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A SYNTHESIS REVIEW OF DIGITAL LITERACY FRAMEWORKS: COMPARATIVE ANALYSIS AND EVALUATION

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Abstract

This synthesis review analyses the evolution of digital literacy frameworks from 2002 to 2024 through a systematic literature review. Through a preliminary study, 322 articles in reputable journals, such as the Scopus and Google Scholar database index, were selected and compiled. In analysing 45 published articles, it was found that the significant progress in understanding digital competence, alongside ongoing gaps and challenges in framework implementation across educational contexts. Based on these insights, recommendations are made for teachers and policymakers to enhance the design and effectiveness of digital literacy frameworks, ensuring they align with the needs of the digital age. In addition, the articles proposed the necessity for continuous adaptation and collaboration to foster digital competence among learners effectively.

Keywords: Digital competence; Education; Systematic literature review; Teacher 21st-century skills;

Abstrak

Kajian sintesis ini menganalisis evolusi kerangka literasi digital dari tahun 2002 hingga 2024 melalui satu kajian literatur sistematik. Melalui kajian awal, 322 artikel dari jurnal bereputasi yang diindeks dalam pangkalan data seperti Scopus dan Google Scholar telah dipilih dan dikompilasikan. Dalam analisis 45 artikel yang diterbitkan, didapati terdapat kemajuan yang signifikan dalam pemahaman mengenai kompetensi digital, di samping wujudnya jurang dan cabaran berterusan dalam pelaksanaan kerangka ini merentasi konteks pendidikan.

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Berdasarkan dapatan ini, beberapa cadangan dikemukakan kepada guru dan pembuat dasar bagi mempertingkat reka bentuk dan keberkesanan kerangka literasi digital agar selari dengan keperluan era digital. Selain itu, melalui artikel yang dikaji dicadangkan keperluan terhadap adaptasi berterusan dan kerjasama yang berkesan bagi memupuk kompetensi digital dalam kalangan tenaga pengajar secara holistik.

Kata kunci: Kajian sistematik literatur; Kemahiran abad ke 21; Kompetensi digital; Pendidikan

1.0 INTRODUCTION

Digital competence represents a multifaceted and complex construct that includes an integrated framework of technological skills, critical knowledge domains, and adaptive attitudes essential for meaningful engagement in contemporary digital societies (Yadav, 2025). This comprehensive concept enables individuals to navigate, interact, and effectively participate in increasingly technology-mediated social and professional environments. The Organisation for Economic Co-operation and Development (OECD) has recognized the significance of fostering 21st-century skills and competences, many of which are supported or enhanced by ICT (OECD, 2023). The OECD highlights the critical role of digital literacy in developing skills and expertise essential for the labour market (Schleicher, 2016). Such definitions form the foundation for creating and structuring digital literacy frameworks, as exemplified by initiatives from the European Commission and the OECD (Yoo-Taek & Fanea-Ivanovici, 2023).

The changing societal and cultural landscape, influenced by new technology, continues to affect the terminology and understanding of digital competence for economic growth, employability, and social inclusion, particularly for marginalized groups (Enciso, Yang & Ugarte, 2024). In the contemporary digital era, proficiency in digital skills has become paramount for individual empowerment and societal advancement. These competencies enable individuals to strategically navigate, critically analyze, and innovatively create digital content while maintaining technological safety and ethical engagement (Enciso, Yang & Ugarte, 2024).

Moreover, digital skills serve as transformative mechanisms for economic progression, enhanced employability, and social equity, providing marginalized populations with critical pathways to educational opportunities and resource access. In addition to the broader, macro-level rationale for developing a digital skills framework, some researchers have emphasized its importance within the university context. According to Johnston (2020), the impetus for creating such a framework arises from the necessity of preparing students with the digital

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competencies required for the workforce of the future. The roots of digital competence are linked to economic competition, where new technologies are seen as opportunities and solutions. Theoretical frameworks of digital literacy and mission statements or frameworks related to information literacy were examined for their commonalities and differences.

