The Role of Digital Literacy as Essential Skill of 21st Century in Elementary School

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Abstract: This study aims to describe the importance of digital literacy in elementary school learning as a 21st-century skill, which is essential to prepare students to face global challenges. The method used is a qualitative descriptive literature study based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Data were obtained from the Scopus database with the keywords "Digital Literacy in Elementary School" and "21st Century Learning in Elementary School". Of the 489 articles found, after a rigorous selection process (2020–2025), 54 articles were obtained that met the inclusion criteria and were analyzed using thematic analysis. The results of the study synthesis show four main categories: (1) students' understanding of digital literacy is still low in the aspects of critical thinking and digital ethics; (2) teacher competency needs to be improved through training and technological support; (3) digital media integration (STEAM, e-comics, educational games) has proven effective; and (4) the digital divide and infrastructure are the main challenges to implementation. This study argues that digital literacy requires a 4-Pillar Collaborative Model between the government, schools, teachers, and parents to strengthen policies and ensure equitable access. Digital literacy in elementary schools should be viewed as a fundamental competency for developing a critical, creative, and character-driven generation.

Keywords : 21st century skills; digital literacy; elementary school; PRISMA; Scopus

Introduction

The development of 21st-century digital technology demands transformation in the world of education, especially in elementary schools. Literacy is no longer limited to reading and writing skills but also encompasses digital awareness, ethics, culture, and security (Nugraha, 2022). Digital literacy is even considered an essential competency of the 21st century because it can equip students to think critically, creatively, communicatively, collaboratively, and responsibly in facing the challenges of the Industry 4.0 and Society 5.0 eras (Sargiyo, 2024; Peea et al., 2024).

Despite its immense potential, digital literacy implementation in schools has not been optimal. Research shows that digital literacy skills can help students understand their digital footprint, manage account security, and appropriately sort the information they share (Yustisia et al., 2023). However, in reality, many students still lack these skills, putting them at risk of exposure to negative content and technology misuse.

Internally, teacher competency also remains a challenge. Several studies have found that teachers' mastery of digital learning media is uneven, resulting in limited technology integration in the classroom (Hamdi et al., 2022; Ningsi et al., 2024). This situation is exacerbated by the digital divide between urban and rural schools, where infrastructure and internet access are highly disparate (Pahrijal & Novitasari, 2023). If we fail to address this issue, the quality gap in education will continue to widen.

Furthermore, although families play a crucial role in supporting children's digital media use, the practice is still limited to monitoring mobile phone and social media use without providing in-depth digital ethics education (Azka Muhammad Razaka & Santi Indra Astuti, 2023). Without adequate guidance, children are at risk of device addiction, cyberbullying, and even personal data security issues.

Several studies also emphasize the importance of utilizing digital learning platforms, such as Belajar.id accounts, Canva, Scratch, and educational games, to support students' digital skills (Mulyati et al., 2024); (Widaningsih et al., 2023); (Musviro et al., 2025). Meanwhile, improving teacher competency through digital application training has proven effective in strengthening professionalism and the quality of learning (Suryandari et al., 2023; Kurnia et al., 2024). However, these efforts are not evenly distributed across all elementary schools.

Therefore, the integration of digital literacy in elementary schools requires collaboration between the government, schools, teachers, and parents in providing facilities, strengthening policies, and conducting ongoing training so that digital literacy can truly support the formation of critical, creative, and responsible character in students (Wahyudi & Suwandana, 2022); (Prasetyo et al., 2024); (Gasque, 2025).
Although the urgency of digital literacy has been recognized globally and numerous studies have identified partial barriers (such as lack of infrastructure or the need for teacher training), there has been no comprehensive systematic review and synthesis that holistically analyzes its three key dimensions—challenges to students' critical and ethical understanding, constraints to teachers' pedagogical competence, and the

effectiveness of innovative digital media integration—in the current primary school context (2020–2025). This gap in synthesis has the potential to result in fragmented policy solutions. Therefore, this article aims to describe and synthesize the role of digital literacy as an essential 21st-century skill in primary schools, while also proposing an integrated conceptual model to address its implementation challenges.

