

Lifelong learning in digital competency among teachers: a systematic review

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Article Info	ABSTRACT
Article history: Received Nov 25, 2024 Revised May 26, 2026 Accepted Jun 8, 2026 Keywords: Digital competency Lifelong learning Professional development Systematic literature review Teacher	This study aims to explore the intersection between digital competency and teacher lifelong learning to address the increasing demand for digitally skilled educators. By identifying barriers such as insufficient training, gender disparities, and the lack of structured digital learning environments, the study contributes to a better understanding of the challenges in fostering digital literacy among teachers. A systematic literature review was conducted using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework, focusing on 25 selected studies published between 2022 and 2024 from Scopus and Web of Science (WoS) databases. The analysis identified three major themes: i) classroom management and teacher training; ii) digital competency and integration; and iii) pedagogical innovation and teaching strategies. The findings underscore the necessity of continuous professional development and structured learning opportunities to equip teachers with the skills needed for effective digital education. This review concludes that while digital advancements provide significant opportunities for enhancing teacher competencies, targeted solutions must address existing barriers. Future research should investigate the role of AI in personalized professional development, incorporate digital ethics into teacher training, and address gender inequalities to foster inclusive and sustainable lifelong learning practices. <i>This is an open access article under the CC BY-SA license.</i> 
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1. INTRODUCTION

Lifelong learning has become an essential competency for individuals to adapt to the demands of the 21st-century. Recognized globally by educators, policymakers, and employers, it entails the continuous, self-directed pursuit of knowledge and skills that transcends traditional educational boundaries, integrating personal and professional growth [1]–[3]. The European Union, for instance, defines lifelong learning as encompassing all activities aimed at improving knowledge, skills, and competencies across personal, social, and vocational contexts [4], [5]. This competency has emerged as a cornerstone for employability, social inclusion, and personal development.

The importance of lifelong learning is particularly prominent in education, where teachers must not only embody these competencies but also instill them in students. Studies have shown that lifelong learning competencies, such as self-management and learning-to-learn skills, are critical for teachers' professional development and adaptability to evolving educational demands [6], [7]. Furthermore, the global shift towards competency-based education underscores the importance of active, self-regulated learning (SRL), further necessitating continuous skill development among educators.

Beyond education, the concept of lifelong learning extends into fields such as medicine and industry. Professionals in these domains rely on lifelong learning to maintain relevance amidst technological and methodological advancements. For instance, radiologists and employees in industry 4.0 have [8]–[10] demonstrated the necessity of ongoing skill enhancement to meet their respective field's dynamic demands. These examples underline the cross-disciplinary relevance of lifelong learning as a driver of adaptability and innovation.

Despite its universal importance, barriers persist that hinder the effective integration of lifelong learning into professional practice. In the field of education, challenges such as limited access to digital resources, gender disparities in technological literacy, and the lack of structured learning environments significantly impact the development of teachers' competencies. This review focuses on the intersection of lifelong learning and digital competency among educators, addressing these barriers through a systematic analysis of relevant literature. By synthesizing insights from recent studies, it highlights the key factors influencing teachers' ability to embrace digital tools and pedagogical innovations for lifelong learning while identifying gaps for future research.

The development of teacher competencies in the 21st-century is critical to addressing educational disparities and enhancing teaching outcomes. The effectiveness of professional learning communities (PLCs) in improving teaching competencies through innovative platforms such as Schoology.com, which enhance learning management and teacher satisfaction in disciplines like science and technology. Similarly, Benvenuti *et al.* [11] underscores the role of AI and advanced technological tools in fostering creativity and problem-solving skills, emphasizing the need for integrating technology into teacher professional development programs.

Continuous digital competency training is a pressing need in many regions. Ovcharuk and Ivaniuk [12] revealed significant gaps in digital literacy among Ukrainian teachers, particularly post-COVID-19, while Sapieva *et al.* [13] found similar challenges among Kazakhstan's primary school teachers. Both studies stress the importance of targeted digital skill development programs to enable teachers to adapt to rapid educational changes. Faculty development programs, as noted by Zehra [14], are equally essential, particularly in health professions education, where competency-based curricula and clinical supervision are key. This aligns with Balyk *et al.* [15] who advocate for structured training programs to enhance academic competencies across various disciplines.

