INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 13, Issue 1, (2024) E-ISSN: 2226-6348

Improving Teachers' Digital Competence in Higher Education: A Systematic Literature Review

Xiaomei Zhang, Nurhasmiza Abu Hasan Sazalli, Miskam, Nuraqilah Nadjwa

Faculty of Social Sciences and Humanities, Universiti Teknologi Malaysia, Malaysia

Corresponding Author Email: xiaomei.z@graduate.utm.my

To Link this Article: http://dx.doi.org/10.6007/IJARPED/v13-i1/20560 DOI:10.6007/IJARPED/v13-i1/20560

Published Online: 28 January 2024

Abstract

Amidst the rapidly evolving technological landscape and the educational disruptions caused by the global COVID-19 pandemic, the importance of teacher digital competence (TDC) has taken centre stage in educational discourse. This study aims to understand how teachers' digital competence has been improved within the context of higher education through an analysis of a selection of articles focusing on practical interventions. A systematic literature review was conducted on improvement of TDC articles sourced from the Web of Science and Scopus databases, from 2013 until 2023. Guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) Statement, this study critically identifies 7 relevant studies through a systematic review process. The results highlight a preponderance of research focused on the analysis of improved TDC areas, the interventions implemented, and their resulting effects. The study found that when it comes to enhancing TDC, the area that received the most attention is digital technology and resources, followed by digital tools, security, and digital content creation. While various approaches have been proposed, the most widely favoured approach for improving teachers' digital competence is through training courses, others are active methodology, use of social media, Hands of the World (HOTW) activities, professional development webinars and blended learning support system. These approaches are all observed to have a high positive impact on TDC enhancement. These findings contribute to a more comprehensive understanding of TDC and offer valuable insights for future research endeavours.

Keywords: Teachers' Digital Competence, Higher Education, TDC Areas, Intervention Approaches, Systematic Literature Review

Introduction

Information technology plays an increasingly important role in modern education, particularly following the outbreak of COVID-19. In this era, being an educator necessitates the mastery of specific skills for using digital tools in teaching and professional development. The significant surge in research worldwide underscores the imperative need to cultivate this essential competence among modern educators. Various organizations and institutions contribute to offering evidence-based scientific support to policymakers. Teacher digital

competence (TDC) is not only driven by the context of the pandemic and national policies but also by educators' own requirements for lifelong learning and professional growth.

Researchers worldwide have concentrated on examining TDC, particularly in the digital era and amid the recent pandemic. Several frameworks and assessment tools have been developed to assess TDC, offering a comprehensive array of competencies and indicators to guide the development and assessment of digital skills in an educational context (Dias-Trindade et al., 2020). However, it is of paramount importance to investigate the actions that can be taken to enhance TDC in higher education to better support teachers in their professional development. This paper presents a systematic literature review aimed at studying the implementation of interventions to enhance TDC and the TDC areas to be improved based on existing works, with the goal of providing recommendations for future research and practice.

While there are numerous systematic reviews available on the topic of digital competence in educational settings, with a particular emphasis on TDC, these reviews offer various perspectives and analytical depths, providing only a partial view of the broader digital competence landscape in higher education (Peters et al., 2022). The goal of this review is to examine practical studies that focus on enhancing TDC in higher education.

Research Questions

- What are the improved areas of TDC in the interventions conducted to improve TDC in higher education?
- What are the approaches adopted in the interventions conducted to improve TDC in higher education?

Literature Review

Digital competence, a fundamental aspect of Lifelong Learning's Key Competences, was initially defined in 2006 and underwent revision in the Council Recommendation of 2018 (European Commission, 2019). The updated definition now characterizes it as the adept and conscientious utilization and interaction with digital technologies in learning, work settings, and societal engagement. This proficiency encompasses skills such as information and data literacy, effective communication and collaboration, media literacy, the creation of digital content (including programming), safety measures covering digital well-being and cybersecurity, understanding intellectual property concerns, problem-solving, and fostering critical thinking abilities (Vuorikari et al., 2022). The report underscores the significance of integrating digital technologies in education, as they offer substantial benefits for teaching and learning (Zhao et al., 2021). It emphasizes the importance of developing basic digital competence for personal growth in today's society and highlights its potential in bridging the digital divide.