2.0 LITERATURE REVIEW

2.1 Concepts of Digital Competence

The concept of digital competence is articulated through a range of terms, including digital literacy, new literacies, and media literacy, each emphasizing distinct aspects of the broader concept. This variety reflects the dynamic and context-specific nature of digital competence, which varies across cultural and educational landscapes (Ilomäki et al., 2016). In professional settings, digital competence extends to include a broad spectrum of skills tailored to specific occupational demands. This diversity underscores the necessity of a coherent and unified framework to guide the development of digital skills in the workplace, ensuring alignment with job-specific requirements and fostering professional growth (Oberländer, Beinicke & Bipp., 2020; Rosado & Bélisle, 2006). Digital competence is a multifaceted concept essential for navigating and thriving in the digital age. It encompasses several key components, each contributing to an individual's ability to effectively and ethically engage with digital technologies.

Digital competence includes a range of interrelated skills essential for effective and responsible technology use. It begins with technical and informational skills, enabling individuals to access, evaluate, and utilize digital information confidently (Marrero-Sánchez & Vergara-Romero, 2023; Avni & Rotem, 2016). Critical and ethical use further reinforces the need for thoughtful evaluation of digital content and adherence to ethical standards in online environments (Ilomäki et al., 2016; Avni & Rotem, 2016). Competence also includes communication and collaboration skills that support meaningful engagement and teamwork in digital spaces (Avni & Rotem, 2016). Additionally, applying digital skills across educational, professional, and personal contexts requires strategic and purposeful use (Ilomäki et al., 2016; Oberländer, Beinicke & Bipp, 2020). Finally, ensuring digital safety and the ability to solve problems using technology is vital for navigating the challenges of digital environments effectively (Le, Sunay & Palsolé, 2022).

In conclusion, digital competence integrates technical skills, ethical awareness, collaborative abilities, and contextual application. Together, these components enable

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individuals to navigate digital landscapes proficiently and responsibly, making it an indispensable skill set in contemporary society.

2.2 Definitions of Digital Competences

Digital competence is defined as the capability to access, manage, evaluate, and create information through digital technologies in a safe and effective manner. It involves critical, collaborative, and creative interactions with technology, which are vital for contemporary life (Enciso, Yang & Ugarte, 2024). This competence includes the knowledge, abilities, skills, and attitudes necessary for accessing, analysing, evaluating, critically reflecting, creating, and communicating effectively within four essential domains: technological, informational, multimedia, and communicative (Enciso, Yang, & Ugarte, 2024). Meanwhile the European Union refer the digital competence as the ability to use technology critically, confidently, and responsibly across work, education, and general societal participation. This concept comprises five core areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving (Le, Sunay & Palsolé, 2022).

This competence is essential for university students to navigate the challenges of the knowledge society and utilize available communication tools effectively (Marrero-Sánchez, & Vergara-Romero, 2023). Digital competence is defined by the European Union as the ability to use technology critically, confidently, and responsibly in work, education, and general participation in society. The framework includes five core domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. This conceptualization reflects the comprehensive integration of knowledge, skills, and attitudes toward technology, emphasizing its significance in navigating the increasingly digital landscape of education and professional environments, particularly in the context of the transformative shifts accelerated by the COVID-19 pandemic (Le, Sunay & Palsolé, 2022).

While digital competence is widely recognized as essential, there are challenges in its implementation and assessment. Disparities in digital skills exist across different regions and demographics, highlighting the need for inclusive educational strategies and resources to bridge these gaps (Enciso et al., 2024). Additionally, the distinction between digital competence, literacy, and skills remains a topic of discussion, emphasizing the need for clear frameworks and standards in digital education (Le, Sunay & Palsolé, 2022).

2.3 Future Education with Digital Literacy Framework

An educational framework is essentially a structured system that organizes institutional

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assumptions, curriculum objectives, educational theories, ethical principles, technologies, pedagogical goals and constraints, as well as professional practices to effectively facilitate the implementation of educational policies. Typically spanning two to five years, frameworks offer guidance, set priorities, organize processes and technologies, and suggest investments and staffing necessary to achieve the desired objectives.

