

Identifying Critical and Underdeveloped Digital Competence Areas Among Pre-Service Teachers Using the DigCompEdu Framework

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Abstract

This study presents preliminary findings from a pilot research project investigating the digital competencies of pre-service teachers. Grounded in the DigCompEdu framework, the research identifies areas where teacher trainees exhibit the highest and lowest self-efficacy, alongside those they perceive as most critical for their professional careers. Fifty-eight first-year trainees completed a self-assessment based on the framework. Results indicate that participants rated themselves highest in Area 2: Digital Resources (33.03%) and Area 1: Professional Engagement (30.36%), while reporting lower proficiency in Area 5: Empowering Learners (22.41%) and Area 6: Facilitating Learners' Digital Competence (23.16%). Frequency analysis revealed that participants prioritised Area 3: Teaching and Learning (27.6%) and Area 6 (22.4%), signalling a discrepancy between current perceived competence and professional priorities. Overall proficiency was situated at level A2 on the DigCompEdu scale, reflecting a foundational level of digital tool integration. These findings suggest that while trainees recognise skill gaps in vital areas, there is an urgent need for targeted training in learner-centred digital pedagogy. This research underscores the necessity of employing established frameworks in early teacher education to foster balanced development across all competence domains.

Keywords: Digital Competence, Digital Pedagogy, Self-Assessment

Introduction

In a contemporary landscape defined by rapid transformation, initial teacher education faces a significant challenge in preparing the next generation of educators for increasingly

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multifaceted professional demands. Furthermore, pre-service teachers must cultivate a robust sense of vocation, ensuring the long-term sustainability and reinforcement of their professional interest and motivation. However, this requires considerable effort on the part of teacher training institutions, as the educational environment and system in which graduates will have to work is not only complex but also constantly changing.

The rapid integration of digital technologies into educational paradigms necessitates a comprehensive understanding of pre-service teachers' digital readiness (Wallace et al., 2022). This readiness is crucial for equipping future educators with the competencies required to navigate and leverage digital tools effectively in diverse learning environments, particularly as they will be teaching digitally native students (Kivunja, 2013). Despite the imperative for digital proficiency, many educators, including pre-service teachers, express dissatisfaction with their digital knowledge and skills, often limiting their integration of technology to basic, demonstrative applications (Pongsakdi et al., 2021). This highlights a significant gap between the theoretical understanding of digital education and its practical implementation, underscoring the need for more targeted and effective training initiatives (Reisoğlu & Çebi, 2020). Consequently, various frameworks have emerged to delineate the characteristics and assess the development of teachers' digital competence, serving as essential guides for both current and future educators (Ma & Ismail, 2025; Rakisheva & Witt, 2022).

One such prominent framework, DigCompEdu, provides a robust model for evaluating and developing the digital competencies of educators across various dimensions (Santo et al., 2022). This framework not only outlines essential digital skills but also emphasises the pedagogical application of technology, moving beyond mere technical proficiency to encompass effective integration into teaching and learning processes (Alarcón et al., 2020). This study will therefore utilise the DigCompEdu framework to analyse the digital readiness of pre-service teachers, focusing on their self-assessed capabilities and the implications for their professional development within the evolving educational landscape (Tsankov & Damyanov, 2019) (Akbar & Biyanto, 2022). This analysis will further identify specific areas where pre-service teachers may require additional support and training, thereby contributing to the refinement of teacher education programmes to better prepare them for the demands of contemporary digital pedagogy (Çebi & Reisoğlu, 2019).

Such an examination is vital for understanding the current educational baggage that pre-service teachers possess upon enrolment, enabling institutions to effectively redesign teaching and learning processes (Niță & Guțu, 2023). Moreover, it is imperative for pre-service training programmes to cultivate not only technical skills but also a deeper understanding of how digital technologies can transform pedagogical approaches, ensuring that future teachers are well-equipped to guide students through a digitally driven educational journey (Reisoğlu & Çebi, 2020).