Method

Search Strategy

This research employed a systematic review approach combined with thematic analysis. This approach was used to identify patterns, themes, and trends in research related to digital literacy in elementary school students published between **2020** and 2025. The use of thematic analysis enabled researchers to synthesize various research findings in depth, resulting in a comprehensive understanding of the issues studied.

The main database used is Scopus and analyzed through Mendeley, because it provides a variety of relevant scientific publications in the fields of education, digital literacy, and 21st-century skills.

Article searches were conducted using the following keyword combinations:

1. “Digital Literacy in Elementary Schools”
2. “21st Century Learning in Elementary Schools”

Inclusion criteria

Selected articles based on criteria :

1. Rise between 2020 to 2025;
2. Focus on elementary school students or teachers;
3. Discussing digital literacy, digital skills, digital media, or learning technology integration;
4. In the form of empirical research or theoretical studies in reputable journals;
5. Accessible in full version.

Exclusion criteria

Articles are issued if:

1. Focus on secondary or college education;
2. Have no empirical data ;
3. Is proceedings , non- scientific reports , or opinion ;
4. Duplicate from other sources .

Analysis: Thematic Analysis

Thematic Analysis refers to the six steps by Braun & Clarke (2006):

1. Familiarization: the researcher reads the entire article in depth.
2. Initial Coding: marking the main concepts, namely “teacher readiness”, “information evaluation”, “effective digital media”.
3. Theme Search: codes are combined into thematic categories.
4. Theme Review: themes are reviewed for consistency and relevance.

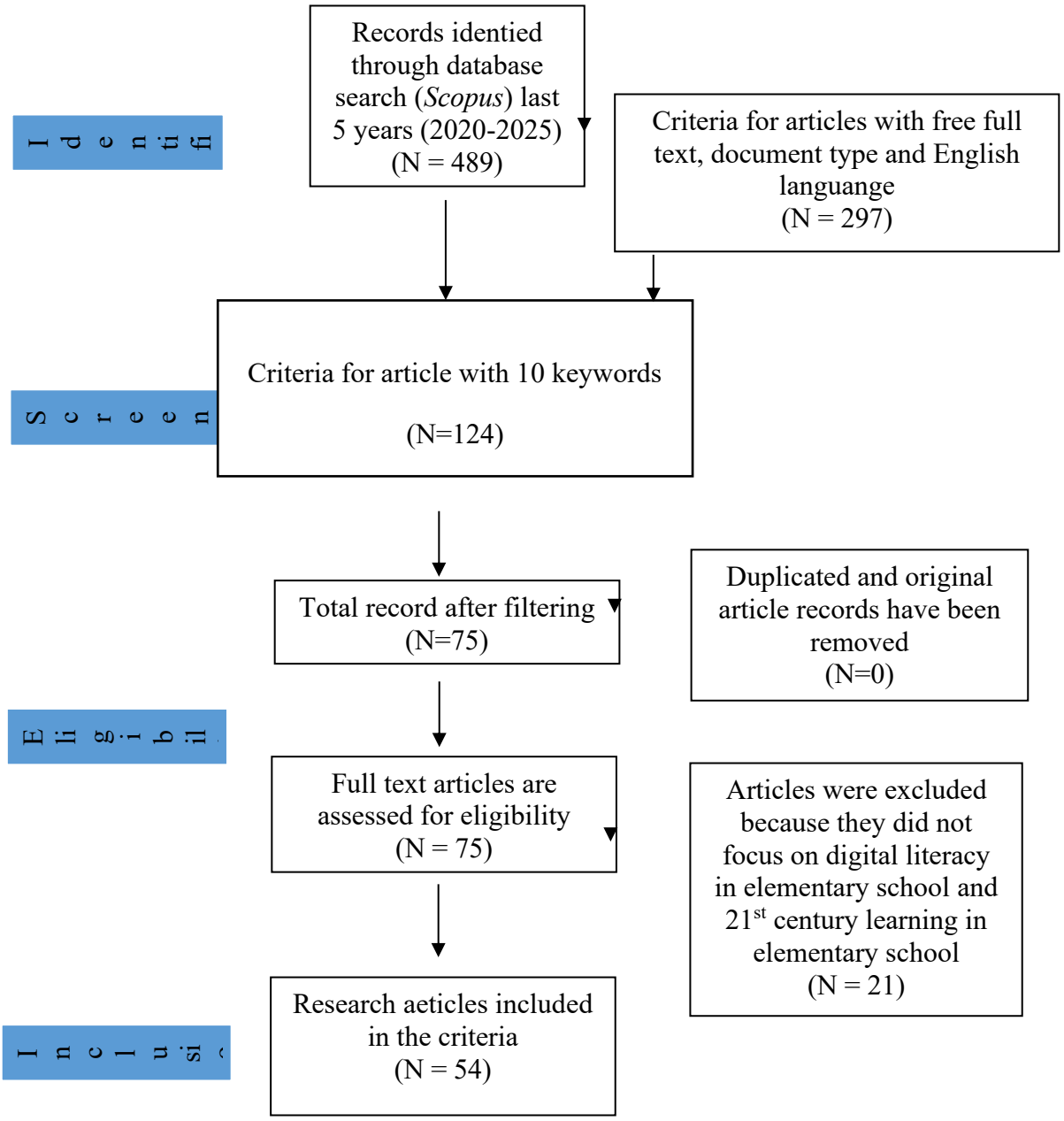
5. Naming of Themes: four final themes were formulated.
6. Report Preparation: findings are presented in the results and discussion sections.

