators with a means of designing effective assignment briefs that reduce student anxiety and provide a basis for confident and optimal engagement with assessed work.

The concept of academic literacies (e.g., Lea & Street, 1998, 2006) provides a useful frame within which to contextualise and examine the challenges faced by students in interpreting assignment briefs. Armed with what prior knowledge they have and only a partial understanding of the disciplinary discourse, students must find ways of engaging with their assessed work. They must do so according to rules and assumptions privileged within their disciplinary contexts which may be at best be only partially visible and acknowledged and at worst arcane and opaque (Lillis, 2001). Their situation is exacerbated by the unequal power differentials inherent in the higher education context which render the assignment brief authoritative in the Bakhtinian sense (1981), and thus incontestable, even when it is problematic. Where assignment briefs are ill-formed, ambiguous or unclear, students can locate difficulties in interpreting them internally,

with consequent implications for their confidence and identities as learners. Assignment briefs have a normative function in that they provide the very fabric upon which students develop confidence in and understanding of valued and privileged ways of thinking and doing within their disciplines (Knight, 2024). This relates strongly to Sadler's (2014) concept of goal knowledge. Goal knowledge is the student's idea of 'what a final work should look like' (Sadler, 2014, p. 4); it is a complex combination of understanding both the end (the final work) and the means, the process and structure by which the end is achieved. The assignment brief plays a key role in providing the basis for students to respond appropriately to the assessed task. Clearly, the student has to invent their own response, but without clear and unambiguous guidance, they cannot be expected to do so successfully.

Although assignment brief design is a relatively unexplored aspect of the assessment process (Gilbert & Maguire 2011), Gilbert and Maguire (2014) provide a robust set of guidelines for the design and delivery of effective assignment briefs and Hughes (2009) outlines a useful framework for the design of effective assessment tasks. Drawing on both, the *5 Cs Framework* was developed by the facilitators as part of doctoral research activities in Ireland and the UK (Walsh, 2021; Knight, 2024). Its aim is to provide an intuitive, portable, and non-disciplinary specific tool to guide educators in a critical engagement with an aspect of the assignment setting process that may otherwise remain unexamined. A further practical motivation in developing the *5 Cs Framework* is to ensure that assignment briefs are cognitively efficient (e.g., Sweller, van Merriënboer, & Paas, 2019). That is, that they support students in processing their instructions and task (i.e., intrinsic cognitive load) and remove, where possible, any distracting and unnecessary material (i.e., extraneous cognitive load) in order to allow students to focus their finite cognitive capacity and affective resources on engaging with the assessed task itself (germane cognitive load).

2. Purpose and objectives

The aim of this workshop is to share the 5 Cs Framework. This framework is intended to support the development of effective assignment briefs by requiring them to be clear, consistent, concise, and comprehensive. It is also important to design opportunities for students and staff to engage in conversation around the brief, promoting critical engagement with disciplinary, academic, and institutional norms at a level appropriate to their needs (Cureton, Groves, Day, & Williams, 2017). It arguably also provides a basis for transformative engagement with the assessment process (Lillis & Scott, 2015).

By the end of the workshop, participants will be able to:

- Identify the characteristics of effective assessment communication.
- Apply the 5 Cs Framework to an assignment brief to identify potential communication issues.
- Use Hughes' Assessment Task Design framework to develop a communicatively effective assignment task.

3. Workshop format

This 45-minute workshop begins with a brief 15-minute explanation by the facilitators of the underlying rationale for the *5 Cs Framework*. Working in pairs, participants will use the framework to engage with and critique an example brief and apply Hughes' Assessment Task Design framework to redesign the assignment task (20 minutes). The workshop will conclude with a 10-minute plenary with opportunities for comment and discussion.

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TEACHING CREATIVE PRESENTATIONS

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Abstract

The *Teaching Creative Presentations* workshop was aimed to empower educators and trainers with innovative techniques for training innovative presentation skills. In an era of increasingly visual and engaging communication, the ability to craft and deliver compelling presentations is essential for students and their future professional prospects. The session covered the discussion on the importance of creativity in presentations, followed by hands-on activities that encouraged participants to think outside the box. Through interactive exercises, attendees discovered methods to foster creativity and audience engagement strategies, including storytelling and designing visually appealing slides. We also delved into the role of body language and vocal delivery in capturing and maintaining audience attention. The workshop equipped participants (teachers and lecturers) with a toolkit of strategies and resources to inspire creativity in their teaching practices to train their students in engaging presentations techniques.

