



Digital Literacy in Elementary School Students: A Systematic Analysis of Trends, Challenges, and Learning Implications

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Keywords:	Abstract
digital literacy elementary school systematic literature review digital competence learning technology	Background: Digital literacy has become a crucial competency in primary education along with the development of digital technology. This study aims to analyze development trends, implementation challenges, and implications of digital literacy learning in primary schools for the 2016-2026 period. Method: The study used the Systematic Literature Review (SLR) method with PRISMA 2020 guidelines. A literature search was conducted through the Scopus database and yielded 72 articles during the identification stage. After a selection, screening, and quality assessment process using the QQM Checklist, 17 articles were obtained and analyzed narratively and thematically. Result: The results of the study show three main findings. First, the implementation of digital literacy in primary schools is dominated by the use of innovative technologies such as Augmented Reality, gamification, virtual field trips, stop-motion, and creative videomaking, which have been proven to increase student engagement and digital competence. Second, teachers' digital competence is a key factor in the success of technology integration, but still faces various obstacles such as low pedagogical readiness, gaps in technology access, and limitations in adaptive technology use. Third, the concept of digital literacy is evolving from merely technical skills to critical-reflective, social-emotional, digital health, and digital citizenship dimensions. Implication: This research implies the importance of systematic digital literacy integration in the elementary school curriculum, strengthening contextual and sustainable teacher professional development programs, and inclusive and equitable education digitalization policies. Novelty: Unlike prior reviews that focus on higher education or discuss elementary school technology use only in general terms, this study offers an SLR specifically on elementary digital literacy, jointly mapping trends, challenges, and implications through rigorous quality appraisal (QQM Checklist).

INTRODUCTION

The development of 21st century digital technology has fundamentally changed the landscape and paradigm of education, thus demanding a comprehensive response from all



stakeholders. (Yusuf, 2025). A global bibliometric review of 3,386 Scopus publications (2014-2024) shows a significant surge in digital literacy research in education peaking in 2023. (Sogalrey et al., 2024). This reflects the academic consensus that digital literacy is not just an additional skill, but a fundamental competency for active, critical, and responsible participation in the digital ecosystem.

The concept of digital literacy has evolved significantly beyond mere technical proficiency. Marín & Castañeda, (2023) affirms this concept as an essential competency for self-fulfillment, active citizenship, social inclusion, and meaningful participation in the 21st century, Ilomäki et al., (2023) break it down into technical, cognitive, social-emotional, and critical dimensions including problem solving, information evaluation, and understanding the socio-ethical implications of technology. The absence of a single consensus regarding the definition of digital literacy reflects its dynamic nature along with technological transformation (Marín & Castañeda, 2023).

The urgency of digital literacy at the elementary school level is becoming increasingly unstoppable. Elementary school students are now interacting more intensively with technology through content, games, and competency tests (Wijayanti et al., 2024). School-based digital literacy interventions have been consistently proven to improve media understanding, critical awareness, and student empowerment (Eyal & Te'eni-Harari, 2024), with the greatest impact on effectiveness found at the elementary school level compared to other levels (C. Li et al., 2025). In addition, students' analytical abilities in searching for and evaluating digital information are positively correlated with parental involvement (Haryanto et al., 2022).

The COVID-19 pandemic accelerated global digital literacy momentum as school closures in 180 countries forced 1.6 billion students to switch to distance learning (J. Li et al., 2022). This crisis exposed systemic weaknesses, such as teachers' unpreparedness in managing digital classrooms (Nikolopoulou, 2022) and the gap in access to technology in remote areas of developing countries (Maity et al., 2022). However, this pressure is accelerating learning innovation that continues to develop post-pandemic (Yusuf, 2025), while establishing digital literacy as a fundamental need in basic education.