Article Selection Procedure

Stage selection follows the **PRISMA** (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guide. The article search was adjusted to the keywords "Digital Literacy in Elementary Schools and 21st Century Learning in Elementary Schools" through the Scopus database. From the Scopus database search, several filters were used to determine the relevance and accuracy of this article. In the first filter, which looked at the last 5 years, namely 2020 to 2025, the first keyword obtained 279 articles and the second keyword obtained 210 articles, so that the total was 489 articles. After that, it was filtered again by looking at the type of document and the full text, with the first keyword obtaining 190 articles and the second keyword obtaining 126 articles. Then, looking at the language, namely English, the first keyword obtained 173 articles, and the second keyword obtained 124 articles. Looking at 10 relevant keywords, the first keyword obtained 86 articles, and the second keyword obtained 38 articles. In the next stage, the search was further narrowed down using open access, with the first keyword yielding 51 articles and the second keyword yielding 24 articles. Thus, the total of these two keywords yielded 75 articles. Furthermore, the total records were filtered after filtering, resulting in 75 articles. No duplications were found, so all articles were retained. Then, the 75 full-text articles were further assessed for eligibility. Of these, 21 articles were eliminated because they did not focus on digital literacy in elementary schools and 21st-century learning in elementary schools. Ultimately, 54 articles met the inclusion criteria and were used in the literature review. These articles were then analyzed using a thematic analysis approach. The process involved open coding and axial coding of the full content of each article to identify recurring themes, concepts, and patterns related to the implementation, challenges, and outcomes of digital literacy in elementary schools. This synthesis of findings led to the grouping of the study results into four main categories, which are discussed in the results and discussion section.

For more details, the following PRISMA diagram will be shown in Table 1.

Table 1. PRISMA Diagram of Literature Review



Based on a study of the categories of methods and types of research from the 54 studies analyzed, the following picture was obtained:

