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A REVIEW OF SCIENTIFIC RESEARCH BY DIGICOMPEDU

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ABSTRACT

The European Framework for the Digital Competence of Educators (DigCompEdu) is a comprehensive and scientifically backed framework designed to outline the key digital skills that educators need. It defines what it means to be digitally competent in an educational context, providing a clear reference point to help educators develop their specific digital competences. The framework applies to educators across all educational levels, including those teaching in early childhood, primary, secondary, and higher education, as well as adult education. It also covers both general education and vocational training, special needs education, and informal or non-traditional learning environments. Essentially, DigCompEdu aims to guide educators in enhancing their digital skills to improve teaching and learning in various educational settings.

In this paper, a literature review method was used to analyze multiple scientific studies within the European context. It was observed that there is a moderate approach to adopting the new DigCompEdu framework across these studies. This is largely influenced not only by educators' perceptions and understanding but also significantly by the readiness of societies to invest in ICT in education. The comparative analysis concludes that teachers require more comprehensive and targeted training to enhance their digital competences and effectively integrate technology into their teaching practices.

Keywords: Digital competence, Education, Technology integration, Digital skills, Educational technology.

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Introduction

The use of computers and communication technologies is bringing major changes to all areas of life. Industry 4.0 offers advanced processing, communication, and production capabilities (Nasution, 2020). Along with Industry 4.0, digitalization, which involves data classification and conversion algorithms, is rapidly evolving. In this digital age, devices like computers, printers, and scanners have become key tools in businesses, shifting traditional accounting towards smart accounting. The old way of handling accounting is now behind us. Software has introduced automatic systems for customer communication, and Big Data is now seen as a helpful solution rather than something to fear (Skender & Ali, 2019).

In parallel, significant advancements are also taking place in education. There is no longer a choice for teachers and educators regarding whether to adopt these new digital innovations. They must accept and adapt to them, with a strong focus on improving themselves and participating in national initiatives aimed at enhancing digital skills (Selim & Üseini, 2019).

In different countries, the state of teachers' and professors' required digital competences varies significantly. With the establishment of the European Framework, DigiCompEdu, many of these competences have become either a future goal or a current reality, depending on the context. For some, they represent targets to be achieved, while for others, they reflect the present state of digital proficiency. This framework has created a broader and more unified approach to enhancing digital skills across the educational landscape, setting a common standard for all educators (Redecker & Punie, 2017).

In today's context, it would be far more effective to assess needs through the Technology Acceptance Model (TAM), organize targeted training sessions, and align all factors within the educational cycle towards the inevitable changes across all sectors, particularly in education (Marikyan, 2023). The Technology Acceptance Model (TAM) is commonly used to predict and explain how users accept information technologies. It focuses on system usage intentions and behaviors, which are influenced by two main factors: perceived usefulness and perceived ease of useThe original measurement scales for TAM have been proven reliable and valid across various technologies and user groups (Davis & Venkatesh , 1996).

Selim et al. present a model that utilizes digital twin technology combined with NFC protocol for user authentication and authorization, demonstrating its potential in data collection, analysis, and enhancing future educational process planning (Selim A. , Ali, H. Saračević, & Ristevski, 2024).

By adopting such an approach, educators and professors can be better prepared to embrace and integrate new technologies, fostering a more innovative and successful educational system. This proactive strategy will not only enhance educators' readiness but also ensure that the education sector remains adaptable and forward-thinking in the face of rapid technological advancements.

Digital Competence Framework For Educators (Digcompedu)

The teaching profession is facing rapidly evolving demands that necessitate a broader and more sophisticated set of competences, particularly in digital skills. The European Framework for the Digital Competence of Educators (DigCompEdu) outlines what it means for educators to be digitally competent, serving as a reference to foster the development of digital competences across Europe. Targeted at educators from early childhood through higher education and vocational training, as well as special needs and non-formal education, the framework is based on research conducted by the European Commission's Joint Research Centre for the Directorate-General for Education, Youth, Sport and Culture (Redecker & Punie, 2017).

The competence framework is not intended as a normative framework or a tool for assessing performance. Rather, the 22 competencies are explained within six categories to inform educators about the competencies they possess, what they have already achieved, and what the next steps might be if they wish to further develop their digital competences (joint-research-centre.ec.europa.eu, 2024).

DigCompEdu details 22 competences organised in six areas:

- Professional engagement
- Digital resources
- Teaching and learning
- Assessment
- Empowering learners
- Facilitating Learners' Digital Competence

1. Professional engagement

These three components encompass Professional Engagement: Communication and collaboration, which involves using digital technologies for information exchange with students, parents, and colleagues; Professional development in an online environment, which includes leveraging digital technologies to collaborate with colleagues for sharing information, teaching materials, or working on joint projects, as well as pursuing one's own professional growth and supporting the professional development of others; and e-portfolio, which entails developing a personal e-portfolio that is accessible to all (joint-research-centre.ec.europa.eu, 2024).