Keywords: *Presentations, creativity, rhetoric.*

1. Introduction

In an era where effective communication is essential, the ability to deliver engaging and memorable presentations has become an essential skill in academic and professional context. While traditional presentation methods focus on structure and clarity, creative presentations go a step further, integrating storytelling, audience interaction, and innovative visuals to enhance engagement and impact. What exactly makes a presentation creative? This paper explores this question by drawing insights from a survey conducted among educators and students, identifying key characteristics that define creativity in presentations.

In the survey, 51 pre-creativity course students were asked the question '*In your opinion, what makes a presentation creative?*'. The problem '*How to teach creative presentations?*' was discussed with 4 teachers experienced in creativity trainings in unstructured phone interviews. In the paper the quotes from respondents' inputs (key words or phrases) are marked *in italics*.

The paper outlines practical strategies for teaching creative presentations in the classroom. Techniques that help students develop originality, and creative spirit are discussed. The methods include thinking in questions, examples of constraint-based tasks, and taking a different perspective.

It must be noted, though that presenting creatively is a competency that encompasses a variety of skills such as verbal and non-verbal communication, innovative thinking, improvising and interacting with the audience. While the paper discusses the techniques to be used in the classroom, online or during trainings, both communication skills and creativity are recommended to be taught before the creative presentation course or training.

2. What are creative presentations?

Creativity is about *thinking*, thinking out of the box, being *original* and *curious*. A creative presentation is *original*, *interesting* and *novel*; it requires a different than usual, *non-standard, out of the ordinary approach*. Creative presentations *spark interest of everyone involved*, they are *exceptional and unique* as opposed to *banal*, *conventional*, *clichéd* or *unimaginative*. Best presentations are *compelling and captivating* and use a *style and format different than standard*, they *make the audience think and are unpredictable*.

Recommendations on how to achieve best results include incorporating *a variety of elements* such as *captivating graphic design*, *data visualisation (e.g. diagrams)*, *mind maps*, *thought-provoking images, photos, drawings, video, and music* to *avoid being bland* and to *stimulate imagination, creativity* and

innovative thinking. Interestingly, one of the students put the emphasis on the *aesthetic* and *artistic* value of the presentation, indicating that it may even be *extravagant*. At the same time, creative presentations should have a clear structure, i.e., their contents should be logically or *chronologically* arranged.

Still, as one of the respondents remarked, creative presentations are creative in both *contents and form*; in other words, *various tools and ways to convey the message* are applied to attract the attention of the audience but at the same time, it is *informative and educative*. What is important is that the presented material *goes beyond the slides or other visual aids and is enriched with illustrative examples*.

Creative presenters deliver their message in a way that helps the audience understand and *remember* it. The trick seems to be to select the *key points* (also to make the presentation short) and present them *in an inventive and appealing manner*, also *from a different perspective than usual*.

Apart from the attractive format, the style of delivery matters; the slides or other visual aids help to deliver the message and should be *clear rather than packed with a lot of text*, more focus should be on (*story)telling and sharing interesting facts* and *valuable information*. Clearly, reading the text on the slides or notes disqualifies the presentation from the creativity contest, *presenting is primarily about what is told rather than displayed or shown*.

Creative presenters *make their audience curious* and interact *with their public in a way that is well thought through, which also allows to flexibly adapt to the participants' needs. Interaction, collaboration and building rapport with the audience* may be achieved through *asking and inviting questions,* (e.g., a Q&A session) and *giving tasks (e.g. quizzes)*. In fact, one of the possible 'tests' if a presentation is interesting, suggested by respondents, were *active participation* and *willingness to find out more manifested by the number of questions*.