Digital competence and digital literacy are often treated as similar terms (Fallon, 2020). Digital competence is particularly relevant in certain higher education contexts, such as teacher education, where teachers are expected to develop their skills in confidently and critically utilizing information (Zhao et al., 2021). Over the past decade, teacher digital competence (TDC) has been described as the collection of skills, attitudes, and knowledge essential for educators to operate effectively, safely, and ethically in various digitally mediated environments (Esteve-Mon et al., 2020; Falloon, 2020). The growing emphasis on policies and

initiatives concerning TDC primarily stems from the escalating demands placed on educators due to the rapid pace of digital transformations in all professional aspects. This includes the responsibility to assist students in developing digital competence (Peters et al., 2022). The global pandemic has further heightened the necessity for educators to work efficiently and remotely, utilizing a variety of digital tools.

Over the years, various TDC frameworks have been introduced by different countries and organizations. Among the most widely recognized frameworks are the European Framework for the Digital Competence of Educators (DigCompEdu) (Redecker, 2017) and the Common Digital Competence Framework for Teachers (INTEF, 2017). DigCompEdu revolves around six distinct competence areas: digital resources, professional engagement, teaching and learning, assessment, facilitating learners' digital competence and empowering learners. These competencies are essential for teachers to facilitate effective, inclusive, and innovative learning strategies using digital tools. The Common Digital Competence Framework for Teachers serves as a reference model for diagnosing and enhancing TDC, encompassing the skills required in the 21st century to enhance teaching practices and support continuous professional development. It comprises of five competence areas: information and data literacy, communication and collaboration, digital content creation, safety and problem solving. While previous studies mostly focused on the concept and dimensions of TDC ((Skantz-Åberg et al., 2022; Fallon, 2020) or the assessment of TDC and the development of measurement tools (Dias-Trindade et al., 2020; Sillat et al., 2021), it is worth noting that the effective ways of improving TDC in higher education are still lack of research.

Methodology

A systematic review is a comprehensive literature analysis aimed at identifying, evaluating, and synthesizing the most reliable and relevant evidence related to a specific research question. Its purpose is to provide well-informed, evidence-based responses (Boland et al., 2017). This review employed the PRISMA methodology, which incorporates essential resources from Scopus and Web of Science for conducting the systematic review. The review process includes well-defined eligibility and exclusion criteria, as well as a structured sequence of review steps, such as identification, screening, and eligibility assessment, culminating in data abstraction and analysis.

The PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), a research approach tailored for systematic literature reviews endorsed by the American Psychological Association (APA), represents a standardized approach to report how many studies were identified for inclusion in this review and what happened to these studies as the review progressed (Torres-Hernández & Gallego-Arrufat, 2022). Two primary journal databases were used in this systematic literature review: Scopus and Web of Science, which have been increasingly chosen as the main databases for academic research (Zhu & Liu, 2020).

Several eligibility and exclusion criteria have been established. First, regarding the type of literature, the selection is limited to research articles, while review articles, book series, books, book chapters, and conference proceedings are excluded. Second, to ensure clarity and avoid translation difficulties, non-English publications have been excluded, focusing exclusively on articles published in English. Third, a specific timeframe of 10 years, spanning from 2013 to 2023, has been chosen to provide an adequate window for capturing the evolution of research and related publications. Lastly, for enhanced accessibility, only open-access articles have been included (refer to Table 1).

Table 1
Inclusion and exclusion criteria

Criterion	Eligibility	Exclusion
Literature type	Journal (research articles)	Journals (systematic review), book series, book, chapter in book, conference proceeding
Language	English	Non-English
Timeline	Between 2013-2023	<2013
Open Access	All open access	Others

Several stages were involved in the systematic review process: identification, screening, and eligibility. The review process was conducted in September 2023. The first phase involved identifying keywords for the search process. Drawing from previous studies, keywords that were similar to and related to "improving," "teacher digital competence," and "higher education" were used (refer to Table 2).