Drawing upon the aforementioned context, this study aims to synthesise and analyse the findings of a pilot investigation into the digital competencies of pre-service teachers. To this end, two research questions were formulated:

1. In which DigCompEdu competence areas do pre-service teachers report the highest and lowest scores?
2. Which digital competence areas do pre-service teachers perceive as most significant for their professional preparation?

Addressing these questions will facilitate the identification of less-developed digital competencies and establish which domains pre-service teachers prioritise within their pedagogical practice.

1 Literature Review

The emphasis on digital competence among pre-service teachers is currently a critical determinant in ensuring the effective integration of digital technologies within educational settings. The modernisation of education should be spearheaded by practitioners who possess a comprehensive understanding of the complexities inherent in utilising Information and Communication Technology (ICT) for both pedagogical delivery and broader educational purposes. The challenge of equipping pedagogical graduates with the set of knowledge and skills proposed by experts should be taken up by all universities that consider themselves modern, focused on high efficiency, and with an eye on preparing teaching staff with high innovation potential (Tomczyk, 2024). The integration of digital competences in educational practices appears to be challenging and ineffective in many educational institutions, thus highlighting the necessity for ongoing research regarding the incorporation of digital skills in teacher education (Dolezal et al., 2025).

Many teacher education programmes, for instance, have yet to fully incorporate robust training modules that address the multifaceted nature of digital competence, focusing instead on narrow technical proficiencies rather than broader pedagogical applications (Falloon, 2020; Instefjord & Munthe, 2015).

As Spiteri and Rundgren (2018) demonstrate in their review of 27 articles, it is essential to emphasise the importance of teachers' professional development in utilising digital technology for educational purposes, with a particular focus on its sustainable integration within their pedagogical practices. Educators must possess not only the capacity to utilise digital technology, but also the appropriate attitudes and the understanding necessary for the practical application of these skills.

According to the review of Tiwari & Magre (2025), the major global trends in teacher training programmes include: a) Increasing integration of digital skills; b) Focus on digital content creation; c) Attention to communication and collaboration. Despite these positive trends, the review identifies several significant shortcomings: a) Short practical implementation; b) Limited digital security awareness; c) Insufficient focus on problem-solving applications; d) Need for more empirical evaluation. In the context of Strydom's (2021) study, it is imperative to evaluate the efficacy of digital literacy short courses critically. The study emphasises the necessity to adopt a framework that fosters a robust theoretical foundation, acknowledges

individual differences, and demonstrates sensitivity towards psycho-sociocultural factors associated with technology adoption and utilisation. This approach, as outlined by Strydom, is proposed as a means to enhance the effectiveness of educational programmes, particularly in the context of 'standardised courses'. As Kaminskiené et al. (2022) assert, a significant challenge in the realm of teacher education is creating opportunities for students to engage in deliberate practice, thereby cultivating the skills essential for effective classroom teaching. Simultaneously, these initiatives should foster a more nuanced theoretical grasp of teaching and learning among pre-service educators. Rakisheva and Witt (2023) emphasise that ensuring the quality training of future teachers requires a clear action plan, including benchmarks, metrics, and indicators of progress for the use of technology in education. Her review of existing ICT competence frameworks highlights their potential to guide initial teacher education by outlining expected digital skill sets and supporting the integration of technology into pedagogy. However, she also identifies a significant gap: most frameworks were not initially designed for pre-service teachers, and many lack empirical validation or the ability to adapt to different educational contexts.

In-service and pre-service teacher development programmes often aim to improve not only technical skills but also attitudes and beliefs about the value of digital tools in teaching and learning. Although Pongsakdi et al. (2021) focus on in-service teachers, their findings are highly relevant for pre-service teacher education. If attitudes can be positively shaped through well-designed training, then early exposure during pre-service education could play a vital role in developing long-term digital readiness. The study conducted by Tondeur et al. (2021) provides clear evidence that the attitudes of preservice teachers are likely to play a significant role in the development of 19 digital competencies. Specifically, preservice teachers who held more positive attitudes towards digital technology demonstrated a pronounced focus on collaboration. In contrast, those with less positive attitudes experienced a more complex engagement with the six strategies and placed greater emphasis on feedback. This aligns with Tiwari and Magre's (2025) call for teacher education curricula to include not only skill development but also reflection and modelling to support attitude change.