Last but not least, it seems that creative presenters feel at ease in their role and are able to create a *friendly and relaxed atmosphere, especially when talking about difficult topics, not avoiding humour, personal touch or sharing their opinions. They speak with passion, are engaged and motivated to share knowledge* and *use non-verbal communication (their voice and body language) to attract and keep the audience attention.* Finally, creative presentations have also been defined as *dynamic and entertaining.*

3. How to teach to present creatively?

To start the class or course in creative presentations effectively, it is recommended to introduce the topic in a warm-up exercise. The example might be a round of introductions '**Do It Differently'**, in which the participants are asked to present themselves in a different way than people who spoke before them.

For any presentation, including creative, to be successful, preparation is key, which was stressed by the students participating in the survey: *one can tell if there was effort put in the presentation preparation, it should be prepared in meticulous detail.* In order to prepare well, one may use the '**Thinking in Questions'** technique in a variety of the classic brainstorming. In principle, brainstorming questions precedes brainstorming solutions, and may be applied as a group exercise or discussion '**What questions to ask to prepare a creative presentation?'**.

It may result in questions such as listed below:

- What kind of presentations do you think of as creative?
- What is the goal of the presentation? Is to inform, sell, convince, share knowledge, inspire, motivate or other?
- How should I structure my presentation for maximum impact?
- How to attract the attention of the audience and keep it throughout the presentation?
- How can I differentiate myself from other presenters?
- What unique personal experiences or perspectives can I share?
- How can I make the presentation visually engaging?
- What tools, aids or props to use to meet the objective of the presentation?
- What might be my sources of inspiration? How will I inspire the audience?
- What interactive elements can I include? How can I involve the audience in my presentation?
- What kind of humorous content, anecdotes, or surprises can I incorporate?
- What unexpected twist or element can I introduce?

One of the students remarked that presenting creatively requires *leaving the comfort zone*. In fact, one of the ways to boost creativity is by imposing limitations or difficulties. Oftentimes, it is the lack of resources or built-in constraints that result in original solutions. In teaching creative presentations this principle may be used by defining conditions that will make it impossible for students to present in a standard way; the examples of tasks are listed in the table below.

Table 1. Examples of 'Imposed constraints' tasks.

Limitation category	Task example	Task description	What does it teach?
Time constraint	***Elevator Pitch***	Presentations must be under 60 seconds.	• Being concise • Being selective
Time constraint	***Dragon's Den***	The maximum time to present and sell an idea or product is 3 minutes.	• Being concise • Being selective • Persuasive communication
Limited resources	***Presentation Without a Presentation***	No PowerPoint/Canva/Prezi or other presentation software is allowed.	• Resourcefulness • Creative solutions
Limited resources	***No Visual Aids***	No visual aids or props are allowed. Students must rely solely on their voice, body language, and storytelling techniques.	• Effective verbal and non-verbal communication skills
Limited resources	***Audio-als***	Only audio materials (e.g. music, podcasts, nature sounds) can be used in the presentation.	• Resourcefulness • Creative solutions
Limited resources	***Power Shortage***	The projector stops working in the middle of the presentation.	• Improvisation • Handling difficult and stressful situations

Source: Own elaboration

Limitations motivate presenters to be creative; on the same note, flexibility of thinking is one of the manifestations of creativity. Like in the example of **Power Shortage**, being confronted with sudden and unexpected changes will require impromptu solutions, for example:

- **Lost Notes** – students may not use notes or text on the slides.
- **Unexpected Interruption** – someone from the group interrupts the presentation, the presenter must handle it, practicing dealing with distractions.

Another variation of the creativity theme is 'a different perspective':

- **Role Reversal** – students present as if they were someone else (e.g., a celebrity, an expert in a different field.
- **Audience-generated Presentation** – the task is to plan the presentation in such a way, that the audience speaking time takes up at least 80% of the presentation time, teaching interacting with the audience.
- **Topic 'Against'** – presenters are given the subject which is contradictory to stereotypes, mainstream ideas or common knowledge – this may help in teaching how to, *spark interest in the most sceptic person in the audience*, as one of the respondents of the survey put it.
- **Team-Swap** – students are requested to continue someone else's presentation mid-way, practising flexibility, stress management and improvisation skills.

Last but not least, teaching creativity is also about shaping attitudes: students should be ready to challenge or even challenge standard ways of presenting. This seems to be a more complex mission and it requires time. Encouraging students to experiment, take risks and practice new ways of presenting is something to do and to remind on a regular basis and on multiple occasions.