Table 2
The search string used for the systematic review process

Databases	Keywords used
Scopus	TITLE-ABS-KEY (("improv*" OR "enhance*" OR "develop*" OR "train*") AND ("Teacher* digital competenc*" OR "Teacher* digital abilit*" OR "Teacher* digital skill*" OR "Teacher* digital literacy") AND ("higher education" OR "universit*" OR "college*"))
Web of Science	TS= (("improv*" OR "enhance*" OR "develop*" OR "train*") ("Teacher* digital competenc*" OR "Teacher* digital abilit*" OR "Teacher* digital skill*" OR "Teacher* digital literacy") AND ("higher education" OR "universit*" OR "college*"))

The second phase is the screening process. Initially, 74 duplicate articles were eliminated after exporting the search reports from the databases and importing them into EndNote to identify duplicates. Following the application of the inclusion and exclusion criteria, 111 articles were deemed ineligible as they did not meet the specified criteria outlined in Table 1. The third phase pertains to eligibility, during which full articles were carefully reviewed according to the quality criteria listed in Table 3.

Table 3
Quality criteria

Quality criteria
1.The research objectives are focused on enhancing teacher digital competence.
2. The research context is in higher education.
3. The areas of digital competence being improved are clearly stated.
4. The research design is aimed to improve teachers' digital competence.
5. There is an actual experiment conducted.
6. The effect of the methods is clearly described in the conclusion based on the results.

After a thorough examination, 56 articles were excluded for various reasons, such as their focus on the development of the assessment tool for teacher digital competence (TDC) or

their lack of relevance to the context of higher education. Finally, a total of 7 articles that met the criteria were subsequently used for quantitative and qualitative analysis (See Figure 1).

