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EVALUATING THE IMPACT OF PROJECT-BASED LEARNING ON THE DEVELOPMENT OF DIGITAL COMPETENCES AMONG HIGH SCHOOL STUDENTS

Borislava Kirilova
Faculty of Mathematics and Informatics, Sofia University (Bulgaria)

Abstract

The explored component of this paper investigates the impact of Project-Based Learning (PBL) on the development of digital competencies in 118 students from American College of Sofia (ACS). The research methodology employed includes an investigation based on an online Digital Skills Accelerator (DSA) self-assessment tool for digital skills aligned with the DigComp 2.2 Framework. DSA is a result of collaborative effort involving five organizations from Poland, Belgium, Spain, the UK, and Ireland. Digital competence encompasses a range of abilities, including information and data literacy, communication and collaboration, digital content creation, and safety – all essential for a workforce that must operate effectively in a knowledge-driven society. Therefore, when considering strategies to foster these competences, it is equally essential to develop specific methods and tools for precisely assessing particular aspects of digital competence. The study is divided into two research stages: (i) gathering data on students' performance and progress in relation to the targeted digital competences, and (ii) analyzing the collected data to ascertain whether there is evidence of improvement in these before-mentioned skills. The results suggest that PBL can effectively assist students in enhancing their digital competencies by employing technology for the acquisition, organization, storage, presentation, and communication of information. It is worth noting that assessing digital competences using existing evaluation tools, which establish the initial scales for their measurement, remains a significant challenge for the author. It means that curricula are tailored to develop digital competencies in each of the areas separately, but there is a noticeable gap in students' preparedness to effectively assess their level of each skill proficiency through interdisciplinary projects.

Keywords: *Project-Based learning, digital competencies, digital literacy, DigComp 2.2 framework, digital skills accelerator.*

1. Introduction

The introduction of digital technologies has brought about significant changes in our daily lives and made their use an inevitable process. Consequently, the notion of "digital competence" is being rapidly established as a key skill set. The conventional framework, historically focused on literacy and numeracy, which serves as a benchmark for educational institutions in preparing young people to cope with the demands of the modern labour market, needs a complete redefinition to capture the complexity of the digital age (Heilmann, 2020). Towards the close of 2006, prompted by the Recommendation of the European Parliament and the Council of the European Union on key competences, the European Union officially acknowledged digital competence as one of the eight key competences for lifelong learning (European Council, 2018, p.10). Digital literacy, a concept of recent emergence, has carved its niche within a domain that previously encompassed related concepts such as ICT, media literacy, information literacy, and computer literacy. Various definitions exist for the terms "digital competence" and "digital literacy". Some authors treat them as interchangeable (Krumsvik, 2008), but Hatlevik and Christophersen (2013) posit distinctions. Whereas "digital literacy" focuses on proficiency with software and hardware, "digital competence" is a broader concept that outlines the skills, reasoning, and critical commentary students should employ. The Council of the European Union's 2018 Recommendation on key competences for lifelong learning is adopted as the definition of digital competence: *digital competence includes confident, critical and responsible use of digital technologies and engagement with them for learning, work and participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital wellbeing and cyber security competences), intellectual property issues, problem solving and critical thinking* (European

Council, 2018). There are different frameworks for defining digital competence, but each is designed for use in a certain country. To be objective, the analysis is based on the most popular international framework, known as DigComp 2.2, first published in 2013 and revised several times since then.