The study of Maderick et al. (2016) demonstrated that pre-service teachers often overestimate their digital readiness, particularly in pedagogical and evaluative applications of technology. This discrepancy is especially relevant here, as several participants in our study rated themselves highly in general digital literacy but scored noticeably lower in domains requiring pedagogical integration or critical use of technology.

1.1 The system of Teacher Education in Hungary

In Hungary, initial teacher education has been situated within the higher education sector since 1958. From 1974, training was delivered at the college level as a three-year programme, which was subsequently extended to four years in 1994. The Hungarian model follows [3] a concurrent structure, wherein theoretical instruction and practical school-based experience

are undertaken simultaneously. The following conclusions can be drawn regarding the relationship between the teacher training system and public education (Barabási, 2022):

- Teacher training takes place in a separate network of institutions.
- Graduates can teach in the lower grades of primary school (grades 1-4).
- They can teach subjects corresponding to their field of expertise in grades 5 and 6 of primary school.
- There is an overlap between graduates of teacher training colleges who can teach in grades 5-8 and those who can teach in schools.

In addition to objective competencies, perceived self-efficacy performs a critical function, even if self-reported data do not necessarily offer an accurate representation of an individual's actual proficiency. However, the primary objective of assessing perceived competence is not to yield an objective measurement of skill, but rather to foster pedagogical self-reflection.

2 Research Material and Method

During the 2024/2025 academic year, a pilot study was undertaken to assess the digital competencies of students enrolled in primary teacher education programmes. Using the DigCompEdu self-assessment tool, the research sought to evaluate participants' digital proficiency across several dimensions. This overarching aim was subdivided into two specific objectives: first, to identify the least developed areas of students' digital competence; and second, to determine which areas students prioritised for further professional development. The survey was administered anonymously via an online platform at Apor Vilmos Catholic College, a higher education institution in Hungary. This pilot forms part of a more extensive longitudinal research project. While the current phase focused on first-year distance learning students, subsequent stages of the study intend to gather comparative data from both senior year groups and full-time students.

2.1 Participants

The research was conducted with first-year students enrolled on the Primary School Teaching programme. From a total number of 70 distance learning students, 58 participated in the survey, yielding a response rate of 82.85%. The sample comprised 91% female and 9% male participants. It should be noted that the current study is limited in scope, as it is based solely on the preliminary findings of this pilot phase, which focused exclusively on distance learning students. Within the first semester of the curriculum, students are required to complete 10 hours of practical training in Information Technology (IT), with a further 10 hours of practical application scheduled for the second semester.

2.2 Instruments

The self-assessment of digital competencies is pivotal for educators within the contemporary digital landscape. Such reflective practice establishes favourable conditions for the effective integration of digital technologies in pedagogy, while simultaneously facilitating continuous professional development and long-term career growth. Studies (Moreira et al., 2023; Nguyen & Habók, 2023) have shown that teachers' self-assessment of their digital skills is a decisive factor in determining the successful implementation of digital technologies in the classroom. However, it must also be noted that although the development of digital competences as part of teacher training is essential, it is not sufficient in the long term; therefore, it is necessary to strengthen teachers' individual motivation and inspiration for regular and continuous self-development.

Consequently, as Dias-Trindade et al. (2021) assert, educators can comprehend the integration of technology into their pedagogical practice, the requisite training to enhance their competencies in underperforming domains, and the progression to digital proficiency. It is imperative to acknowledge that educators' knowledge is perpetually evolving, thus underscoring the necessity for ongoing learning and self-development. Furthermore, in view of the rapid evolution of this type of knowledge, proficient users recognise that they are not yet fully prepared and that there is always a need to develop their knowledge.