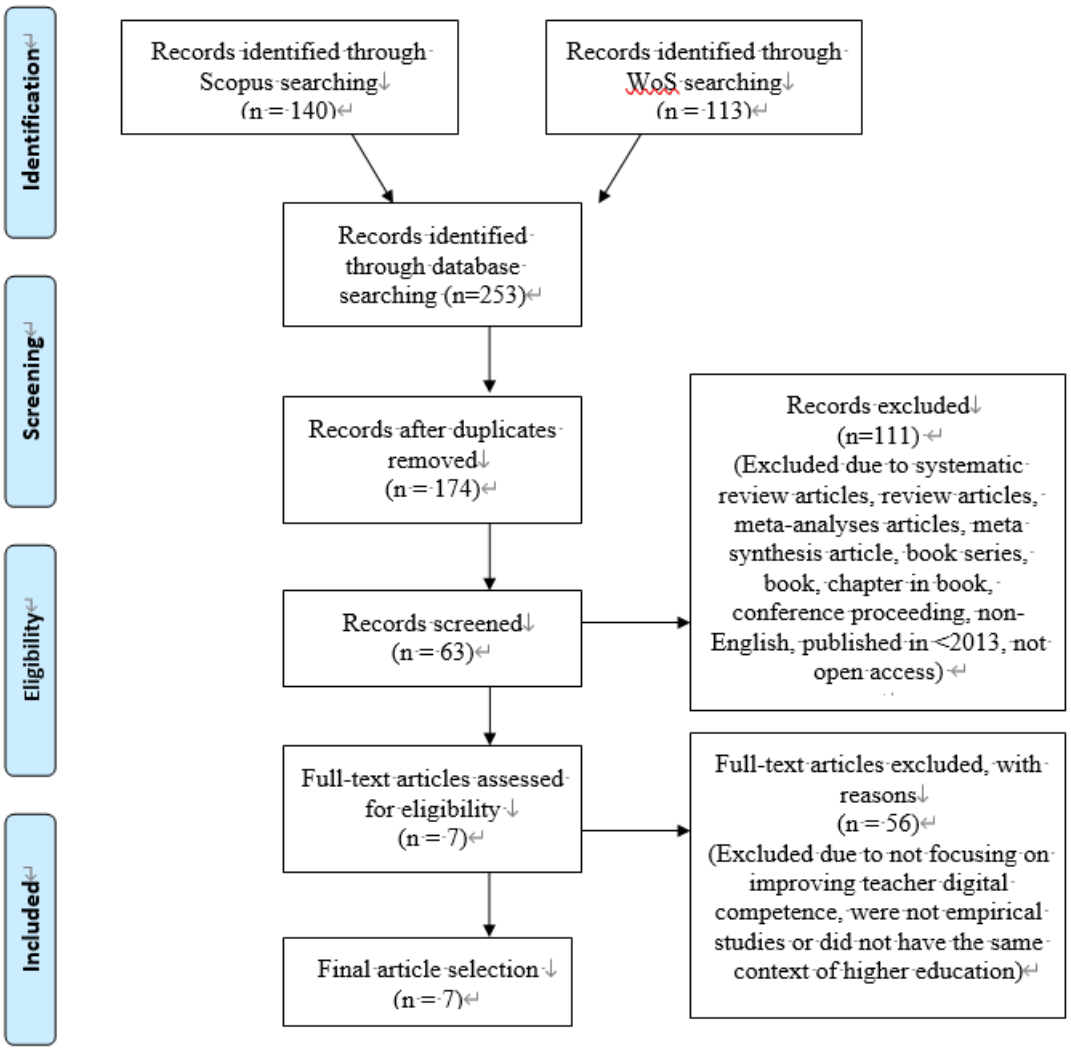

Figure 1. PRISMA Flow Diagram (Adapted from Moher et al., 2009)

To conduct a thorough review of the articles and analyse the data, several themes were coded after carefully reading the included articles and with reference to the quality criteria. Entries related to improved TDC areas and the approaches adopted in the interventions within the context of these themes were listed in Table 4.

Table 4
Summary of Reviewed Studies

Themes	Smagulova et al. (2021)	Ihnatova et al. (2022)	Schina et al. (2020)	Romero-García et al. (2020)	Robles Moral & Fernández Díaz (2021)	Tonner-Saunders & Shimi (2021)	Rahmi et al. (2022)
The Improved TDC Areas							

digital technology and resource	/		/			/	
digital tools	/	/					
information literacy				/			/
computer literacy							/
media literacy							/
communication literacy							/
visual literacy							/
technology literacy							/
didactic, curricular, and methodological			/				
relational, ethics, and security			/	/			
personal and professional			/				
communication and collaboration				/			
digital content creation				/	/		
problem solving				/			
The Approaches Adopted in the Interventions							
training course	/	/	/				
active methodology				/			
use of social media					/		
HOTW activities						/	
professional development webinars						/	
blended learning support system							/

Results

All the selected articles were published after the year of 2020, indicating that the importance of improving teachers' digital competence received special attention after the epidemic. Despite the titles of the selected articles focusing on teacher digital competence (TDC), the participants in these studies were university students majoring in foreign languages

Smagulova et al (2021); Ihnatova et al (2022), pedagogy Schina et al (2020); Moral & Díaz (2021), biology and geology (Romero-García et al., 2020). The universities involved include University of Rovira i Virgili Schina et al (2020), Universidad Internacional de La Rioja Romero-García et al (2020), and University of Murcia in Spain Moral & Díaz (2021), as well as Universitas Mahasaraswati Denpasar, IKIP Saraswati Tabanan IKIP and Universitas Negeri Padang in Indonesia Rahmi et al (2022), University of Dundee in Scotland Tonner-Saunders & Shimi (2021), Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University in Ukraine Ihnatova et al (2022), and Buketov Karaganda University in Kazakhstan (Smagulova et al., 2021). Most of them were from Spain and Indonesia. Regarding the research methods, there are three quantitative studies Smagulova et al (2021); Moral & Díaz (2021); Tonner-Saunders & Shimi (2021), two case studies Schina et al (2020); Romero-García et al (2020) and two mixed methods studies (Ihnatova et al., 2022; Rahmi et al., 2022). This review primarily focuses on the improvement of TDC, and the response to the research questions is provided by analysing the selected articles with respect to the areas of improved TDC and the approaches these interventions employed.

The Improved Areas of Teachers' Digital Competence

The teacher digital competence (TDC) areas improved in the selected articles varies based on the terminology and research context. Most articles use the term "digital competence", while others employ "digital literacy." The DigCompEdu framework is frequently referenced to define this term. The primary areas emphasized are digital tools and digital content creation.

The term "digital competence" is employed in five articles. In their study, Smagulova et al (2021) define TDC as encompassing effective communication in social networks, proficient online information retrieval, adept application and dissemination of digital content, as well as the creation of digital and multimedia educational resources to address educational challenges. Their focus is on improving the creation of digital educational content and the application of digital technologies in the educational process. Schina et al.'s (2020) definition of TDC is aligned with Díaz-Lauzurica and Moreno-Salinas (2019) and the DigCompEdu framework Redecker (2017) as encompassing ICT competence, didactic, and methodological skills, which are also the main themes of their article. Tonner-Saunders and Shimi (2021) also utilized DigCompEdu framework Redecker (2017) to develop student teachers' digital technology skills. Romero-García et al (2020) adapted the definition of TDC and enhanced all five areas contained in the Common Digital Competence Framework for Teachers (INTEF, 2017). Moral and Díaz (2021) emphasized digital content creation, focusing on developing digital content, integrating and adapting digital materials, programming, identifying requirements and technological solutions, and fostering creative innovation and the effective use of digital technology.