2. Materials and methods

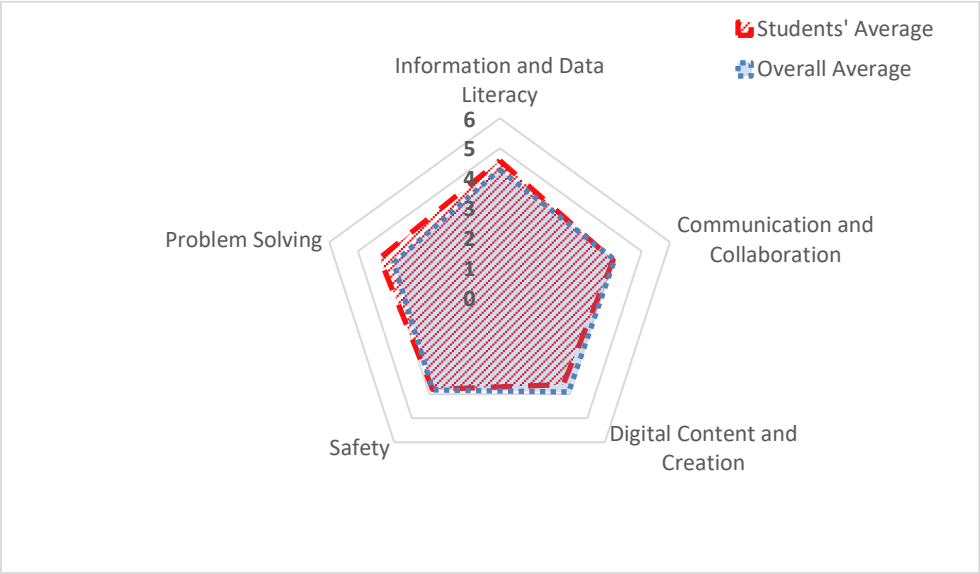
Project-based learning is based on the idea that students who learn by solving real-world challenges will be able to make connections between new concepts and apply their knowledge to real-life problems (Reyes & Orongan, 2023). Engaging in authentic scenarios assists students in grasping the significance of safety across diverse situations. This approach emphasizes active learning, problem solving and collaboration. Developing these competencies not only leads to a more profound understanding of the subject, but also to an increased awareness of responsibility towards the learning process. (Barron & Darling-Hammond, 2008). Furthermore, PBL often involves the use of digital tools for research, data analysis, and presentation. This exposure to technology enhances students' digital literacy, a crucial component of "information and data literacy" (Ertmer & Ottenbreit-Leftwich, 2010). Digital competencies extend beyond mere operational skills and knowledge of how to utilize specific technology or information (Coker, 2020), but creation of videos, websites, presentations, and multimedia materials enhances students' digital content creation skills. They also encompass the capacity to employ digital tools critically and effectively (Shopova, 2014). If students lack the essential digital competencies required to critically use the correct information, they may find the project development process challenging and need to dedicate more time to mastering digital technologies to attain satisfactory outcomes (Scheel et al, 2022). An online DSA self-assessment tool in line with the DigComp Framework, developed by five organizations from Poland, Belgium, Spain, UK and Ireland was used to investigate the influence of Project Based Learning in developing 118 students' digital competencies at American College of Sofia. The evaluation tool was utilized because: i). its creation was in line with the guidelines of the prominent EU research project, DIGCOMP. The initiative stems from the European Parliament's recognition of digital competence as one of the eight essential competences for lifelong learning; ii). the tool is intuitive, easy to navigate, and accessible to a diverse audience. iii). it is adaptable to different skill levels and backgrounds. It is suitable for users with varying degrees of digital proficiency; iiii). DSA provides clear and actionable feedback to users. It covers 21 competences grouped into five areas (Table 1). The questionnaire consists of 21 questions (one per skill) which includes six proficiency levels (from 1=basic to 6=advanced). In a few seconds after finishing the self-assessment each survey participant received their digital "radar chart" providing with an overview of personal strengths and weaknesses.

Table 1. The DigComp conceptual reference model (Vuorikari et al, 2022).

Competence Areas	Competence
Information and Data Literacy	1.1 Browsing, searching and filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content
Communication and collaboration	2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.3 Engaging in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette
Digital content creation	3.1 Developing digital content 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licences 3.4 Programming
Safety	4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment
Problem solving	5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps

3. Results

Figure 1. Comparison of students' results across the five competence areas with the overall average.