The implementation of digital literacy in elementary schools faces multidimensional challenges. From the teacher perspective, the main obstacles are limited technological knowledge, unclear curriculum standards, and a lack of relevant training (Pappa et al., 2024); despite teachers being required to master both technical and pedagogical competencies to create meaningful learning (Marín & Castañeda, 2023). In developing countries, these problems are exacerbated by limited infrastructure, technical support, and training time (Magtolol & Oropa, 2025). From a policy perspective, sustainable integration requires a supportive ecosystem involving school leadership, curriculum standards, and stakeholder collaboration (Ilomäki et al., 2023).

Despite the rapid growth of the literature, systematic studies of digital literacy specifically at the elementary school level remain very limited, generally focusing on higher education (Ilomäki et al., 2023). Studies in elementary schools also largely discuss technology use in general, without integrating trends, challenges, and pedagogical implications (Wijayanti et al., 2024). This gap justifies the importance of this Systematic Literature Review (SLR) based on the 2020 PRISMA guidelines, to map trends and comprehensively synthesize challenges and implications as a basis for policy and learning innovation in elementary schools.

METHOD

Research Design

This study uses the Systematic Literature Review (SLR) method guided by the PRISMA 2020 framework (Page et al., 2021) to ensure a systematic, transparent, and replicable

process of identification, selection, evaluation, and synthesis of literature. Aiming to synthesize empirical evidence on digital literacy in elementary schools, this study is guided by three main questions: RQ1: What are the development trends of digital literacy research in elementary schools from 2016 to 2026?; RQ2: What are the challenges of implementing digital literacy at the elementary school level?; RQ3: How are digital literacy research findings implemented in learning practices?

Literature Search Strategy

The literature search used the Watase Uake tool, based on the Scopus database, as the sole source. This selection has limitations due to the potential for missing publications from Web of Science (WoS) and education-specific databases such as ERIC (Education Resources Information Center) and DOAJ (Directory of Open Access Journals). Using keyword combinations such as "digital literacy in elementary schools," "digital literacy primary school," and "digital competence teacher primary school," this initial search process yielded 72 articles.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were applied to ensure the study's relevance to the research focus. Details of these eligibility criteria are presented in Table 1 below:

Table 1. Inclusion and Exclusion Criteria

Aspects	Inclusion Criteria	Exclusion Criteria
Year Range	Articles published in 2016-2026	Articles published before 2016
Publication Type	Scientific journal articles and conference proceedings	Books, technical reports, theses/dissertations, opinions, and editorials
Text Availability	Available in full text version	Full text not available or only abstract available
Topic	Directly related to digital literacy or digital competence in elementary schools	Not relevant to digital literacy or not focused on basic education
Educational level	Focusing on elementary schools, including cross-level studies that include extractable elementary school data	Does not cover elementary school level at all
Research Design	Empirical research: quantitative, qualitative, and mixed-method	Purely theoretical articles, non-systematic reviews, or conceptual essays without empirical data