Two other articles use the term "digital literacy." Rahmi et al (2022) perceived digital literacy skills as the interest, mindset, and capacity of individuals to judiciously employ digital technology and communication tools to access, organize, merge, scrutinize, and assess information, facilitate the generation of new knowledge, and engage in intellectual and technical talents for creation and communication with others. When addressing areas for improvement, they incorporate subdisciplines of digital literacy skills, encompassing information literacy, computer literacy, media literacy, communication literacy, visual literacy, and technology literacy. Ihnatova et al (2022) used both terms and focused on the

use of digital technologies in the foreign language teaching process, particularly the use of digital tools.

The Approaches Adopted in the Interventions to Improve Teachers' Digital Competence

Various approaches were employed to enhance teachers' digital competence in the selected articles. The most commonly used approach was the implementation of training courses for pre-service teachers (Smagulova et al., 2021; Ihnatova et al., 2022; Schina et al., 2020). Smagulova et al (2021) introduced the course "Technology for the Development of Foreign Language Multimedia Educational Tutorials Based on Authentic Audio-Visual Materials" to empower both current and prospective foreign language instructors in improving their teacher digital competence (TDC) in creating multimedia educational materials. This comprehensive course blends theoretical and methodological principles for designing multimedia language tutorials with the acquisition of digital skills for effective content creation using software tools. The results showed that they successfully increased the awareness and digital skills of future EFL teachers through their training course, with 80% of participants scoring over 60% in the final assessment, reaching a high level of training effect. Ihnatova et al (2022) implemented the course "Digital Technologies in Foreign Language Teaching: Theories, Methods, Application," which employed a blended learning approach to equip prospective educators with essential skills for effectively integrating digital tools into their teaching practices, with an emphasis on pedagogically sound technology use. Participants in the course reported significant learning progress, with 83.2% rating their didactic and teaching practice competencies as "rather high to very high." Regarding digital competence development, 91.6% provided a positive assessment, indicating a strong preference for this aspect. In Schina et al.'s (2020) research, undergraduate Pedagogy students underwent specialized training to address Sustainable Development Goals (SDGs) using Information and Communication Technologies (ICT), including computers and digital technologies. This training focused on incorporating SDGs through Educational Robotics and aimed to enhance students' competence in TDC, which includes ICT proficiency and pedagogical and methodological abilities, while also equipping them with the skills needed to integrate SDGs into Educational Robotics projects. This study revealed that future teachers evaluated their TDC positively after completing the training, with perceived improvements in relational skills, ethics, security, personal, and professional aspects.

Romero-García et al (2020) demonstrated a substantial improvement in all five areas of TDC proposed by the National Institute of Educational Technologies and Teacher Training (INTEF), with a notably large effect size. The educational experiment, utilizing active methodologies and digital tools, effectively enhanced the TDC of future teachers. This program, rooted in collaborative learning, encompasses 14 topics delivered through a combination of 15 sessions lasting 120 minutes each (held weekly) and 5 shorter 60-minute sessions spread across the semester. Additionally, a total of 20 well-planned working sessions encouraged real-time collaborative activities within the virtual classroom, bridging the gap between theory and practical application, thereby enhancing their TDC through various digital tools for content creation, collaboration, and evaluation.

Besides that, in Moral and Díaz's (2021) study, the main objective was to explore undergraduate students' perspectives in primary education regarding the development of TDC. They employed two image-centric social networks, Pinterest and Instagram, to assess the digital and media competencies of prospective Primary Education teachers at University

of Murcia. An instructional intervention centred on using social media to convey specific scientific content. Students' active engagement with Pinterest was observed in the study, but it is essential to note that mere activity does not guarantee effective learning. The quality of learning depends on how teachers integrate technological resources into their teaching environments. Students highly valued Instagram as a valuable educational tool, finding it motivating and capable of seamlessly integrating knowledge. These findings align with previous research recognizing the validity of using information and communication technology, such as social networks, in teaching science. Participants also acknowledged the importance of both initial and ongoing training to effectively incorporate social media into education.