Preparing students for self-evaluation of digital competencies involves a combination of targeted instruction, practical experiences, and the development of metacognitive skills. Upon initial observation, the author noted the amount of time it took students to finalize the questionnaire and submit the survey results to Google Classroom. Remarkably, all participants successfully completed these tasks within 18 minutes, whereas the developers of the online tool used had indicated an expected time of approximately 30 minutes to answer all questions. This fact caused concerns that students may not have developed the skills necessary to self-assess their competence accurately. Assessing one's own abilities can be challenging, especially if they lack experience or a clear understanding of what proficiency in a specific digital competence entail. ACS faculty engaged in PBL seamlessly integrate digital skills across subjects, incorporating projects, case studies, and data analysis that necessitate the use of digital tools and technologies. Although students are familiar with a range of learning resources including online tutorials, interactive simulations, and multimedia materials, it is evident that the use of digital tools by themselves does not lead to a detailed understanding of the core of digital skills and their indispensable role in their future growth. Another potential explanation for these results could be that students have been exposed to a limited set of digital tools and applications, which restricts their broad perspective and therefore their ability to comprehensively assess their competence. The researcher chose to conduct individual interviews with each participant before summarizing the results of the study. It was revealed that approximately 79% of the participants lacked clarity about the distractor that closely matched their level of proficiency. It is important to note that this challenge did not stem from the language barrier, but rather from students' lack of clarity in terms of determining their level of digital expertise. Even with established benchmarks or reference points, they encountered difficulties in accurately self-assessing their own proficiency. The remaining approximately 21% of the sample considered themselves to be at the advanced level and accordingly their average results are between 5.3-6.0. Since the students had to upload their "radar chart" at Google Classroom and it was not anonymous, is too likely 25 students may fear that acknowledging their skill gaps could expose them to criticism or judgment, which can discourage honest self-assessment. Competence is a subjective concept and can vary from person to person. What one person considers proficient, another might view as beginner-level. This subjectivity makes self-assessment more challenging. The evaluation of digital skills has proven to be a real challenge, and existing systems have failed to initiate effective and systematic processes (Cukurova et al., 2017). However, all respondents were unanimous in their conviction that PBL has a key role in establishing digital competencies, presenting compelling arguments to support their position. This implies increased student awareness not only in terms of recognizing definitions, but also in their ability to distinguish between digital competencies and literacy. As an outcome, it is evident (figure 1) that the average results for the sample group closely align with the overall average results (the overall average results are retrieved from the Digital Skills Accelerator website). While it is anticipated that with the growing size of the sample, results should approach points of stability, it is somewhat surprising to observe how quickly this stabilization occurs within a relatively small sample.

Future research directions encompass two key areas: i). exploring points of stability within samples of different social origins and/or levels of education. ii). investigating whether the ongoing efforts to enhance digital competences within society will expand these boundaries, i.e., if the surface area on the charts will grow.

4. Conclusion

The proliferation of various digital competence frameworks, models, and strategies has led to a significant shift in their focus. Rather than primarily addressing the measurement and operational interpretations of digital competence, attention has turned towards the definition and indicators related to this concept. Surprisingly, despite numerous theoretical analyses, there is a noticeable absence of practical tools that schools can use for self-assessing digital competence, which could provide essential guidelines for potential development (Sillat et al., 2021). It's important to highlight that assessing digital competencies using existing evaluation tools, which establish the initial criteria for measurement, remains a substantial challenge for the author. Research studies have consistently shown the positive impact of constructivist pedagogy on the development of digital competences (Romero-García et. al, 2020). Research made by Dolezal et al., (2022). highlights that the significance of the student-centered approach in fostering digital competence is undeniable. The role of project-based learning in developing digital competence is indisputable because when working on a project, students must employ critical thinking, creativity, and analysis, and after selecting the appropriate resource, adapting it to their needs and applying it, achieve a specific outcome (Atanasova & Minkova, 2023). Additionally, they gain experience in applying these skills to solve authentic problems, which is a valuable aspect of their digital competence development. Students in active learning environments often develop a sense of ownership and agency over their education, which further motivates them to explore and utilize digital resources for their projects. In conclusion, it can be said that the integration of PBL in high school has shown a noticeable positive impact on the development of students' digital competencies. However, it should be noted that ascertaining the extent of this impact on each of the study participants is difficult, and for some of them, the acquisition of these skills is probably not completely conscious. More serious attention should be paid to establish clear criteria and rubrics for different levels of competence in digital skills, so students have a reference point for self-assessment.

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