Teacher self-efficacy in technology integration plays a pivotal role in fostering lifelong learning and professional competency. Şen and Durak [16] found that English teachers' confidence in using technology significantly influences their lifelong learning tendencies, while Padillo *et al.* [17] highlights the link between self-efficacy and improved instructional delivery and classroom management. Together, these findings reinforce the importance of continuous professional development in cultivating teaching practices that meet modern educational demands.

Lifelong learning also enhances intercultural and pedagogical competencies. Studies in Croatia, such as Burai and Kardum [18] and Mandarić *et al.* [19] demonstrate gaps in intercultural skills and lifelong learning programs, highlighting the need for national-level initiatives to address these challenges. These findings align with broader research, such as Pereza and Mršić-Pelčić [20] and Adams *et al.* [21], which emphasize multicultural competencies and student-centered teaching as critical for 21st-century education. Overall, structured professional development and technology integration are essential for empowering teachers to thrive in evolving educational landscapes.

This study theoretical framework based on lifelong learning theory. The European Union (EU) defines lifelong learning as “all learning activity undertaken throughout life, with the aim of improving knowledge, skills, and competencies within a personal, civic, social, and employment-related perspective” [22]. This theory emphasizes the dynamic and continuous nature of learning, encouraging individuals to adapt to changes in technology, society, and the economy. It also highlights the importance of self-directed learning and the integration of diverse learning experiences—both formal and informal [23]. In the context of digital competency, the lifelong learning framework underscores the need for teachers to not only acquire technical skills but also cultivate critical thinking, adaptability, and collaborative learning to meet the demands of 21st-century education. By embedding this theory, this study aligns its exploration of digital competency and teacher training with a well-established conceptual foundation that promotes inclusivity and adaptability in professional development.

A systematic literature review (SLR) relies on well-defined research questions to establish its scope and ensure relevance. These questions guide the decision-making process for including or excluding studies, maintaining focus on the central theme. Clear questions also help classify and organize data, enabling a structured analysis and synthesis of findings. They further contribute to reducing bias by ensuring that all relevant perspectives are considered [24]. For this review, the PICo framework—comprising population, interest, and context—was used as recommended in [25] for developing research questions in qualitative studies. The guiding questions are: i) how does continuous professional development in lifelong learning

competency influence the teaching practices of educators in modern educational systems? ii) what is the impact of digital competency on teachers' ability to facilitate lifelong learning in digitally integrated classroom environments? and iii) what are the key barriers teachers face in adopting pedagogical innovations to enhance lifelong learning in the context of digital education?

2. METHOD

The methodology follows the preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework to ensure transparency, accuracy, and consistency throughout the review [5]. This approach provides detailed guidance on locating, screening, and incorporating studies, enhancing the reliability of the analysis.

2.1. PRISMA

The PRISMA technique is a commonly used standard for conducting systematic literature reviews that ensures openness, accuracy, and consistency throughout the process [5] PRISMA guidelines, which provide directions on how to methodically find, filter, and incorporate studies into a review, can assist researchers in improving the precision and rigor of their analyses. The approach also emphasizes the value of randomized trials, recognizing their capacity to reduce bias and offer solid support for the review. Because of their extensive coverage and resilience, two significant databases—Web of Science (WoS), and Scopus—were used in this investigation. The PRISMA technique is a useful tool for doing systematic literature reviews.

2.2. Systematic searching strategy

The PRISMA process consists of four phases: identification, screening, eligibility, and data extraction. In the identification phase, relevant databases were searched to capture all potentially applicable studies. The screening phase involved evaluating studies against predetermined criteria to remove duplicates and irrelevant items. The eligibility phase ensured that remaining studies met inclusion requirements, while the final data extraction phase compiled and synthesized relevant information from selected works.