4. Conclusions

Teaching creative presentations is more than just refining public speaking skills: it is about sparking interest and inspiring others, fostering originality and audience engagement. Through the survey, identified key characteristics that define a creative presentation were defined, highlighting the importance of innovative thinking, interaction, and visual aids. By implementing training methods such as imposing constraints or improvisation exercises, educators can equip students with the tools to develop and deliver captivating presentations.

Being creative is not an innate talent but a teachable skill that can be nurtured through ongoing practice and venturing new ways of presenting. As classrooms evolve to meet the demands of modern communication, integrating creative presentation techniques can enhance students' ability to convey ideas effectively in academic, professional, and public settings. By continuing to refine and expand the strategies covered in the paper, educators can empower students to become confident, compelling speakers in an increasingly communication-driven world.

GO AND GAMIFY AWAY

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Abstract

This workshop aims to test and operationalize Gamify Away, an innovative, gamified framework designed to meet the specific needs of target groups while equipping participants with organizational game design competencies. Gamify Away is an ongoing development tool, originally conceived as part of a PhD project focused on the intersection of education and games in museums, and, in this case, it is especially oriented towards collections risk management. In today's fast-paced world, where information and demands are overwhelming, professionals often struggle to integrate engaging, game-based activities to increase fruition as well as knowledge. Gamify Away may offer a practical solution, providing a simple, adaptable, and hands-on tool for educators and mediators. The workshop will adopt a hands-on approach methodology that will guide participants through the process of game creation using the framework. The session is designed for 20 participants, divided into 4 groups of 5 members. Each group will have access to a toolkit comprising a board game, dice, cards, and other tools such as markers, pens, and small figurines, that will help participants brainstorm a game narrative and, by the end of the workshop, present their game synopsis based on the educational objectives and outcomes, and game mechanics that they have decided upon. Participants are expected to leave with practical knowledge of how to develop educational games tailored to their specific contexts, empowered to create new, engaging game-based learning experiences.

Keywords: *Framework, gamification, learning objectives and outcomes, analogue prototype testing.*

1. Introduction and objectives

Nowadays, digital dependencies are a reality, and digital competencies are a must-have. Traditional educational methods are questioned, and the potential of game-based learning to promote collective problem-solving competencies is highlighted (Rye, Sousa & Sousa, 2025). Nevertheless, despite the availability of several tools and frameworks (Chou, 2019; Marczewski, 2018; Schell, 2008; Hunicke, LeBlanc & Zubek, 2004), the creation of certain software, games or other educational gamified learning activities are often not fully considered. Furthermore, the means by which they are evaluated often don't provide all the necessary data, which relates to the inherent complexity, hard to understand. It is recognized that knowledge retention is determined by the individuals' competencies, emotions, experiences and motivations (Tokuhama-Espinosa, 2011; Norman, 2004; Ryan & Deci, 1985), but it is also assumed that it is possible to consolidate activities able to optimize game creation at an early stage, based on a clear definition of educational objectives and outcomes. Created for museum contexts, it is believed that Gamify Away can be extended to several educational purposes. Dwelling on Csikszentmihalyi's (1990) Flow theory and understanding that an educational (digital or analogue) gamified experience can be a tool to reiterate already conveyed information, it is believed that in a well-balanced activity, challenges need to be adjusted to the specific needs of each target audience. They should be ultimately related to the educational goals that cultural institutions or others intend to deploy. Difficulties may appear along the way, but they shouldn't cause permanent anxiety or stress by being too high, nor should they lead to boredom states by being too low. According to Falk and Dierking (2011), a museum experience should integrate personal, social and physical contexts in order to be remembered, but even so, it is important to note that visitors may not recall all that has been said or experienced, perhaps only a few details that could fade over time (Falk & Dierking, 2001) and that's why differentiated solutions may be needed.

This workshop represents an opportunity to iterate a framework entitled Gamify Away, built upon early obtained results with gamified prototype testing (Andrez, Homem & Pinto, 2024; Andrez *et al*, 2023). Appropriating Campbell's (2004) hero's journey, gamification strategies (Chou, 2019; Marczewski, 2018; Zichermann & Cunnigham, 2011), the Flow theory (Csikszentmihalyi, 1990) and recently found results

related to the comparison between two groups (n=66) inside a museum, a relation between all of them has been established.