The present study investigates the digital competences of pre-service teachers by utilising the Teachers (DigcompEdu) Framework as a foundational conceptual framework. In addition to the six areas of competence in teachers' professional activities (1. Professional Engagement, 2. Digital Resources, 3. Teaching and Learning, 4. Assessment, 5. Empowering Learners, 6. Facilitating Learners' Digital Competence), the DigCompEdu Framework also sets out six progressive levels of proficiency (Table 1). Based on the points achieved, respondents can be assigned to the appropriate group, as shown in the following table (Table 1).

Digital Competence Level	Score
A1 – Newcomer	less than 19 points
A2 – Explorer	between 19 and 32 points
B1 – Integrator	between 33 and 47 points
B2 – Expert	between 48 and 62 points
C1 – Leader	between 63 and 77 points
C2 – Pioneer	more than 77 points

Table 1: Digital competence levels of the DigCompEdu CheckIn Questionnaire.

3 Results

The proficiency level in digital competencies is measured on a scale that varies according to the specific area or domain and the number of competencies included within it. The mean average of the total results is 27.293, with a standard deviation of 8.997. Consequently, the level of teachers' proficiency can be classified as 'Explorer – A2', as illustrated in Table 1. When analysed in a stratified manner, the findings reveal that the majority of respondents (60%) were located at the proficiency level 'A2–Explorer', 26% were at level 'B1–Integrator', and 12% demonstrated a proficiency level 'A1–Newcomer', as illustrated in Figure 1. However, none of the respondents are at levels 'C1–Leader' and 'C2–Pioneer'.

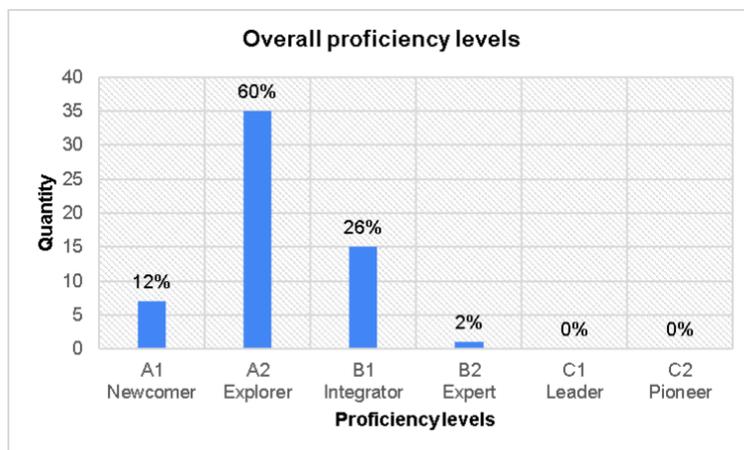


Figure 1: Overall proficiency levels.

The results for individual areas are displayed in the table below (Table 2). The results indicate that AREA 5 – Empowering Learners (22.414) can be identified as the weakest area, while AREA 2 – Digital Resources (33.034) is the strongest area. The analysis of the results indicates that the strongest area (AREA 2) is currently classified as level B1, but this classification is based exclusively on a value of 1.034. In addition, it can be posited that, except for AREA 1 – Professional Engagement and AREA 2, all other areas are situated closer to the lower level (A1) than the higher level (B1) based on their values. This distribution of data indicates that the values are minimal, and the respondents' digital competence is inadequate.

	AREA 1	AREA 2	AREA 3	AREA 4	AREA 5	AREA 6
Mean	30.362	33.034	24.983	25.000	22.414	23.155
Standard Error	1.367	1.490	1.450	1.591	1.329	1.572
Median	30	33	23	22	21	19
Mode	26	33	17	22	17	17
Standard Deviation	10.410	11.351	11.046	12.115	10.122	11.973
Coefficient of Variation	0.343	0.344	0.442	0.485	0.452	0.517
Proficiency Level	A2	B1	A2	A2	A2	A2

Table 2: Descriptive statistics of digital competence areas.