2.2.1. Identification

The search began with selecting key terms, then expanding them using dictionaries, thesauri, encyclopedias, and prior research. Search strings were tailored for WoS and Scopus, resulting in 795 initial records from both databases, as shown in Table 1.

Table 1. The search string used for the systematic review process

Databases	Search string
Scopus	TITLE-ABS-KEY ((“lifelong AND learning” OR “continuing AND learning” OR “long-lasting AND learning) AND digital AND (competency OR capability)) AND (LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2024)) AND (LIMIT-TO (DOCTYPE , “ar”)) AND (LIMIT-TO (SUBJAREA , “SOC”)) AND (LIMIT-TO (PUBSTAGE , “final”)) AND (LIMIT-TO (SRCTYPE , “j”)) Date of access: October 2024
WoS	(“lifelong AND learning” OR “continuing AND learning” OR “long-lasting AND learning) AND digital AND (competency OR capability) (Topic) and 2023 or 2024 or 2022 or 2021 or 2020 (Publication Years) and Article (Document Types) and English (Languages) and Article (Document Types) Date of access: October 2024

2.2.2. Screening

During screening, duplicate entries were removed, and studies were evaluated for alignment with the research questions. Non-English publications, works published before 2020, and items outside the social sciences or education were excluded. This process narrowed the pool to 68 articles, as shown in Table 2. The literature was the first criterion because it is the primary source of useful advice.

Table 2. The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2022-2024	<2022
Literature type	Journal (article)	Conference, book, review
Publication stage	Final	In press
Subject area	Social sciences, education	Besides social sciences, education

2.2.3. Eligibility

In the review process, 68 articles were initially selected for evaluation, but various exclusion criteria were applied at different stages of the analysis. Articles were excluded based on several factors, including the irrelevance of the study's field, titles that lacked significance in addressing the main research question, and abstracts that did not align with the study's objectives. Furthermore, some articles were excluded due to the unavailability of full-text access, which limited a comprehensive assessment of their content. After applying these criteria, 43 articles were excluded from the analysis, reducing the number of studies for further consideration.

Following this exclusion process, 25 studies were retained and included in the qualitative analysis, as shown in Figure 1. These studies were deemed to have significant relevance to the research objectives and provided sufficient data to support in-depth qualitative evaluation. By focusing on these selected studies, a more targeted exploration of the research topic was made possible, allowing for an in-depth understanding of the subject matter and contributing valuable insights to the overall analysis.