Selection Process

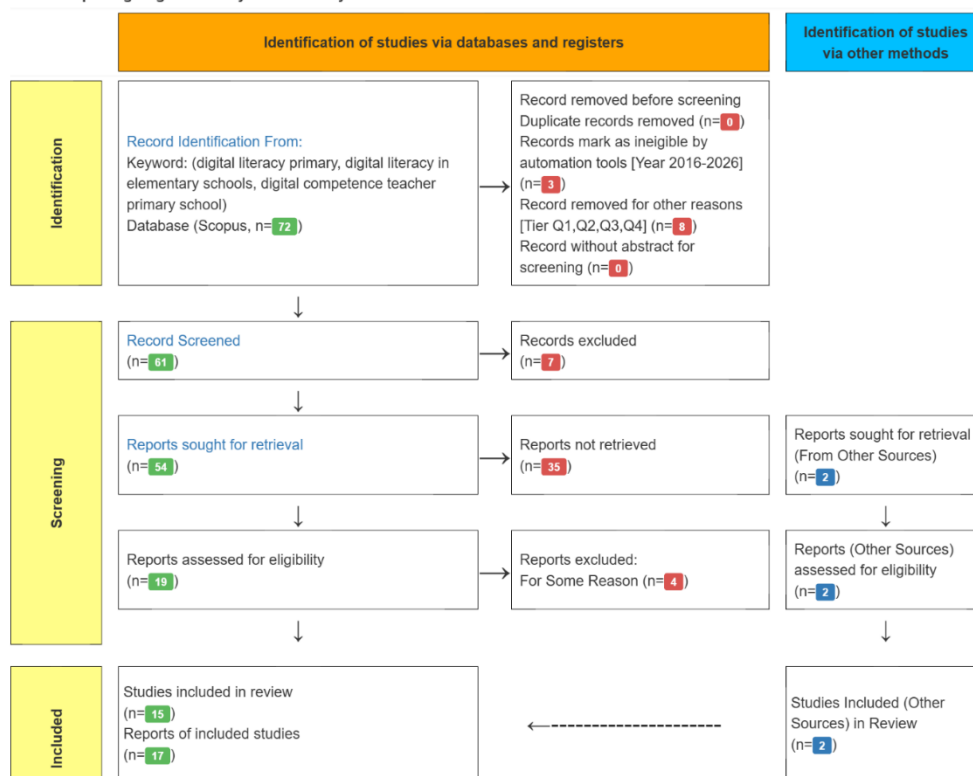
During the identification stage, a search of the Scopus database using the Watase Uake application yielded 72 articles. Prior to initial screening, automated elimination was performed, leaving 61 articles ready for processing. This data cleaning included the removal of articles outside the 2016-2026 period (n=3), the removal of documents outside the Scopus Q1-Q4 ranking (n=8), and the elimination of duplicates (n=0) and articles without abstracts (n=0).

During the screening stage, a review of titles and abstracts excluded 7 irrelevant articles, leaving 54 articles for full-text download. However, due to limited document access, 35 articles could not be fully accessed. Consequently, only 19 articles were successfully selected for further analysis during the eligibility assessment stage.

In addition to Scopus, searches from other sources yielded two additional reports. After undergoing eligibility assessment, both reports were deemed eligible and included in the final review.

The eligibility stage was conducted through an in-depth review of 19 Scopus articles to assess their focus, methodological quality, and contextual relevance. As a result, four articles were excluded due to methodological limitations or not meeting the inclusion criteria. Finally, 15 Scopus articles and two articles from other sources were declared eligible, resulting in a total of 17 articles synthesized. All stages of this selection process are summarized in the PRISMA flowchart in Figure 1:

Prisma Reporting: Digital Literacy In Elementary School



Generate From Watase Uake Tools, based on Prisma 2020 Reporting

Figure 1. Prism Flow Diagram for Literature Search

Data Synthesis

Selected articles were then systematically extracted to capture data on study characteristics, learning contexts, digital literacy approaches, and empirical findings regarding trends, challenges, and implications in elementary schools.

Data synthesis used a narrative-thematic approach to accommodate the diversity of study designs and contexts. Coding and thematic grouping were conducted independently based on the research questions. All stages were documented as an audit trail to ensure transparency, consistency, and traceability of the synthesis process.

Document Appraisal

The quality assessment of studies in this SLR used the Quality Appraisal Checklist for Quantitative, Qualitative, and Mixed-Methods Studies (QQM Checklist) version 2 from Tang et al., (2025) and was first published on PsyArXiv (<https://doi.org/10.1177/20965311251371227>). This tool was chosen because it can assess quantitative, qualitative, and mixed-methods studies within a single, integrated framework. This is highly appropriate for the characteristics of the reviewed corpus of literature, which consists of 17 articles with diverse methodological approaches.

The selection of the QQM Checklist was based on four key considerations: the instrument is specifically designed for social sciences and education, making it more relevant than medical-based tools like the MMAT or JBI; its scoring structure integrates 8 universal indicators as well as method-specific indicators; its three-point scoring system (1=Absent, 2=Partially, 3=Yes) provides more detailed results than a dichotomous yes/no system; and its inclusion of research ethics indicators is crucial given that the majority of the studies reviewed involved elementary school children as participants.