Thus, frameworks have been constructed to elicit in the educational landscape the specific outcomes that the rising adoption of digital resources has been driving in sectors including economics, job markets, or leisure endeavors. These frameworks are typically organizational mechanisms that teachers may not be well-acquainted with. The frameworks under consideration pertain to policies that focus on the incorporation of information and communication technology within the educational context. It is crucial to highlight the notable lack of information literacy tools, reference schemas, and guidelines within the majority of these frameworks, which are essential for empowering teachers and students to effectively and intelligently investigate information sources (Yoo-Taek & Fanea-Ivanovici, 2023).

3.0 MATERIALS AND METHODS

3.1 Research Questions

The present study aims to characterize the trends in digital frameworks, including their theoretical foundations, literature reviews, or background, as examined in various studies. This research provides a reflection on a collection of studies highlighting the growing prominence of digital frameworks within global education systems. The study seeks to address the following research questions:

(1) What are the main characteristics of framework studies on digital competencies in education?

(2) What are the key strengths of the theoretical frameworks employed in these studies?

3.2 Research Design

To comprehensively address the research questions, an extensive literature review was undertaken using the methodological framework proposed by Dixon-Woods (2010) and aligned with qualitative data analysis approaches described by Silverman (2001, 2010).

First Phase: A search were conducted in the Scopus and Google Scholar databases using the keywords “digital competence” AND “digital framework.” To enhance the quality of the retrieved literature, filters were applied to include peer-reviewed journal articles and

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education-focused publications relevant to teachers and educational stakeholders. This procedure yielded 322 records published between 2002 and 2024.

Second Phase**:** Specific inclusion and exclusion criteria were applied, resulting in 45 articles being retained for analysis, Table 1.

Table 1. *Inclusion and exclusion criteria of the literature review process*

Inclusion Criteria	Exclusion criteria
Qualitative, quantitative and mixed studies	General articles on ICT not related to education field
All levels of education on digital framework	Studies not related to education on digital framework
Articles from 2002 to 2024	Articles before 2002
Journal (Article)	Proceedings of conferences, books, book chapters and master and doctoral theses

Third Phase**:** Data categorization was guided by the Textual Discursive Analysis (TDA) approach developed by Moraes and Galiazzi (2011), which supports category construction that may be non-mutually exclusive, thereby enabling a more holistic synthesis of the selected studies.

4.0 RESULTS AND DISCUSSION

The twenty evolving selected frameworks exemplify various initiatives aimed at integrating ICT in education. These documents were chosen for their capacity to represent a broad spectrum of approaches, illustrating the diverse strategies developed for the integration of ICT in educational settings (Table 2).

Table 2. *Authors' compilation based on the frameworks cited herein*

Digital Framework	Year	Country	Main Characteristics	Key Strengths	Elements in the Framework
Digital Transformation: A Framework for ICT Literacy	2002	USA	Developed by ETS, aimed at providing a clear framework for ICT literacy, helping to assess and	Focuses on large-scale global assessments of ICT literacy.	ICT literacy assessments, skills for using ICT in everyday life, communication

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Digital Framework	Year	Country	Main Characteristics	Key Strengths	Elements in the Framework
(ICT Literacy Panel, 2002)			improve ICT literacy globally.		and content creation.
European Information Literacy Framework (SCONUL) (Society of College, National and University Libraries, 2011)	2002-2004	Europe	European project developing a framework for digital age skills, focusing on new ways of organizing and classifying knowledge.	Emphasizes new forms of knowledge and critical skills in the digital age.	Digital knowledge classification, critical thinking, content creation, information management.
European Pedagogical ICT Licence (EPICT) (European Schoolnet, 2006)	1999	Denmark	Focuses on the continued professional development of teachers through ICT integration in classroom pedagogy.	Supports teachers in the pedagogical use of ICT, with practical application in schools.	ICT integration, practical ICT skills for teaching, pedagogical strategies, professional development.
Techno-pedagogical Competence Framework for Teachers (Villeneuve, et al., 2012)	2007	Canada	Aimed at improving the pedagogical use of ICTs among college teachers through a framework for reflection and	Facilitates professional development for teachers in the use of ICT in pedagogy.	Pedagogical reflection, ICT integration, professional development in ICT use, communication and