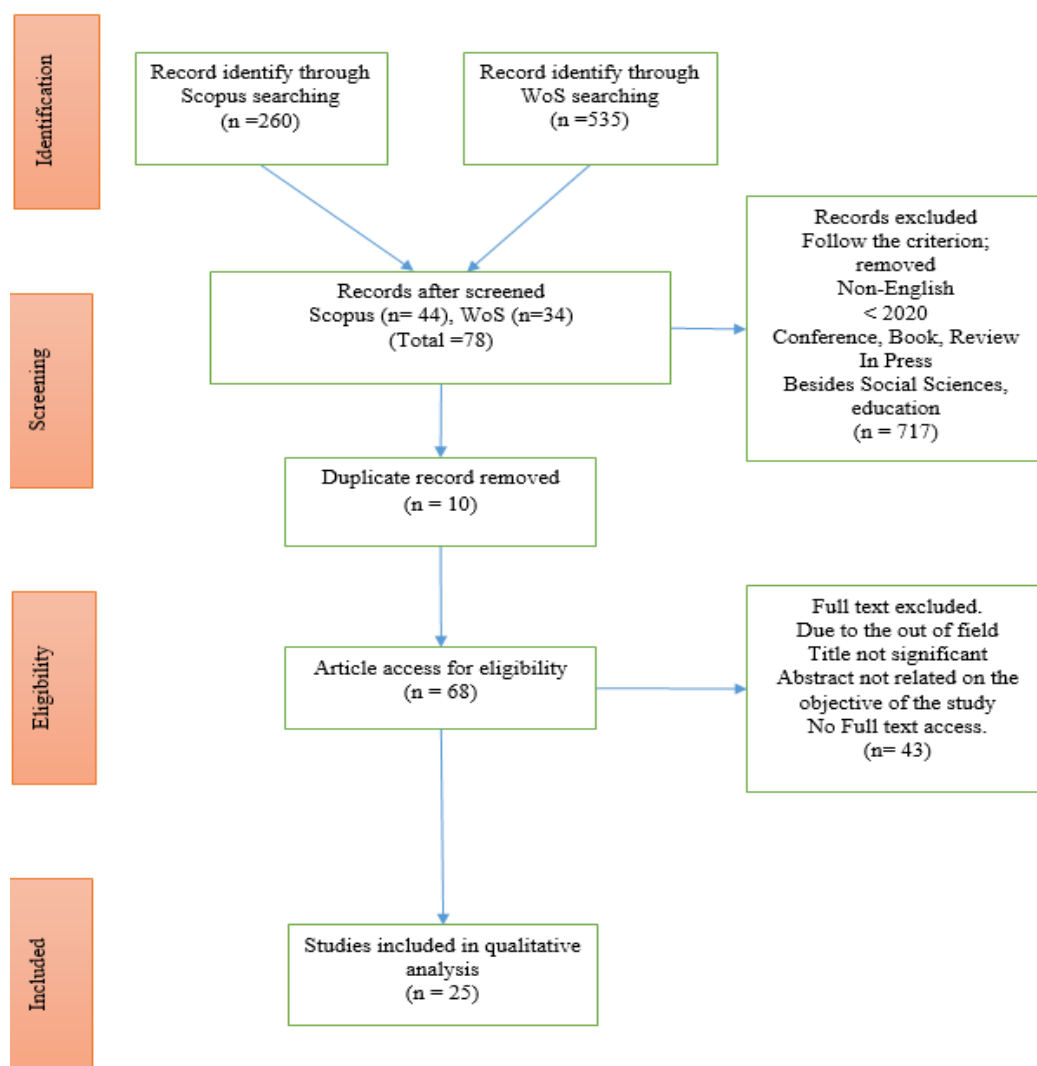


Figure 1. Flow diagram of the proposed searching study [26]

2.3. Data abstraction and analysis

An integrative approach was used to synthesize findings from quantitative, qualitative, and mixed-method studies. Data collection involved reviewing the 25 included studies to identify relevant themes and subthemes, as shown in Figure 1. Co-authors collaborated to refine themes based on evidence, with validation by two subject-matter experts in teaching, learning, and SLR methodology. Adjustments were made based on expert feedback to maintain clarity and relevance.

2.4. Quality of appraisal

After identifying the primary studies as in Table 3 (see Appendix) [27]–[50], [4], [33], their quality was evaluated to determine the robustness of the research presented and to allow for quantitative comparison. This review adopted the quality assessment framework from [51], which consists of six criteria specific to SLRs. Each criterion was rated using a three-point scale: “yes” (Y) with a score of 1 for full compliance, “partly” (P) with a score of 0.5 for partial fulfilment with some gaps, and “no” (N) with a score of 0 for non-fulfilment.

The six quality assessment criteria were: i) is the study’s purpose clearly stated? (QA1); ii) are the significance and usefulness of the work clearly explained? (QA2); iii) is the research methodology clearly described? (QA3); iv) are the core concepts of the approach well defined? (QA4); v) is the work compared with, and measured against, similar studies? (QA5); and vi) are the study’s limitations clearly identified? (QA6). The evaluation process involved three independent experts who assessed each study against the criteria. Scores for each criterion were then summed across all experts to produce a total score. A study was required to achieve a combined score above 3.0 to advance to the next stage, ensuring that only research meeting the minimum quality threshold was included in the final analysis.

3. RESULTS AND DISCUSSION

3.1. Results

Background of the selected study based on quality assessment; Table 4 shows the result of assessment performance for selected primary studies. Here is the quality assessment Table for the selected papers. The study by Otto *et al.* [45] achieved the highest score of 100% due to clear articulation of purpose, usefulness, methodology, defined concepts, comparison with other work, and mention of limitations. The study by Déniz and Pérez [49] scored the lowest (58.33%), as it partly met the criteria for the concepts of approach and comparison with other work, and did not mention the limitations.