Following the developer's flexibility recommendations (Tang et al., 2025), several adjustments were made to the checklist: first, the cut-off point was set at $\geq 60\%$ as the inclusion threshold to balance the inclusiveness of trend mapping and the credibility of the findings, with quality categorized as High ($\geq 80\%$), Moderate (51–79%), and Low ($\leq 50\%$). Second, the Setting, Ethics, Sample, Validity, and Analysis Method indicators were given priority emphasis in interpretation due to their high relevance to the objectives of this SLR.

Assessment was conducted through an independent, in-depth reading of each article, beginning with determining the type of research method and selecting relevant sections. Each indicator was assessed based on textual evidence using a point system: 3 for complete and clear evidence, 2 for incomplete/unspecific evidence, and 1 for no evidence. The total scores were then summed and converted into percentages by dividing the total score by the maximum score for that study type, then multiplying by 100.

Of the 17 articles reviewed, there were 5 qualitative studies (A1, A12, A16, A17, and some A15), 7 quantitative cross-sectional studies (A3, A5, A7, A8, A11, A13, and A15), and 5 mixed-methods cross-sectional studies (A2, A4, A6, A9, and A14). The scoring instrument was adjusted based on a combination of 8 general indicators and method-specific indicators, with a maximum score of 42 for qualitative (14 indicators), 36 for quantitative (12 indicators), and 54 for mixed-methods (18 indicators).

RESULT

Study Quality Assessment Results

Table 2. Summary of Study Quality Assessment

No.	Author & Year	Method	Score	Max.	%	Year	Country	Category
A1	(Delacruz, 2019)	Qualitative	29	42	69%	2019	USA	Moderate
A2	(Hyman et al., 2020)	Mixed-Methods	51	60	85%	2020	Canada	High
A3	(Hadad et al., 2023)	Quantitative	31	36	86%	2023	Israel	High
A4	(Sun et al., 2017)	Mixed-Methods	34	54	63%	2017	Taiwan	Moderate
A5	(Pérez Escoda & Rodríguez Conde, 2016)	Quantitative	24	36	67%	2016	Spain	Moderate
A6	(Choi et al., 2025)	Mixed-Methods	43	54	80%	2025	South Korea	High
A7	(Rojo-Ramos et al., 2020)	Quantitative	24	36	67%	2020	Spain	Moderate
A8	(W. Li et al., 2021)	Quantitative	34	36	94%	2021	China	High
A9	(Robles Moral & Fernández Díaz, 2021)	Mixed-Methods	33	54	61%	2021	Spain	Moderate
A10	(Shi et al., 2023)	Mixed-Methods	35	54	65%	2023	China	Moderate
A11	(Y. Li et al., 2025)	Quantitative	27	36	75%	2025	China	Moderate
A12	(Ricoy & Sánchez-Martínez, 2022)	Qualitative	32	42	76%	2022	Spain	Moderate
A13	(Rangnow et al., 2024)	Quantitative	36	36	100%	2024	Germany	High
A14	(Nevrelova et al., 2024)	Mixed-Methods	39	54	72%	2024	Ceko/Slovakia/Austria	Moderate
A15	(C. Wang et al., 2024)	Quantitative	33	36	92%	2023	New Zealand	High
A16	(Beaumont, 2025)	Qualitative	37	42	88%	2025	Australia	High
A17	(Hoelscher, 2024)	Qualitative	20	42	48%	2024	USA	Low

The results of a study of 17 articles using the QQM Checklist (Tang et al., 2025), showed an average quality score of 76%, which is in the Moderate category. The quality distribution

shows that 7 articles (41%) are categorized as High ($\geq 80\%$), 9 articles (53%) are categorized as Moderate (51-79%), and 1 article (6%) is categorized as Low ($\leq 50\%$).

The corpus of 17 articles reviewed exhibited diverse methodological quality with an average QQM score of 76% (Medium category), reflecting the varied contexts across 8 countries, various research methods, and the publication period of 2016-2025. All articles were included in the SLR synthesis because they exceeded the inclusion threshold of $\geq 50\%$ (Note: There is a data inconsistency in your original draft, which listed the inclusion threshold as $\geq 50\%$, whereas the previous paragraph set it at $\geq 60\%$). In the synthesis narrative, findings from High category articles (A2, A8, A13, A15, A16) will be given greater weight, particularly for claims related to pedagogical implications that require a strong methodological evidence base.