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Digital Framework	Year	Country	Main Characteristics	Key Strengths	Elements in the Framework
			professional development.		information skills.
Common European Framework for Teachers' Professional Profile in ICT for education (European Commission, 2005)	2003-2005	Europe	Developed under the eLearning Initiative to help educational stakeholders reflect on ICT practices in initial teacher education (ITE) and continuing professional development (CPD).	Provides a comprehensive approach for teachers' ICT competence in European educational systems.	Teacher professional profile, ICT competence for ITE and CPD, reflection, collaboration, and assessment practices.
SAMR Model (Puentedura, 2006)	2006	USA	Framework focused on the use of digital resources in teaching, categorized into four levels: Substitution, Augmentation, Modification, and Redefinition.	Aids in evaluating the level of digital resource integration in teaching practices.	Levels of digital resource integration: Substitution, Augmentation, Modification, Redefinition.
ICT Competency Framework for Teachers – UNESCO (UNESCO,	2008-2013	International	Provides competency parameters for teachers including technology literacy, pedagogical	Focuses on building teachers' competencies for integrating ICT in education.	Technology literacy, pedagogy integration, ICT in curriculum, teacher

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Digital Framework	Year	Country	Main Characteristics	Key Strengths	Elements in the Framework
2023)			knowledge, and ICT understanding for teaching and learning.		competencies for assessment, and professional development.
DQ Institute Digital Intelligence (DQ) Framework (DQ Institute, 2021)	2017	International	Includes eight indicators such as digital safety, emotional intelligence, digital rights, and identity, with 24 components focusing on digital citizenship and ethical use of technology.	Focuses on ethical digital usage and develops emotional intelligence in students and teachers.	Digital safety, digital rights, emotional intelligence, digital citizenship, ethical usage, screen time management.
Digital Competency Framework for Teachers (Redecker & Punie, 2017)	2017	International	Categorizes competencies into professional and pedagogical skills, covering areas like research, collaboration, content development, and evaluation in digital environments.	Comprehensive coverage of professional and pedagogical competencies for teachers in digital contexts.	Research, collaboration, content development, evaluation, feedback, empowerment of learners, pedagogical strategies.
Professional Digital Competence	2017	International	Includes seven indicators: subject, basic skills, school	Emphasizes digital awareness	Pedagogical skills, leadership,

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Digital Framework	Year	Country	Main Characteristics	Key Strengths	Elements in the Framework
Framework for Teachers (Krumsvik, 2014)			and society, pedagogy, leadership, interaction, and change management. Focuses on digital awareness and resource usage in teaching.	and leadership in the learning process.	resource management, digital awareness, interaction, and communication.
Digital Teaching Professional Framework (ETF) (Education and Training Foundation, 2018)	2018	International	Categorizes teacher competencies into three stages: Exploring, Adapting, and Leading, with a focus on resource usage, accessibility, and self-development.	Progressive stages of professional development and integration of digital resources.	Instructional planning, digital resource use, accessibility, feedback, self-development.
ITU Digital Skills Framework (International Telecommunication Union, 2018)	2018	International	Categorizes digital skills into basic, intermediate, and advanced, ranging from MS Word usage to artificial intelligence and cybersecurity.	A clear and structured categorization of skills for teachers and learners.	Basic skills (e.g., MS Word), intermediate skills (e.g., email), advanced skills (e.g., AI, cybersecurity).
Competency Profile for the	2019	International	Focuses on open educational resources, digital	Highlights digital resource	Open educational resources,

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Digital Framework	Year	Country	Main Characteristics	Key Strengths	Elements in the Framework
Digital Teacher (Ally, 2019)			resource access, and pedagogical strategies for digital teaching.	access and pedagogical strategies in teaching.	digital access, pedagogical strategies, content development.
Digital Competency Framework for Students and Teachers - Government of Quebec (GoQ) (Gouvernement du Québec, 2019)	2019	Canada	Encompasses 12 indicators, focusing on digital resources for learning, information literacy, creativity, critical thinking, and problem-solving.	Strong focus on ethical citizenship and digital competency for both students and teachers.	Digital resources, information literacy, innovation, creativity, problem-solving, communication, collaboration, ethical citizenship.
Digital Competence Framework for Austria – DigComp Project (Federal Ministry of Education, Science and Research Austria, 2022)	2022	Austria	Defines digital competencies for all citizens, with focus on digital safety, problem-solving, content creation, communication, and data literacy.	Provides clear competencies for digital literacy across all citizens.	Digital safety, problem-solving, content creation, communication, data literacy, critical thinking.