Table 4. Quality assessment of primary studies

ID	QA1	QA2	QA3	QA4	QA5	QA6	Total score	by Max PS (%)
PS 1	1	1	0.5	1	0.5	0.5	4.5	75.00
PS 2	1	1	1	1	0.5	0.5	5	83.33
PS 3	1	1	1	1	0.5	0.5	5	83.33
PS 4	1	1	1	1	0	0	4	66.67
PS 5	1	1	1	1	1	1	6	100.00
PS 6	1	1	1	0.5	0.5	0	4	66.67
PS 7	1	1	1	1	0.5	0.5	5	83.33
PS 8	1	1	0.5	1	0.5	0.5	4.5	75.00
PS 9	1	1	1	0.5	1	0.5	5	83.33
PS 10	1	1	0.5	0.5	0.5	0.5	4	66.67
PS 11	1	1	1	1	0.5	0.5	5	83.33
PS 12	1	1	1	1	1	1	6	100.00
PS 13	1	1	0.5	1	1	0.5	5	83.33
PS 14	1	1	0.5	0.5	0.5	0.5	4	66.67
PS 15	1	1	1	1	0.5	1	5.5	91.67
PS 16	1	1	1	0.5	0.5	0.5	4.5	75.00
PS 17	1	1	1	1	1	1	6	100.00
PS 18	1	1	1	1	0.5	0.5	5	83.33
PS 19	1	1	0.5	0.5	0.5	0.5	4	66.67
PS 20	1	1	1	1	1	1	6	100.00
PS 21	1	1	1	1	0.5	1	5.5	91.67
PS 22	1	1	0.5	0.5	0.5	0.5	4	66.67
PS 23	1	1	0.5	0.5	0.5	0.5	4	66.67
PS 24	1	0.5	0.5	0.5	0.5	0.5	3.5	58.33
PS 25	1	1	1	1	1	0.5	5.5	91.67

The systematic review incorporated 25 studies published between 2022 and 2024, selected using the PRISMA framework. Data were collected through Scopus and WoS databases, utilizing clear inclusion and exclusion criteria to ensure the relevance and quality of the studies. The analysis identified three primary themes: i) classroom management and teacher training; ii) digital competency and integration; and iii) pedagogical innovation and teaching strategies. Key findings include the effectiveness of cooperative learning in improving teacher competencies [27] and the significance of reflective practices for intercultural competency development [43]. The studies also reveal that while digital tools enhanced learning experiences during the COVID-19 pandemic, their efficacy was limited by insufficient information and communication

technology (ICT) training and inadequate technological infrastructure [32], [44]. The findings were validated by integrating quantitative, qualitative, and mixed-methods research, supported by expert reviews to ensure clarity and relevance.

3.1.1. Teacher competency in lifelong learning

Digital competence emerges as a crucial predictor of lifelong learning skills, as shown by Tekedere and Göker [40], who found digital literacy to be the strongest factor influencing lifelong learning outcomes. The study emphasizes the importance of developing online information searching strategies alongside digital literacy to access, process, and apply information effectively. Similarly, Thwe and Kálmán [1] highlight the positive correlation between teacher trainers' perceptions of lifelong learning and the use of learning strategies to enhance competencies, with variations observed across geographical regions. These findings underscore the need for culturally sensitive training programs that address regional educational contexts while promoting universal lifelong learning goals.