Key Findings of the Study

The findings from 17 articles regarding development trends, implementation challenges, and implications of digital literacy learning in elementary schools are presented briefly in Table 3:

Table 3. Key Findings

Author/Year	Title	Key Findings
(Delacruz, 2019)	Building Digital Literacy Bridges: Connecting Cultures and Promoting Global Citizenship in Elementary Classrooms through School-Based Virtual Field Trips	VFT effectively promotes global citizenship and expands digital vocabulary. Four dimensions of multiliteracies were successfully integrated. Students were motivated to share cultures across schools.
(Hyman et al., 2020)	Testing a school-based program to promote digital health literacy and healthy lifestyle behaviours in intermediate elementary students: The Learning for Life program	DHL increased significantly post-intervention ($p=0.009$) but declined at 2-month follow-up. 97% of students accessed the internet without supervision. Effective short-term, but not sustained.
(Hadad et al., 2023)	Cultural background in digital literacy of elementary and middle school students: Self-appraisal versus actual performance	Large gap between self-appraisal (high) and actual performance (very low: 1.49/5 and 0.23/5). High-context cultural background influences literacy patterns. Intensity of technology use does not automatically improve literacy.
(Sun et al., 2017)	Stop-motion to foster digital literacy in Elementary School	Kolb-based stop-motion filmmaking significantly improved digital concept understanding. Production-based approaches are more effective than passive instruction. Exam orientation in Taiwan is a major obstacle.
(Pérez Escoda & Rodríguez Conde, 2016)	Evaluación de las competencias digitales autopercibidas del profesorado de Educación Primaria en Castilla y León (España)	Elementary school teachers have low self-perception of pedagogical digital competence. Basic technical skills are better than pedagogical competencies. Pedagogically-focused digital training is urgently needed.
(Choi et al., 2025)	AI and Digital Literacy Training Support Strategies for Elementary School Teachers in South Korea: Insights from Needs Analysis and Delphi Survey	Korean elementary school teachers are not ready to integrate AI despite national policies. Disparities based on gender, experience, and educational background. Delphi produced a 3-tier training system; specialized AI/DL curriculum is needed.
(Rojo-Ramos et al., 2020)	Study of the Digital Teaching Competence of Physical Education	The majority of elementary PE teachers are at A2 (basic) level despite actively using technology personally. Large gap between personal and