Gamify Away is a hands-on approach gamified framework able to kick start a game-based learning experience by deblocking ideas in a certain order based on validated exploratory studies (Andrez, Pinto & Homem, 2022), scientific approaches and insights based on results. In this workshop it is intended to demonstrate and validate a first iteration of this framework outside a cultural institution context.

The following sections describe the workshop's practical approach methodology, briefly presenting its current structure, along with its cycles, interactions and some rules, followed by final considerations.

2. Methodology

The workshop will start with a presentation of the framework and its explanation, a how-to-play approach and set rules to follow. Participants will be invited to take part in a group by choosing where to sit. For better time optimization, there is a 20-participant limit, which allows to divide attendees into 4 groups of 5 members. Upon onboarding and explaining, there will also be shown how aggregated considerations regarding the Flow theory (Csikszentmihalyi, 1990) and the hero's journey by Campbell (2004) can be taken into account upon the final stage of the activity. Groups will test out Gamify Away for about 30 minutes and each group will have access to a toolkit comprised of a board game, cards, markers, dice, hourglasses, figurines and coins. Help will be offered when needed, or when there is doubt amongst participants. By the end of the session, each group should be able to articulate a clear first game idea based on Gamify Away elements, game selection mechanisms and constant iterations. After each group presentation, a brief discussion will cover key insights, followed by a code for a quick online questionnaire to assess the overall workshop satisfaction and framework utility and usability.

3. Gamify Away: A Kickstarter gamified framework with iteration cycles

This framework was created to help kick start the first steps of game design experiences based on learning outcomes. The framework is also a gamified experience that needs to be played in order to apprehend all the game-like components. Once the groups are settled participants will have 3 minutes to define their context, target audience and one main objective before starting to play. Although the framework is based on collaborative work, each participant will have their own figurine or pawn, and time will be tracked for the whole session and in between moves within each group using a one-minute hourglass. The board game is divided into three main categories (learning outcomes, game mechanics and set) that participants will need to brainstorm upon, always keeping in mind the chosen context, target audience and objective. Also, the board has special houses, such as "move cards", "card enhancement", and "surprise cards", with fun activities and reading-out-loud moments. The goal of this gamified approach is to write down and iterate brainstorming ideas for each category using blank cards and markers to get a better selection of cards in the end. Along the way, participants need to iterate every time they encounter the "move cards" house, where they choose the best cards from each category to pass into the first iteration placement, which allows only 3 ideas in each category. Moving along the board is made with the help of a dice, and for every well-written card or iteration between the one-minute mark, participants get a money chip. By the end, when 3 cards from each category are placed on the board, the participant with more money chips chooses the best cards from each category for the final iteration stage, where also mixing ideas into new cards is allowed. The best-written cards are presented, and afterwards, the group has 5 minutes to write down a brief game synopsis based on all the categories that they have decided upon.

4. Final considerations

It is worth noting that Gamify Away is an ongoing development tool that relies upon several iterations regarding possible game-like scenarios. It is understood that this structure can change, regarding the final given evaluation, ongoing workshop satisfaction and immersion. Gamify Away tries to simplify a fairly complex activity that is inherent to game experience creation, but the tool can shed some more insights on how and why to get started. It is believed that game design is always a well-balanced collaborative product, a result of a differentiated group of people that brainstorm, make, test and analyse the best solution by trying to implement prototypes that may change over time. The complexity of a learning gamified experience relies upon several considerations and info-communicational dynamics that are aggregated around each context, team, institution, target audience, financial support, stakeholders and the cultural and social dimensions by which the experience is integrated, amongst other factors. With that in mind, this workshop may be an opportunity to consolidate a more robust framework that is able to kick

start a collaborative imagining and creation game tool relying on already established frameworks and theories. Although it is understood that the subjectivity and unpredictability of game creation and learning retention outcomes exist, Gamify Away may serve as a powerful starting point for generating strong ideas. However, for these ideas to become reality, teams must equip themselves with diverse competencies and expertise, including design, pedagogy, storytelling, and technical development. Collaboration, iteration, and a willingness to experiment are key ingredients to transform initial concepts into engaging and impactful gamified learning experiences.

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