Finally, Matsumoto-Royo *et al.* [52] explore complex thinking as an essential subset of lifelong learning, focusing on higher-order skills like critical, innovative, and systemic thinking. Their comparative analysis of training practices highlights the importance of integrating complex thinking and digital literacy to prepare teachers and students for the challenges of modern education. Across the reviewed studies, a consistent relationship emerges between lifelong learning and digital competence, highlighting self-regulated learning, ongoing professional development, effective technology integration, and critical reasoning as essential to teachers' professional growth and adaptability in evolving educational contexts. The findings emphasize a critical link between lifelong learning and digital literacy among teachers, focusing on self-regulation and continuous professional development. Karlen and Hertel [29] highlight the importance of SRL in enabling teachers to manage cognitive and metacognitive resources effectively. However, its implementation remains limited due to insufficient training, prompting the introduction of the intelligent, nurturant, socratic, progressive, indirect, reflective, and encouraging (INSPIRE) model to support teachers in cultivating SRL among students. Furthermore, Reyhav *et al.* [31] demonstrate that professional development grounded in lifelong learning supports teachers' effective use of technology and improves pedagogical outcomes. Their findings indicate that teachers were more likely to perceive technology integration as successful when technological tools were easy to use and offered clear pedagogical benefits. This reinforces the need for continuous professional development to sustain effective digital teaching, as shown in Figure 2.

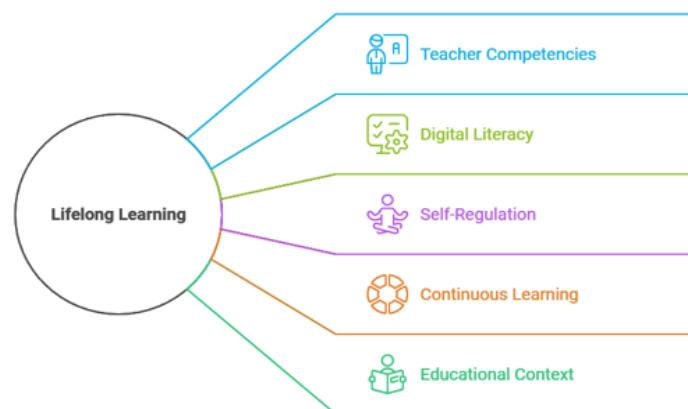


Figure 2. Teacher competency in lifelong learning

3.1.2. Digital competency and integration

The shift to digital learning during the COVID-19 pandemic exposed significant gaps in teachers' digital competency, emphasizing the need for structured training to integrate digital tools effectively. For example, Alt and Naamati-Schneider [28] showed how health management students used digital tools like idea mapping to foster active learning and teamwork, while Paños-Castro *et al.* [32] highlighted teachers in the Basque Country adapting to platforms like Google Classroom despite limited ICT training. Both studies underscore the importance of preparing educators for digital teaching environments.

Digital collaboration and communication have also become essential. Rodríguez-García *et al.* [33] observed intermediate digital collaboration skills among teacher trainees, noting gender disparities in proficiency, while Jarupongputtana *et al.* [34] advocated for community-based learning models that combine

digital literacy and interdisciplinary learning to foster digital citizenship and lifelong learning among pre-service teachers.

In vocational and healthcare education, structured digital learning has proven effective in enhancing lifelong learning competencies. Zervas and Stiakakis [36] found that Erasmus programs and educational platforms significantly improved students' digital skills, whereas daily computer use was insufficient. Similarly, Sanerma *et al.* [35] demonstrated how digital tools in healthcare education boosted students' collaborative skills and confidence.

Overall, the research highlights the importance of digital competency in modern education. While many educators and students faced challenges during the pandemic, the integration of structured digital tools and training encouraged collaboration, communication, and active learning, essential for lifelong learning [28], [32]–[36] has been illustrated in Figure 3.



Figure 3. Enhancing digital competency in education

3.1.3. Pedagogical innovation and teaching strategies

Research on teacher lifelong learning and digital competency highlights the transformative role of digital education, particularly during COVID-19. Studies emphasize pedagogical innovations and adaptive strategies in fostering teacher competency. For example, Cavaletto and Miglietta [27] shows cooperative learning enhances curricular and extracurricular skills via peer-to-peer approaches, while Kittelmann *et al.* [43] underscores reflective and experiential models like Kolb's cycle in developing intercultural competencies.