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4.1 Synthesis of Trends from Existing Educational Digital Frameworks

The evolving nature of technology and its integration into teaching practices highlights the importance of a multi-dimensional approach to digital competence. The most recent iterations of leading frameworks stress that digital literacy must move beyond technical proficiency, embedding higher-order capabilities such as critical thinking, problem-solving, communication and creativity (European Commission JRC, 2024; UNESCO, 2023; Tondeur et al., 2023). Most educational frameworks place significant emphasis on broadening digital literacy beyond technical proficiency, incorporating critical thinking, problem-solving, communication, and creativity. As digital competence now extends to areas such as data literacy, cybersecurity, and digital citizenship, the new framework should adopt a holistic perspective, recognizing that digital literacy is not merely a set of technical skills but an essential set of competencies that empowers teachers to use technology effectively while considering its societal impact. A framework grounded in this understanding will not only enable teachers to harness the potential of digital tools but also equip them to foster responsible and ethical use of technology in students.

Another key trend from the educational frameworks is the integration of pedagogy with digital tools. Many frameworks, such as the SAMR model and European Pedagogical ICT License (EPICT) (European Schoolnet, 2006), highlight the importance of blending digital tools with pedagogical strategies to enhance teaching and learning meanwhile SAMR model and competency guides like the Digital Teaching Professional Framework (DTPF) illustrate how purposeful technology use can transform learning rather than merely automate existing tasks (Shimalla, 2024; Zulfiani et al., 2025; Education and Training Foundation, 2024). This integration emphasizes the role of technology in supporting diverse learning needs and goals, suggesting that digital literacy should not be viewed as a standalone skill. In this context, the new framework must ensure that teachers are equipped to integrate digital tools seamlessly into their teaching practices. Digital literacy should thus be positioned as an integral component of pedagogy, supporting a variety of instructional approaches while enhancing student engagement and learning outcomes.

Professional development and continuous learning also emerge as central themes in many of the frameworks examined. The rapid pace of technological advancement means that teachers are required to regularly update their skills of adapting practice to new tools and methodologies to remain effective in their teaching (UNESCO, 2023; Education and Training

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Foundation, 2024). Frameworks such as EPICT, AUSPICT, and the Digital Teaching Professional Framework stress the importance of ongoing professional development opportunities that empower teachers to stay current with emerging technologies and pedagogical practices. In developing a new digital literacy framework, it is crucial to prioritize pathways for continuous learning that offer flexibility and access to training, resources, and collaborative opportunities. This will help ensure that teachers are not only proficient in the use of technology but also capable of adapting their practices to align with new digital trends and teaching methodologies.

Furthermore, many frameworks highlight the importance of self-assessment, reflection, and feedback in the development of digital literacy. The Common European Framework the Common European Framework for the Digital Competence of Educators (DigCompEdu), for example, encourage teachers to reflect on their practices and assess their digital competencies regularly. Incorporating mechanisms for self-assessment and feedback into the new framework would empower teachers to evaluate their progress, identify strengths and areas for improvement, and adapt their teaching practices accordingly. By fostering a culture of reflection, the new framework can encourage teachers to continuously refine their digital skills, enhancing both their pedagogical and technical capabilities (UNESCO, 2023).

A notable trend across many frameworks is the emphasis on digital citizenship and ethical technology usage. Frameworks like the DQ Institute's Digital Intelligence (DQ) Framework and the European Digital Competence Framework for Educators (DigCompEdu) underline the importance of fostering responsible digital behaviour, privacy awareness, and an understanding of digital rights. The new framework should prioritize these elements, ensuring that teachers are equipped to model ethical digital behaviours and teach students how to navigate digital spaces responsibly. Emphasizing digital citizenship will help students become critical consumers of technology, making informed decisions about their online interactions while respecting privacy, security, and ethical standards (DQ Institute, 2021; European Commission, 2022).