2. Digital resources

The area of "Digital resources" refers to various online tools and materials that support teaching and learning processes. This encompasses the competencies required for effective internet searching, which allows educators to gather relevant information; selection and evaluation skills for critically assessing the quality and credibility of digital content; adaptation and creation of educational materials tailored to specific learning objectives; and efficient management of these resources to enhance the overall educational experience. Digital resources play a crucial role in modern education by providing access to a wealth of information and interactive tools that facilitate engaging and effective learning environments (joint-research-centre.ec.europa.eu, 2024).

3. Teaching and learning

The area of "Teaching and Learning" refers to the process of planning and implementing technology in educational practices. This includes the use of knowledge transfer technologies and digital tools within instruction. Creating an authentic and stimulating digital learning environment is also essential, involving elements such as presentations, cloud-based resources, collaborative workspaces, and video conferencing connections. Additionally, it encompasses the application of learning management systems, which provide interfaces for organizing learning activities, facilitating communication with students, and employing online assessment methods and content delivery. Together, these components contribute to an engaging and effective teaching and learning experience that leverages technology to enhance educational outcomes (joint-research-centre.ec.europa.eu, 2024).

4. Assessment

The area of "Assessment" includes methods and tools for evaluating student performance in a digital context. Summative assessment uses electronic grade books and digital tools to summarize achievements, while formative assessment continuously monitors performance and provides timely feedback. Additionally, creating e-portfolios helps document learning and track development. Together, these methods enable a comprehensive understanding of student learning, allowing educators to tailor their approaches to better support individual and group needs (joint-research-centre.ec.europa.eu, 2024).

5. Empowering learners

The area of "Empowering Learners" includes competencies that promote inclusive and personalized learning environments. It involves the universal design of high-quality digital teaching materials accessible to all students, as well as using digital technologies for differentiated instruction tailored to individual needs. Additionally, it ensures that all students receive appropriate support based on their circumstances and focuses on assistive technology to aid those needing extra educational assistance. Collectively, these competencies foster equitable access to education and accommodate diverse learning needs (joint-research-centre.ec.europa.eu, 2024).

6. Facilitating Learners' Digital Competence

The area of "Facilitating Learners' Digital Competence" focuses on equipping students with essential skills to navigate the digital landscape effectively. This includes fostering information literacy, where learners learn to find, evaluate, and utilize digital information critically. It also encourages creativity and collaboration through digital tools that enhance communication and teamwork. Additionally, it emphasizes digital safety and responsibility, ensuring students understand how to protect their personal information and engage ethically online. By integrating these elements into teaching, educators can help students become confident digital citizens prepared for future challenges (joint-research-centre.ec.europa.eu, 2024).

Digital competences have been used even before their definition, but their application is most often within the mandatory use of ICT in teaching. After the definition of the European framework for digital competences, they have now found their place in contemporary education and the modern era (Selim & Ali, 2022).

Methods and Finding

The literature preview method encompasses a comprehensive analysis of the existing body of literature pertaining to teachers' digital competences and the development of relevant frameworks. Additionally, a comparative analysis methodology is employed to examine various models or frameworks for digital competences, with the objective of identifying both differences and similarities, as well as evaluating their overall effectiveness. This dual approach not only enhances the understanding of the theoretical underpinnings of digital competences but also facilitates critical insights into their practical implications in educational settings.

According to Ghomi, a self-assessment tool was developed to measure teachers' digital competence based on the European Framework for the Digital Competence of Educators (DigCompEdu) and was evaluated with 335 participants in Germany. The tool's internal consistency was measured using Cronbach's alpha for both the entire survey and its six individual competence areas, demonstrating satisfactory reliability. To assess validity, hypotheses were tested using the Mann-Whitney U test and Spearman rank correlation on groups with distinct attributes. The results revealed significant differences in digital competence between STEM and non-STEM teachers, as well as between computer science and non-computer science teachers. Additionally, teachers with positive or neutral attitudes toward technology scored higher than those with negative attitudes, and those experienced in using technology in the classroom achieved significantly higher scores. These findings confirm the instrument's validity, suggesting it is a reliable and valid measure of teachers' digital competence (Ghomi, 2019).

According to the authors Cabero-Almenara et al. the study emphasized employed an ex post facto research design with a cross-sectional approach, utilizing both descriptive and hypothesis-testing methods. The research involved 6,664 teachers from various Latin American universities who self-assessed their Digital Teaching Competence (DTC) based on the European Union's DigCompEdu framework. The findings revealed that the surveyed teachers reported an intermediate level of digital competences overall. However, significant differences were observed in relation to several key variables that influence the development of these competences. These results highlight the importance of understanding the current state of digital competence among university faculty and suggest the need for targeted interventions to enhance these

skills (Cabero-Almenara, Gutiérrez-Castillo, Cabero-Almenara, Barroso-Osuna, & Palacios-Rodríguez, 2023).