The shift to blended learning, as noted by Kayi [44], revealed benefits such as improved delivery and competency growth, but faced challenges from poor access and low pedagogy quality. Otto *et al.* [45] highlight student-centered digital practices that require educator adaptation, addressing barriers like digital literacy and resource gaps. Similarly, Durgunoğlu *et al.* [46] and Nair and Solanki [48] identify challenges in marginalized communities-limited resources, low proficiency-stressing institutional readiness and robust knowledge management.

Across the literature, key themes include collaboration, reflective learning, and adaptability, calling for teacher education programs to balance digital skill development with pedagogical innovation [27], [43], [45], [46]. Gaps remain, such as the need for gender-sensitive training due to disparities in digital collaboration skills [33]. Integrating AI-driven, personalized professional development is recommended to meet diverse educator needs and promote SRL [40].

Practical strategies include cooperative and experiential learning to improve engagement [27], [43], addressing institutional barriers via targeted investment in infrastructure and training [46], [48], and embedding AI and digital ethics for inclusive, adaptive, and future-ready environments. These approaches tackle the challenges of digital adaptation while preparing educators for evolving demands.

3.2. Discussion

Previous research has highlighted several important insights into lifelong learning and digital competencies, yet there are notable gaps and limitations that this study addresses. For instance, studies such as those by Ovcharuk and Ivaniuk [12] have emphasized the critical need for continuous teacher training in digital literacy, especially post-COVID-19. However, these works largely focus on isolated geographical or contextual challenges (e.g., in Ukraine and Kazakhstan) without providing a comprehensive or comparative framework applicable to diverse educational systems. In contrast, the current review incorporates a broader range of contexts and systematically analyzes the barriers and opportunities across multiple studies published between 2022 and 2024.

Furthermore, earlier works often highlight the importance of PLCs and technological tools in enhancing teacher competencies [11] but fail to address the integration of these tools into structured lifelong learning programs. This study bridges that gap by emphasizing the interplay between digital competency, classroom management, and pedagogical innovation as integral components of lifelong learning.

Another key limitation in previous research lies in its narrow focus on specific dimensions, such as gender disparities in digital literacy [33]. While these studies underline important disparities, they do not propose actionable solutions to address these issues. In contrast, this review advocates for inclusive and gender-sensitive training programs as part of a holistic strategy to foster digital literacy and lifelong learning.

Finally, while previous works acknowledge the role of digital tools in fostering active learning and collaboration [28], [32], they often overlook the long-term sustainability of these practices within formal educational structures. The current study advances the field by offering strategic recommendations for continuous professional development, focusing on structured, evidence-based training that integrates digital competency with lifelong learning initiatives. By addressing these shortcomings, this study provides a more comprehensive understanding of the challenges and strategies in equipping educators for the digital age, emphasizing the importance of holistic, inclusive, and sustainable approaches to lifelong learning.

4. CONCLUSION

This systematic literature review highlights the significant relationship between teacher lifelong learning and digital competency, emphasizing their roles in navigating the challenges of modern education. The findings reveal that while digital advancements provide transformative opportunities, educators face persistent barriers, such as inadequate training, limited digital resources, and gender disparities in digital literacy. Themes such as SRL, reflective practices, and collaborative teaching emerge as pivotal in fostering teacher competencies.

Additionally, the integration of structured digital tools and pedagogical innovations has proven to enhance teaching practices, though institutional readiness and equitable access to technology remain critical concerns. The review underscores the need for inclusive, structured, and evidence-based professional development programs to address these gaps effectively.

Further research could comprehensively examine the gender disparities in digital literacy highlighted in the article by investigating their root causes and devising targeted strategies to address these inequalities, thereby fostering more inclusive lifelong learning practices. Additionally, studies could explore the role of AI tools in enhancing teachers' digital competencies and facilitating SRL, with a particular focus on evaluating the effectiveness of AI-driven personalized training modules. Furthermore, future research should investigate the integration of digital ethics training into lifelong learning programs for educators to promote the responsible and equitable use of technology in education.

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C : Conceptualization

M : Methodology

So : Software

Va : Validation

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CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available within the article.