Customization and flexibility are also integral to effective digital literacy frameworks. Recognizing variations in teachers' digital competence levels, frameworks such as Digi.KomP3.8 provide scalable and adaptable guidelines that accommodate diverse educational contexts and stages of professional development (Kampylis, Punie & Devine, 2021; Federal Ministry of Education, Science and Research Austria, 2022). Collaboration and

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community engagement further reinforce digital literacy development, as emphasized in DigCompEdu and OECD policy perspectives, which advocate professional learning communities and shared practices to enhance collective digital capacity (European Commission, 2022; OECD, 2023).

Collaboration and community engagement are also essential aspects of digital literacy development. Frameworks such as the Common European Framework and DigCompEdu emphasize the value of collaboration within the educational community, encouraging teachers to share knowledge, experiences, and best practices. The new framework should foster a collaborative environment where teachers can engage in professional learning communities, participate in peer learning, and exchange ideas across institutions. This collaborative approach will not only enhance individual professional growth but also help build a collective understanding of how to leverage digital tools effectively in education (European Commission, 2022; OECD, 2023).

Based on the synthesis of trends across existing educational digital literacy frameworks, three frameworks emerge as the most relevant and applicable for future research: the European Digital Competence Framework for Educators (DigCompEdu), UNESCO's ICT Competency Framework for Teachers, and the Digital Intelligence (DQ) Framework by the DQ Institute. DigCompEdu offers a comprehensive and pedagogically aligned structure that not only focuses on technical digital skills but also emphasizes instructional design, learner engagement, and professional collaboration (European Commission, 2022). Its tiered progression model and adaptability across educational contexts make it highly suitable for empirical studies examining differentiated levels of digital competence. Similarly, UNESCO's ICT Competency Framework provides a global standard for aligning digital literacy with broader educational goals such as inclusive education and lifelong learning. It promotes continuous professional development, reflective practice, and integration of digital tools into pedagogy, making it an essential framework for evaluating both teacher preparedness and institutional readiness (UNESCO, 2023).

Complementing these frameworks, the DQ Institute's Digital Intelligence (DQ) Framework introduces an essential ethical dimension to digital literacy, focusing on responsible digital behaviour, privacy awareness, and digital rights. With increasing concerns over data ethics, cybersecurity, and students' online well-being, the DQ Framework provides a forward-looking approach that is particularly relevant in addressing the social and emotional implications of digital engagement in education (DQ Institute, 2021). Taken together, these

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three frameworks represent a balanced and multidimensional understanding of digital literacy that incorporates technical proficiency, pedagogical integration, and ethical responsibility. Their use in future studies will provide a robust foundation for exploring how educators can be empowered to navigate the complexities of digital teaching and learning in an evolving technological landscape.

5.0 CONCLUSION

In conclusion, the formulation of a comprehensive digital literacy framework must be underpinned by a critical synthesis of trends identified in existing educational models. These trends reveal the necessity for a holistically constructed, pedagogically embedded, and dynamically evolving approach to digital literacy that aligns with the multifaceted demands of 21st-century education. Integrating core components such as comprehensive digital competence, ongoing professional development, digital citizenship, contextual adaptability, and collaborative practice ensures the framework's relevance across diverse educational contexts.

By adopting such an integrative model, the framework can function not merely as a prescriptive guide but as a transformative instrument for enhancing teachers' digital capacity and pedagogical effectiveness. Moreover, it offers a foundational structure for embedding critical digital literacies into educational practice, thereby supporting learners in developing the competencies necessary for ethical, responsible, and critical engagement with digital technologies.

This approach situates digital literacy not as an isolated skill set but as a core element of professional teaching standards and educational equity, reinforcing the imperative for systemic, evidence-informed strategies. As digital transformation continues to reshape educational landscapes, the proposed framework stands as a strategic response one that is both theoretically grounded and practically actionable to ensure educators and learners are equipped to navigate and shape the digital future of education.

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