Tonner-Saunders and Shimi (2021), on the other hand, delved into the engagement and development of digital technology skills among student teachers through participation in Hands of the World: Can You See What I Say (HOTW) activities and professional development webinars. This project provided a rich learning environment for student teachers, enabling them to enhance their digital literacy through real-world projects and professional development webinars. Student teachers engaged in intercultural learning by becoming members of the project's Facebook group, attending or viewing professional development webinars, or actively participating in the project, and they complemented their learning through university resources and professional literature. Student teachers in the project found it highly beneficial, engaging, and enlightening, showing substantial progress in enhancing ICT skills and confidence, deepening ICT pedagogical knowledge, and effectively applying their learning to their professional practice.

In the study by Rahmi et al (2022), a support system was introduced to enhance the digital literacy of pre-service teachers. They created a prototype for a blended learning support system using a 4D model. This support system, based on a comprehensive initial concept, included lesson plans and content in various formats, accessible through the Learning Management System. It also integrated assessment tools for evaluating learning achievements and improving digital literacy skills. The digital literacy content, spanning text, images, audio, video, and animations, was seamlessly incorporated into 14 interactive teaching materials, strategically designed to enhance digital literacy skills. During the development phase, the support system was transformed into a prototype, which was validated by experts and lecturers. Findings on the creation of a prototype blended learning support system for enhancing digital literacy revealed that all elements of the support system fell within the valid category. The incorporation of digital literacy skills into each part of the support system proved highly effective in advancing future teachers' digital literacy competencies

Discussions

This review analysed the former researches related to the improvement of teachers' digital competence through the aspects of the improved teacher digital competence (TDC) areas and the approaches of the interventions implemented. Through the above results, it can be proved that the current researches related to the improvement of TDC seldom implemented practical studies with only 7 articles being included according to the criteria. The participants of the selected articles are all pre-service teachers or future teachers, which means the effective approaches to improve in-service teachers' digital competence are still lacking. The research context is mostly in Spain and Indonesia, which is consistent with the findings of

others (Basilotta-Gómez-Pablos et al., 2022) and also requires more worldwide research under this topic.

The articles selected for the present study showed varying results in terms of the improved areas of TDC, with some using the term "digital competence" and others using "digital literacy." Researchers who used the term "digital competence" often define it as a combination of skills such as effective communication in social networks, online information retrieval, and the creation of digital educational resources. Those emphasizing digital literacy skills see it as the capacity to use digital technology and communication tools for information access and analysis or integrate subdisciplines of digital literacy, including information, computer, media, communication, visual, and technology literacy. Regarding the TDC areas being improved, the DigCompEdu framework is a commonly used reference. Among the various competences, digital technology and resources are the primary concerns, followed by digital tools, security, and digital content creation, while other TDC areas such as personal and professional development, communication and collaboration, problem-solving, didactic, curricular, and methodological aspects are not given as much attention. Since all these areas are crucial and necessary for enhancing TDC, more attention should be directed toward improving TDC aspects related to personal development, collaboration, pedagogy, and so on.

By exploring a variety of approaches of interventions aimed at enhancing TDC, it can be concluded that the most prevalent approach is the implementation of training courses for pre-service teachers. These courses often combine theoretical and methodological principles with practical skills for effective content creation. In addition to traditional coursework, some studies investigate active teaching methods supported by technology, focusing on collaborative learning and the integration of digital tools. Social media and digital platforms are used to assess and develop digital and media competencies in future teachers. Some studies also employ online learning or blended learning support systems to enhance TDC, including the use of multimedia materials. Referring to the effect of the implementations, it can be seen that training courses, active methodology, Hands of the World (HOTW) activities and professional development webinars proving highly effective, and the continuous training program improving teachers' skills in digital, communicative, and scientific matters are required (Schina et al., 2020; Robles Moral & Fernández Díaz, 2021). They also suggested that the training programs should include students into the process of designing a fragment of the pedagogical activity (Smagulova et al., 2021; Ihnatova et al., 2022). However, it is important to note that these programs primarily target students destined to become future teachers or pre-service teachers, indicating the necessity of developing tailored approaches for in-service teachers based on their specific needs and circumstances. Furthermore, fostering autonomous learning and encouraging participation in learning communities supported by andragogy are TDC improvement approaches that warrant further development. In order to meet the lifelong learning requirements of teachers in higher education, a comprehensive framework or model should be designed to combine the advantages of various approaches.