To identify which digital competence areas were perceived as most important for future teaching practice, participants were asked to select the single area they considered most essential. The frequency analysis demonstrated (Figure 2) that Area 3 was selected most frequently (16 selections, 27.6%), followed by Area 6 (13, 22.4%) and Area 2 (11, 19.0%). In contrast, areas 5, 1, and 4 were selected with comparatively lower frequency, with 8 (13.8%), 5 (8.6%), and 5 (8.6%) selections, respectively. This finding suggests a tendency among participants to assign greater importance to specific areas, particularly Areas 3 and 6, relative to other areas.

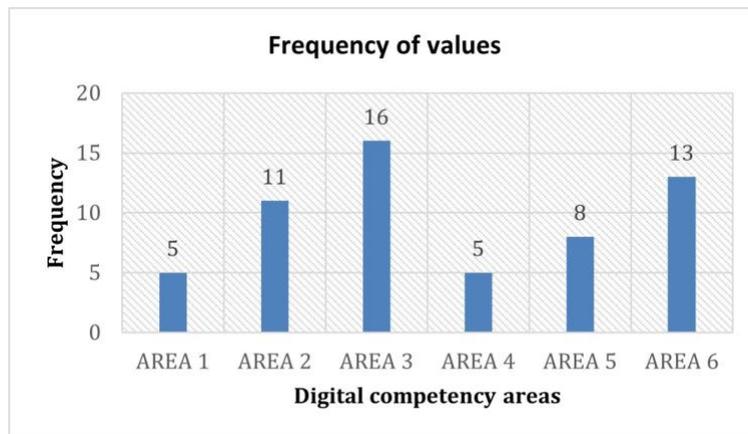


Figure 2: Frequency analysis.

Figure 3 compares the relative mean digital competence scores and the proportion of participants selecting each area as the "most important" competence. The mean competence scores, which had been normalised to the highest-scoring area (Area 2, 100%), ranged from 67.9% (Area 5) to 100% (Area 2). In contrast, the perceived importance percentages, based on participant selections, ranged from 8.6% (Areas 1 and 4) to 27.6% (Area 3). Areas 3 and 6 have been assigned significantly higher importance ratings than expected, given their actual levels of competence. Conversely, Areas 1 and 4 have been allocated lower importance ratings, despite displaying comparatively higher competence scores.

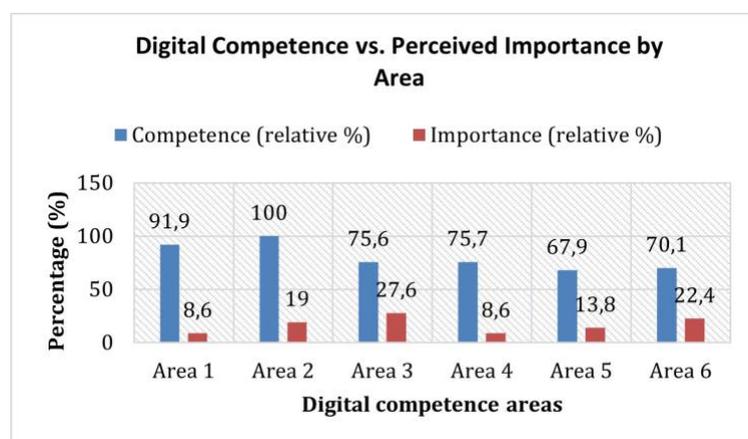


Figure 2: Percentage of digital competence and perceived importance.

4 Discussion

Using the DigCompEdu framework, this study investigated the digital competencies of pre-service educators—a subject of significant contemporary debate within the field. It addressed two primary objectives: 1) in which competence areas do trainees exhibit the highest and lowest levels of proficiency? 2) which digital domains do they perceive as most critical for their professional development?

Question 1 revealed that pre-service teachers were most skilled in Area 2: Digital Resources, with an average score of 33.03. They also did well in Area 1: Professional Engagement (30.36). On the other hand, participants scored lowest in Area 5 (22.41) and Area 6 (23.16), which involve using technology to help learners and assess their digital skills.

This suggests that although future teachers feel confident in finding and creating digital materials or sharing them online, they lack experience in using these tools in ways that adapt to different learner needs or explicitly build students' digital skills.