Author/Year	Title	Key Findings
	Teachers in Primary Schools in One Region of Spain	professional-pedagogical digital literacy. Age and experience do not correlate significantly.
(W. Li et al., 2021)	A Moderated Mediation Model of the Relationship Between Primary and Secondary School Teachers' Digital Competence and Online Teaching Behavior	Teachers' digital competence influences online teaching behavior indirectly, mediated by intention to use. Perception of student learning difficulty moderates this relationship negatively. Supports TPACK + TAM integration.
(Robles Moral & Fernández Díaz, 2021)	Future Primary School Teachers' Digital Competence in Teaching Science through the Use of Social Media	Pre-service teachers were unfamiliar with using social media for pedagogical purposes. After Instagram and Pinterest-based intervention, perception of pedagogical potential changed significantly.
(Shi et al., 2023)	The Implementation Mechanism and Effectiveness of a National Plan of a Digital Competence Training Program for Chinese Primary and Secondary School Teachers	DCTP program implemented in 4 stages. Public institutions more effective than private. Infrastructure barriers in remote areas and low teacher motivation are the main obstacles.
(Y. Li et al., 2025)	The Path From Digital Competence to Adaptive Use: An Empirical Analysis of 9,726 Primary and Secondary School Teachers	Digital competence does not directly yield adaptive use. Three transformation pathways identified; the ECN-DTS-PU-TAI-AU pathway is the longest but strongest. Contextual norms and perceived usefulness are crucial mediators.
(Ricoy & Sánchez-Martínez, 2022)	Raising Ecological Awareness and Digital Literacy in Primary School Children through Gamification	Gamification and tablets improved students' digital literacy and ecological awareness. Learning motivation increased significantly. Families reported sustained behavioral changes at home.
(Rangnow et al., 2024)	Digital health literacy among primary and secondary school teachers-a quantitative study	Teachers' DHL is varied; protecting privacy was the lowest subscale (>50% difficulty). Operational and navigation skills are relatively high. No significant differences based on gender.
(Nevrelova et al., 2024)	Enhancing digital literacy in primary education through augmented reality	AR via Quiver app creates an immersive learning environment and motivates students. Grade 1 students were more enthusiastic than Grade 6. Without strong pedagogical guidance, AR activities tend to shift toward play.
(S. Wang et al., 2023)	Opportunities to learn literacy in digital classrooms in New Zealand primary schools: Does class achievement level make a difference?	Low-achieving classes received less autonomy and drill tasks, while high-achieving classes received creative tasks. This OTL inequality worsens the existing gap cycle.
(Beaumont, 2025)	Creative Videomaking in Diverse Primary Classrooms: Using Drama and Technology to Enhance Oral and Digital Literacy	Videomaking facilitates multifaceted literacy and inclusion. SEND and EAL/D students showed increased engagement and self-confidence. Creativity stimulates critical thinking and identity development.
(Hoelscher, 2024)	Digital primary source literacy: Developing skills for online archival research	Three key competencies: locating/accessing, critical evaluation, and integrating primary sources. In the era of AI and deep fakes, critical evaluation of digital primary sources is increasingly crucial. Google search alone is insufficient.

Trends in Digital Literacy Research Development in Elementary Schools (2016-2026)

Digital literacy research trends in elementary schools (2016-2026) are mapped into two main themes out of a total of five. First, there is a shift from a focus on technical-operational skills (Pérez Escoda & Rodríguez Conde, 2016) towards holistic critical-reflective competencies that integrate collaboration, communication, and global citizenship (Delacruz, 2019), where Hadad et al., (2023) revealed the gap in students' real abilities and Hoelscher, (2024) emphasized the importance of critical evaluation in the AI/deep fake era. Second, experiential and creative approaches are developing, ranging from stop-motion filmmaking (Sun et al., 2017) ICT-based gamification for motivation and problem solving (Ricoy & Sánchez-Martínez, 2022) to creative videomaking that supports creativity, inclusion, and student identity (Beaumont, (2025).

Third, new technologies are present as a medium for digital literacy, including virtual field trips (Delacruz, 2019), augmented reality via Quiver (Nevrelova et al., 2024), to artificial intelligence as a new literacy domain (Choi et al., 2025). Fourth, strengthening teachers' digital competence has consistently become a global strategic focus (Choi et al., 2025; Y. Li et al., 2025; Pérez Escoda & Rodríguez Conde, 2016; Rojo-Ramos et al., 2020; Shi et al., 2023). Fifth, the scope of digital literacy extends to specific domains such as digital health literacy (Hyman et al., 2020; Rangnow et al., 2024) and digital primary source literacy (Hoelscher, 2024). Temporally, the research surge in 2020-2025 reflects the acceleration of academic attention post-COVID-19 pandemic.

Challenges of Implementing Digital Literacy in Elementary Schools

The challenges of implementing digital literacy in elementary schools are mapped into four clusters, with the first two clusters as follows. First, teachers' limited digital pedagogical competence is the most consistent challenge (Pérez Escoda & Rodríguez Conde, 2016), coupled with low motivation due to a lack of connection to professional benefits (Rojo-Ramos et al., 2020), requiring specific training, including in AI (Shi et al., 2023; Choi et al., 2025). Second, there is a competency gap in students, where their self-perception is high but their actual abilities are low, and there is limited technological autonomy for students in low-achieving classes, which exacerbates the digital literacy gap (S. Wang et al., 2023). Third, infrastructure and system barriers include the vulnerable use of augmented reality without pedagogical guidance (Nevrelova et al., 2024), technical constraints and preparation time for creative videomaking (Beaumont, 2025), and the impact of interventions that are not sustainable without a sustainable program (Hyman et al., 2020). Meanwhile, conceptual challenges arise from the reduction of digital literacy to merely technical skills due to exam orientation (Sun et al., 2017). This factor means that high teacher digital competence does not automatically result in innovative learning without the support of norms and perceptions of the usefulness of technology (Y. Li et al., 2025).