Conclusion

Higher education must be ready to adapt to the demands of our digitally immersed society, and university teachers, as integral components of the university, must confront and address the social challenges posed by this digital era. This review analysed previous research concerning the enhancement of teachers' digital competence (TDC), focusing on the improved areas of TDC and the approaches of the interventions employed. The analysis

revealed that while there is a limited number of practical studies on this topic, the TDC areas that receive the most attention are digital technology and resources, followed by digital tools, security, and digital content creation. Various approaches have been proposed, with training courses being the most widely favoured approach for improving TDC, along with active methodology, the use of social media, Hands of the World (HOTW) activities, professional development webinars, and blended learning support systems.

The study exhibits several strengths that enhance its value. Firstly, it addresses a highly relevant and contemporary topic, as the importance of TDC has been magnified by the COVID-19 pandemic which has seldom been explored yet. Secondly, the study offers a comprehensive analysis of the selected articles, covering various facets such as the focus of improved areas of TDC and the approaches adopted in the interventions. This comprehensive approach enriches the depth and breadth of the research. Finally, the study recognizes the need for tailored interventions of other TDC areas and for in-service teachers, offering insights and recommendations for future research and development in the field of TDC.

Despite its strengths, the study has some limitations. Notably, there is a restricted number of practical studies included, which might constrain the generalizability of findings and the ability to draw broad conclusions. Furthermore, the homogeneous participant demographics, with all participants being pre-service or future teachers, may limit the applicability of the findings to in-service teachers or those in diverse educational contexts.

In addition to the strengths and limitations, the study provides valuable recommendations for future research. Firstly, further investigation into the effectiveness of interventions for in-service teachers is warranted to offer a more comprehensive understanding of how digital competence can be improved among educators who are already actively teaching. This could help tailor interventions to the specific needs of in-service teachers, considering their unique challenges and contexts. Secondly, given the predominantly Spanish research context in the selected articles, future research should explore TDC in a more diverse range of geographical and educational settings. Comparative studies across different countries and regions could provide insights into how cultural and contextual factors influence the development of digital competence among educators. Lastly, as the field of digital competence is evolving rapidly, it is essential for future research to stay current with emerging technologies and trends in education. This would ensure that the interventions and strategies identified in the study remain relevant and effective in the ever-changing landscape of digital education.

References

Basilotta-Gómez-Pablos, V., Matarranz, M., Casado-Aranda, L. A., & Otto, A. (2022). Teachers' Digital Competencies in Higher Education: A Systematic Literature Review. International Journal of Educational Technology in Higher Education, 19(1), 1–16. https://doi.org/10.1186/s41239-021-00312-8

Boland, A., Cherry, M. G., & Dickson, R. (2017). Doing a systematic review: A student's guide, SAGE.

Dias-Trindade, S., Moreira, J. A., & Ferreira, A. G. (2020). Assessment of University Teachers on Their Digital Competences. Qwerty. Open and Interdisciplinary Journal of Technology, Culture and Education, 15(1), 50-69. https://doi.org/10.30557/QW000025

Díaz-Lauzurica, B., & Moreno-Salinas, D. (2019). Computational Thinking and Robotics: A Teaching Experience in Compulsory Secondary Education with Students with High Degree of Apathy and Demotivation. *Sustainability*, *11*(18), 5109. https://doi.org/10.3390/su11185109

Esteve-Mon, F. M., Llopis-Nebot, M. Á., Viñoles-Cosentino, V., & Adell-Segura, J. (2022). Digital Teaching Competence of University Teachers: Levels and Teaching Typologies. *International Journal of Emerging Technologies in Learning (Online)*, *17*(13), 200-216. https://doi.org/10.3991/ijet.v17i13.24345

European Commission. Directorate General for Education, Youth, Sport and Culture (2019). *Key Competences for Lifelong Learning.* Publications Office of the European Union. https://data.europa.eu/doi/10.2766/569540