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APPENDIX

Table 3. Primary studies

No	Authors	Title	Year	Journal	Scopus	WOS
1	[27]	Cooperative and competitive learning as transformative factors of educational processes for extracurricular skill enhancement	2024	Frontiers in Education	/	
2	[28]	Online argumentation-based learning aided by digital concept mapping during COVID-19: implications for health management teaching and learning	2022	Health Education	/	

Table 3. Primary studies (continue)

No	Authors	Title	Year	Journal	Scopus	WOS
3	[29]	Inspiring self-regulated learning in everyday classrooms: teachers' professional competences and promotion of self-regulated learning	2024	Unterrichtswissenschaft	/	
4	[30]	Competency frameworks, alternative credentials and the evolving relationship of higher education and employers in recognising skills and achievements	2023	International Journal of Information and Learning Technology	/	
5	[31]	Lifelong learning processes in professional development for online teachers during the COVID era	2023	Frontiers in Education	/	
6	[32]	COVID and ICT in primary education: challenges faced by teachers in the Basque Country	2022	Sustainability (Switzerland)	/	
7	[33]	Communicating and collaborating with others through digital competence: a self-perception study based on teacher trainees' gender †	2022	Education Sciences	/	
8	[34]	Interdisciplinary community based learning to enhance competence of digital citizenship of social studies pre-service teacher's in Thai context: pedagogical approaches perspective	2022	Journal of Curriculum and Teaching	/	
9	[35]	Interprofessional students' experiences of specialisation education on the design and development of digital health and social care services	2024	Cogent Education	/	
10	[36]	Digital skills in vocational education and training: Investigating the impact of Erasmus, digital tools, and educational platforms	2024	Journal of Infrastructure, Policy and Development	/	
11	[37]	Model of AI acceptance in higher education: arguing teaching staff and students perspectives	2024	International Journal of Information and Learning Technology	/	
12	[38]	PhD progression: a micro-credentialing program motivates and supports PhD students' professional development at a US University	2024	Studies in Graduate and Postdoctoral Education	/	
13	[39]	Learning analytics and evidence-based K12 education in Japan: usage of data-driven services for mobile learning across two years	2023	International Journal of Mobile Learning and Organisation	/	
14	[3]	Relationships between the perceptions of lifelong learning, lifelong learning competencies and learning strategies by teacher trainers in Myanmar	2023	International Review of Education	/	/
15	[40]	The role of online information searching strategies and digital literacy levels in predicting students' lifelong learning competencies	2023	Participatory Educational Research	/	
16	[41]	Measuring teachers' competencies for a purposeful use of augmented reality experiments in physics lessons	2023	Frontiers in Education		/
17	[42]	Exploring complex thinking in latin american universities: comparative analysis between programs and alternative credentials	2024	Journal of Latinos and Education		/
18	[43]	Experiential learning during lockdown: a teaching case describing intercultural competency development through the mechanism of reflection using different digital teaching methods	2023	Journal of International Education in Business		/
19	[44]	Transitioning to blended learning during COVID-19: exploring instructors and adult learners' experiences in three Ghanaian universities	2024	British Journal of Educational Technology		/
20	[45]	Emerging digital practices supporting student-centred learning environments in higher education: a review of literature and lessons learned from the COVID-19 pandemic	2024	Education and Information Technologies		/
21	[46]	Moving to remote learning in adult education: Challenges and solutions of limited technological resources and capabilities	2022	Frontiers in Education		/
22	[47]	Between accessibility and adaptability of digital platform: Investigating learners' perspectives on digital learning infrastructure	2024	Higher Education Skills and Work-Based Learning		/
23	[48]	Student perceptions of knowledge management and institutional readiness for online classes amid COVID-19 pandemic	2023	Knowledge Management & E-Learning-An International Journal		/
24	[49]	The perception of the learner about his/her competency development in a EFL gamified learning situation	2023	Aula Abierta		
25	[50]	Visual literacy shown through a magnifying lens by high school students	2023	Interactive Technology and Smart Education		

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