According to García-Vandewalle et al., the study focused on assessing the digital competence of teacher trainees in Melilla, Spain, using the Spanish adaptation of the European Framework for Digital Competence of Educators (DigCompEdu). The research employed quantitative methods to analyze self-assessment responses collected through a questionnaire based on the DigCompEdu framework. Factor analysis was conducted to categorize indicators within each competence area, and differences between undergraduate and postgraduate students were examined. Additionally, Ordinary Least Squares (OLS) regression was used to estimate correlations between student characteristics and their competencies. The findings revealed variations in students' self-assessed digital competence levels across different areas, particularly highlighting discrepancies between bachelor's and master's students. Notably, the study identified significant gaps in digital competence within teacher training programs, especially in the domain of digital security. These results emphasize the need for enhanced digital security training and the development of more comprehensive digital skills, in alignment with the DigCompEdu framework (García-Vandewalle García, García-Carmona, Trujillo Torres, & Moya Fernández, 2023).

According to Bayrak Karsli et al., the study employed an explanatory mixed-method design to assess the digital competence levels of teacher educators using the DigCompEdu Framework. The research included 113 teacher educators from a major state university in Türkiye. The findings revealed that participants predominantly used Learning Management Systems (LMS), digital presentations, videos, and digital assessment tools in their teaching practices. Teacher educators reported a high level of competence in using digital technologies and rated their work environment as technically adequate. Based on the DigCompEdu framework, the participants' overall digital competence was categorized at the "Integrative - B1" level, indicating a curiosity for and openness to innovations. Additionally, interviews conducted during the study underscored the need for professional development programs to further enhance the digital skills of both teacher educators and pre-service teachers. These findings offer valuable insights into the current digital competence levels of teacher educators and highlight key areas for improvement, particularly in supporting ongoing digital skill development (Bayrak Karsli, Küçük, Kılıç, & e Albayrak Ünal, 2023).

According to Santos and Neuza, the study utilized a qualitative methodological approach by conducting semi-structured interviews with 22 Portuguese higher education professors who teach online, to assess the applicability of the European Framework for the Digital Competence of Educators (DigCompEdu) in online higher education. The data were analyzed through content analysis and presented using descriptive statistics. The findings indicate that DigCompEdu is largely applicable to online higher education, with most areas rated between "very applicable" and "applicable." However, less favorable results were observed in competencies 6.4 ("Responsible Use") and 6.5 ("Problem Solving") within Area 6. Additionally, lower applicability was found in the area of "Promoting Digital Competence of Learners," as professors believed that young adult students should already possess the necessary digital skills, making it less their responsibility to enhance this competence (Santos & Neuza, 2024).

According to Bekiaridis and Attwell, the integration of AI competencies into the existing DigCompEdu framework aligns AI-related skills with its six key areas: Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, and Facilitating Learners' Digital Competence. For each area, the supplement explores how AI can be utilized, suggests activities for educators to develop relevant skills, and outlines progression levels for building competencies. It also identifies potential challenges and offers strategies to address them. Key AI competencies highlighted include data literacy, computational thinking, ethical AI use, and curriculum design incorporating AI. The study emphasizes challenges such as data privacy concerns, algorithmic bias, unequal access to AI technologies, and the evolving roles of educators. It underscores the importance of continuous professional development and the ethical, responsible integration of AI into education (Bekiaridis & Attwell, 2024).

Conclusion

In conclusion, while digital competences are closely linked to the motivation of educators, they are also significantly influenced by the level of technological development within a country. For educational practices to meet the expectations and needs of both teachers and students, there must be a concerted effort to invest more in technological advancements, particularly in the education sector. This investment is essential not only to enhance educators' digital skills but also to create an environment where innovative teaching and learning can thrive, ultimately benefiting the broader educational landscape.

The collection of studies on teachers' digital competence, grounded in the DigCompEdu framework, highlights several key findings and broader implications for the future of education. Overall, the studies reveal that while many educators possess intermediate to advanced digital skills, there remain significant gaps across different educational contexts, subject areas, and regions. These differences, influenced by factors such as teaching experience, subject specialization, and attitudes towards technology, underscore the need for tailored professional development programs.

One consistent finding is that teachers who have more experience with digital tools and maintain positive attitudes towards technology demonstrate higher competence levels. This suggests that fostering an open, technology-positive culture and providing practical exposure can significantly boost digital skills. Conversely, gaps in areas like digital security, as observed in teacher trainees, point to the importance of including specific competencies in teacher education curricula.

Looking ahead, predictions suggest that digital competence will become an increasingly critical aspect of effective teaching as technology continues to evolve and permeate classrooms. The demand for continuous professional development will likely grow, particularly in emerging areas such as artificial intelligence, digital security, and data literacy. As educators face new challenges, future research and interventions should focus on personalized and context-specific training programs that cater to diverse teaching environments. This will ensure that teachers are equipped not only with basic digital skills but with the ability to innovate and lead in tech-integrated education.

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