Falloon, G. (2020). From Digital Literacy to Digital Competence: The Teacher Digital Competency (TDC) Framework. *Educational Technology Research and Development*, *68*(5), 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Ihnatova, O., Zhovnych, O., & Drobakha, L. (2022). The Effectiveness of Blended Learning in English Teacher Training. *Journal of Teaching English for Specific and Academic Purposes*, *10*(3), 377-388. https://doi.org/10.22190/JTESAP2203377I

INTEF. (2017). *Common Digital Competence Framework for Teachers* – September 2017. https://bit.ly/2yE7Vye

Kitchenham, B., & Charters, S. (2007). *Guidelines for Performing Systematic Literature Reviews in Software Engineering.* Technical Report EBSE-2007-01, Keele University and Durham University Joint Report. https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Peters, M., Ejjaberi, A. E., Martínez, M. J., & Fàbregues, S. (2022). Teacher Digital Competence Development in Higher Education: Overview of Systematic Reviews. *Australasian Journal of Educational Technology*, *38*(3), 122-139. https://doi.org/10.14742/ajet.7543

Rahmi, U., Azrul, A., & Mahande, R. D. (2022). The Prototype of Blended Learning's Support System to Improve the Pre-Service Teacher's Digital Literacy. *Journal of Educators Online*, *19*(3), 1-16. https://doi.org/10.9743/JEO.2022.19.3.5

Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu.* Publications Office of the European Union.

Robles Moral, F. J., & Fernández Díaz, M. (2021). Future Primary School Teachers' Digital Competence in Teaching Science through the Use of Social Media. *Sustainability*, *13*(5), 2816. https://doi.org/10.3390/su13052816

Romero-García, C., Buzón-García, O., & de Paz-Lugo, P. (2020). Improving Future Teachers' Digital Competence Using Active Methodologies. *Sustainability*, *12*(18), 7798. https://doi.org/10.3390/su12187798

Schina, D., Esteve-González, V., Usart, M., Lázaro-Cantabrana, J. L., & Gisbert, M. (2020). The Integration of Sustainable Development Goals in Educational Robotics: A Teacher Education Experience. *Sustainability*, *12*(23), 10085. https://doi.org/10.3390/su122310085

Sillat, L.H., Tammets, K., & Laanpere, M. (2021) Digital Competence Assessment Methods in Higher Education: A Systematic Literature Review. *Education Sciences, 11*(8), 402. https://doi.org/10.3390/educsci11080402

Skantz-Åberg, E., Lantz-Andersson, A., Lundin, M., & Williams, P. (2022). Teachers' Professional Digital Competence: An Overview of Conceptualisations in the Literature. *Cogent Education*, *9*(1), 2063224. https://doi.org/10.1080/2331186X.2022.2063224

Smagulova, G. Z., Sarzhanova, G. B., Tleuzhanova, G. K., & Stanciu, N. (2021). The Development of Future Foreign Language Teachers' Digital Competences in Creating Multimedia Tutorials. *The Education and Science Journal, 23*(6), 216–245. https://doi.org/10.17853/1994-5639-2021-6-216-245

Tonner-Saunders, S., & Shimi, J. (2021). Hands of the World Intercultural Project: Developing Student Teachers' Digital Competences through Contextualised Learning. *Pixel-Bit: Revista de Medios y Educación*, 61, 7-35. https://doi.org/10.12795/pixelbit.88177

Torres-Hernández, N., & Gallego-Arrufat, M. J. (2022). Indicators to Assess Preservice Teachers' Digital Competence in Security: A Systematic Review. *Education and Information Technologies*, *27*(6), 8583-8602. https://doi.org/10.1007/s10639-022-10978-w

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2, The Digital Competence Framework for Citizens: With New Examples of Knowledge, Skills and Attitudes.* Publications Office of the European Union.

Zhao, Y., Pinto Llorente, A. M., & Sánchez Gómez, M. C. (2021). Digital Competence in Higher Education Research: A Systematic Literature Review. *Computers & Education*, 168, 104212. https://doi.org/10.1016/j.compedu.2021.104212

Zhu, J., & Liu, W. (2020). A Tale of Two Databases: The Use of Web of Science and Scopus in Academic Papers. *Scientometrics*, *123*(1), 321-335. https://doi.org/10.1007/s11192-020-03387-8