These findings align closely with those reported by Howard et al. (2021), who argue that initial teacher education should include more training on using technology in a learner-centred manner.

Regarding RQ1, pre-service educators rated themselves highest in Area 2: Digital Resources, as indicated by their mean scores (33.03), with Area 1: Professional Engagement close behind (30.36). The lowest ratings came from Area 5: Empowering Learners (22.41) and Area 6: Facilitating Learners' Digital Competence (23.16).

Looking at RQ2, frequency analysis showed participants most often prioritised Area 3: Teaching and Learning (27.6%). This was followed by Area 6 (22.4%) and then Area 2 (19%). Curiously, areas with the highest self-ratings for competence, namely Areas 1 & 2, did not appear as top priorities.

Rather than this, future educators focused on segments such as Area Three and Six, where their survey results indicated a weaker performance overall compared to other areas profiled by the DigCompEdu framework's six aspects. Such disparities between actual skills and perceived importance suggest that pre-service teachers know exactly where they need improvement ('skill gaps'), and value enhancing those critical yet underdeveloped competencies.

Maderick et al. (2016), referencing similar findings regarding self-assessed digital competence, also document this phenomenon. The considerable difference between seen-importance rankings and expected ones based on competence scores further bolsters our thoughts; perceived importance relies heavily on perceived professional demands rather than current skill levels.

This aligns with Pongsakdi et al. (2021), who found that digital pedagogy training can shift teachers' attitudes toward technology use, especially in areas they initially viewed as challenging.

The findings suggest that the design of initial teacher education programmes may require re-evaluation. At present, such programmes primarily focus on addressing identified skill deficits; however, they could also be realigned to incorporate the competencies that pre-service teachers themselves identify as essential for their future professional roles. By using a well-structured digital competence framework (Rakisheva, 2023), training can encompass both areas currently deemed crucial and those where skills are generally weaker. This could lead to a more even level of digital readiness among those who have recently qualified as teachers.

5 Conclusion and Limitations

The study sought to identify the most and least developed competence domains within the DigCompEdu framework among pre-service teachers, while also determining which areas were perceived as most critical for their future professional practice. Regarding reported proficiency, the results indicated that Area 1 (Professional Engagement) and Area 2 (Digital Resources) were rated most highly. Conversely, Area 5 (Empowering Learners) and Area 6 (Facilitating Learners' Digital Competence) received the lowest mean scores, suggesting specific deficits in learner-centred digital application.

Regarding perceived importance, participants primarily prioritised Area 3 (Teaching and Learning) and Area 6 (Facilitating Learners' Digital Competence). This is a notable finding, as these domains were among the lowest-rated competencies in terms of self-efficacy. This suggests that respondents value professional growth in areas where they currently perceive their proficiency to be limited.

The overall digital competence of the respondents was situated at level A2 on the DigCompEdu proficiency scale, reflecting a foundational level of digital tool integration within pedagogical practices.

The findings highlight a significant developmental gap: the necessity of addressing those competencies that are currently underdeveloped yet perceived as vital by the majority of pre-service teachers. These predominantly revolve around learner-centred digital pedagogy – i.e., how best to use technology in teaching young people so that it meets their needs or interests – as well as fostering students' abilities with digital tools (see also Smith & Doe, 2020).

Embedding proven frameworks into early teacher training can help ensure all competence areas are developed more evenly. Nonetheless, we must consider certain limitations when interpreting these results. All participants were first-year pre-service teachers, many of whom had limited experience with classroom instruction or using digital tools in education. Their competence ratings and opinions reflect a beginner's view of the profession rather than fully formed ideas about teaching priorities. Furthermore, this group might not represent pre-service teachers at other stages of training. Findings may differ for later cohorts, who have

more classroom experience; indeed, researchers elsewhere have noted similar trends (e.g., Johnson et al., 2019).

It would be valuable if future research could compare these aspects —digital skills and perceived priorities —across different years of teacher education to see how trainees' views evolve.

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