Implications of Digital Literacy Research Findings for Learning Practices

The analysis of 17 articles yielded two main initial implications. First, the curriculum should be reoriented from a technical approach to a critical-reflective one, requiring students to develop metacognitive awareness (Hadad et al., 2023), strengthening bias evaluation competencies in the era of AI-generated content (Hoelscher, 2024), and implementing an experiential approach based on content production, which is more effective than passive learning (Sun et al., 2017). Second, the role of teachers should shift to that of critical literacy facilitators, given that their digital competencies influence online teaching behavior through their intention to use online teaching (W. Li et al., 2021). This transformation ultimately requires support for intrinsic motivation, contextual norms, and perceived usefulness of technology (Y. Li et al., 2025).



Third, creativity- and production-based learning designs most effectively integrate digital literacy, such as through creative videomaking, which builds inclusion and positive student identities (Beaumont, 2025), or tablet gamification, which enhances material mastery (Ricoy & Sánchez-Martínez, 2022). Fourth, inclusive and differentiated approaches must be strengthened because students in low-achieving classes often receive less digital autonomy (S. Wang et al., 2023), and programs must be more culturally sensitive (Hadad et al., 2023). Fifth, cross-domain integration is an urgent need that includes digital health literacy in elementary schools (Hyman et al., 2020), teacher professional development (Rangnow et al., 2024), and a policy framework in the form of layered training, regional support, and competency certification (Choi et al., 2025).

DISCUSSION

Thematic synthesis findings show a dominant trend in the implementation of digital literacy in elementary schools (2016-2026) through the use of innovative technologies based on experiential and creative approaches such as virtual field trips (Delacruz, 2019), stop-motion (Sun et al., 2017), ICT gamification (Ricoy & Sánchez-Martínez, 2022), Augmented Reality (Nevrelova et al., 2024), and creative videomaking that support inclusion and student confidence (Beaumont, 2025). The highest effectiveness of school-based interventions at the elementary school level is confirmed by the meta-analysis of (C. Li et al., 2025), while also marking a shift in focus from consumption-based to production-based literacy. In Indonesia, the potential of this technology in increasing learning engagement and numeracy literacy has been seen by (Suwarto et al., 2022; Kamba et al., 2024; dan Laila et al., 2025), although its implementation is still hampered by teachers' competency and pedagogical readiness (Diyaurrehman et al., 2025). Globally, the focus of digital literacy has now shifted from merely technical skills to collaborative, critical, and ethical competencies (Bueno-Baquero et al., 2026; Ilomäki et al., 2023; C. Wang et al., 2024).

The second trend is strengthening teachers' digital competencies as a determinant of successful technology integration. Cross-national studies consistently demonstrate the influence of these competencies on the quality of technology-based learning (Beaumont, 2025; Choi et al., 2025; Y. Li et al., 2025; Pérez Escoda & Rodríguez Conde, 2016; Rojo-Ramos et al., 2020; Shi et al., 2023). However, teachers are often still unprepared to integrate AI (Choi et al., 2025), and digital competency alone has been shown to be insufficient without the support of motivation, perceived usefulness, and institutional norms (Y. Li et al., 2025). Curriculum constraints and exam pressures also limit innovation in the classroom (Zhang et al., 2026), so teacher professional development is now urgently needed to include pedagogical, social, and attitudinal dimensions in digital spaces (Robles Moral & Fernández Díaz, 2021; Marín & Castañeda, 2023).

The third trend is the expansion of the scope of digital literacy beyond technical skills, including digital health literacy (Hyman et al., 2020; Rangnow et al., 2024), critical evaluation of digital sources and deep fakes (Hoelscher, 2024), , cultural-digital literacy that is sensitive to students' backgrounds (Hadad et al., 2023), and its relationship to self-efficacy and informal digital learning (Zakir et al., 2025). The gap between students' perceptions and actual abilities (Hadad et al., 2023) emphasizes the need for digital literacy to be taught explicitly through strengthening metacognitive awareness. The bibliometric study of (Bueno-Baquero et al., 2026) further confirms the shift in research direction towards digital citizenship and mental and emotional aspects.

The implementation of technology-based strategies still faces multidimensional challenges: the digital learning gap for low-achieving students (S. Wang et al., 2023) infrastructure barriers and socioeconomic disparities (Shi et al., 2023; Maity et al., 2022; Pierce & Cleary, 2024) and teachers' pedagogical unpreparedness for integrating AI and

online learning (Choi et al., 2025; W. Li et al., 2021). Even high digital competence does not necessarily lead to innovation without the support of an institutional context (Y. Li et al., 2025) therefore, professional development needs to integrate hands-on practice, pedagogical reflection, and professional learning communities (Amemasor et al., 2025).

These findings lead to three policy implications. First, digital literacy needs to be systematically integrated into the curriculum across subjects not as a separate program by encompassing information, communication, creativity, security, and problem-solving competencies from elementary school, according to the DigComp 2.1 framework (Hyman et al., 2020; Ricoy & Sánchez-Martínez, 2022; Amemasor et al., 2025). Second, teacher professional development must be contextual and encompass technical, pedagogical, and ethical dimensions (Choi et al., 2025; Shi et al., 2023). Third, school digitalization policies need to ensure inclusivity so that all students, including marginalized groups and those with special needs, receive equal digital learning opportunities (Beaumont, 2025; Pierce & Cleary, 2024; S. Wang et al., 2023).

CONCLUSION

A systematic review of 17 articles from 2016-2026 yielded three key findings. First, the implementation of digital literacy in elementary schools is characterized by three dominant trends: the use of innovative technologies (AR, gamification, stop-motion, virtual field trips, creative videomaking) proven to increase student engagement and digital competence; strengthening teachers' digital competence as a determining factor for successful technology integration; and expanding the concept of digital literacy from technical skills to cognitive, socio-emotional, digital health, and critical literacy dimensions. Second, implementation remains hampered by structural challenges in the form of gaps in access and infrastructure, low teacher pedagogical readiness, and the gap between digital competence and its adaptive-innovative use, exacerbated by cultural and socio-economic factors that create digital literacy disparities between student groups. Third, the transformation of digital literacy in elementary schools requires simultaneous changes at three levels: micro (active, creative, production-based, and inclusive learning), meso (contextual, sustainable, and community-based teacher professional development), and macro (integrated curriculum and policies oriented towards critical-reflective competence).

Limitation and Future Study

A systematic review of 17 articles yielded three key findings. First, three dominant trends characterize the implementation of digital literacy in elementary schools: innovative technologies (AR, gamification, stop-motion, virtual field trips, creative videomaking) have been shown to increase student engagement and digital competence; teachers' digital competence is a determining factor in the success of technology integration; and the concept of digital literacy expands from technical skills to cognitive, socio-emotional, digital health, and critical literacy dimensions. Second, implementation is hampered by gaps in access to infrastructure, low teacher pedagogical readiness, and the gap between digital competence and its innovative application, which is exacerbated by cultural and socio-economic factors. Third, although a systematic quality assessment using the QQM Checklist was conducted, one article (Hoelscher, 2024) was included despite falling below the methodological quality threshold due to its significant conceptual contribution. Furthermore, the assessment process was conducted without formal inter-rater reliability, thus potentially exposing the researcher to subjective bias.

Implication / suggestions (implikasi / Saran)

On that basis, this study recommends the integration of digital literacy across subjects based on the DigComp 2.1 framework, teacher professional development based on field



needs through LPTK-school collaboration, and digitalization policies that ensure inclusivity and digital balance for all students.

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