1. **Experimental and Quasi-Experimental Research:** There are 25 articles that use experimental or quasi-experimental designs, most of which involve

elementary school students as samples to test the effectiveness of digital learning media or strategies. These articles include: (Susanta et al., 2025), (Gellen et al., 2025), (Liang et al., 2024), (Listyaningrum et al., 2025), (Wangid et al., 2021), (Wilkes et al., 2020), (Dewi et al., 2025), (Wen & Walters, 2022), (Dharma et al., 2025), (Dwidarti et al., 2025), (Wijayanti et al., 2025), (Rahardjo et al., 2025), (Hamimah et al., 2020), (Adiansha et al., 2025), (Li et al., 2023), (Bayu et al., 2023), (Vourletsis & Politis, 2022), (Septinaningrum et al., 2022), (Istiq'faroh et al., 2020), (Chevalier et al., 2022), (Korosidou & Griva, 2024), (Laakso et al., 2021), (Pasani & Amelia, 2025), (Alenezi & Alfaleh, 2024), (Macaruso et al., 2020), and (Yarmini et al., 2025). The instruments used are generally in the form of tests/pre-post tests to measure literacy, reading, writing, critical thinking, problem solving, and observation skills and projects to evaluate collaboration, character, and creativity. Digital products such as modules, digital story media, e-comics, AR, and educational games are the main intervention media.

2. **Survey/Quantitative Research** : Twenty-one articles used a survey or quantitative approach. The research involved teachers, students, schools, or elementary school children as samples. These articles include: (Castro et al., 2025), (Ma'rufah Rohmanurmeta et al., 2024), (Jung et al., 2024), (Monjelat et al., 2020), (Souza & Prates, 2024), (Talreja & Agashe, 2024), (Mazman Akar & Özer, 2025), (Rundel & Salemink, 2021), (Zainil et al., 2024), (Chiner et al., 2025), (Purnama et al., 2021), (Gavin, 2021), (León et al., 2022), (Stošić et al., 2024), (Kapitány-Fövény et al., 2022), (Suwarto et al., 2022), (Septiari et al., 2025), (Hadad et al., 2023), (Ma et al., 2024), (Ramos et al., 2023), and (Tongli et al., 2024)) . The main instrument was a questionnaire/survey questionnaire to measure digital literacy, teacher perceptions, learning motivation, online risks, and children's psychological well-being. Some studies also used observation, interviews, or statistical data as supporting instruments.
3. **Qualitative Research:** Five articles used a qualitative approach to explore the phenomenon of digital literacy and teachers' adaptation to technology, including: (Krueger, 2022), (Seong & So, 2024), (Pflaumer et al., 2021), (Hungerford-Kresser et al., 2023) (case studies), and (Jung et al., 2024) (combined survey & case study). Research instruments included interviews, observations, content studies, and examples of student inquiry research. Qualitative research emphasized in-depth understanding of digital media use, digital literacy, and pedagogical challenges.
4. **Longitudinal Research**: One article, (Lazonder et al., 2020), used a longitudinal design to examine the development of elementary school children's digital literacy skills over three years. The instruments used were literacy tests and observations of student development.

5. **Literature Review:** One article (Go et al., 2025)is a literature review examining trends in digital divide research. This study does not use a sample but rather examines articles and strategies for reducing the digital divide.

Overall, the most commonly used instruments are pre-post tests/tests, questionnaires/surveys, observations, and interviews. Experimental research generally uses digital media such as modules, e-comics, AR, and educational games as intervention tools, while survey research emphasizes measuring perceptions, digital literacy, motivation, and online risks. Qualitative and longitudinal research provides in-depth insights into digital literacy practices, critical thinking skills, problem-solving, and teachers' adaptation to technology.

Table 2. Literature Review: 54 Digital Literacy Research Articles in Elementary School

No.	Category	Title and Author (Year)	Research purposes	Method / Sample	Instrument Study	Key Results
1	Understand Ding Elementary School Digital Literacy	Sorting Out Information Users: A Qualitative Analysis of Student Questions (Krueger, 2022)	Evaluate the importance of evaluating information sources and integrating media & research skills.	Qualitative; analysis of research content, standards, and theoretical perspective s tives ; confirmed with example study investigation student	Content analysis & student inquiry research examples	Integration of essential digital literacy skills across the curriculum
2	Understand Ding Elementary School Digital Literacy	Linked (Seong & So, 2024)	Examining the use of hyperlinke d online resources by elementary school students to address	Case study / 3 6th grade Korean elementary school students	Post-reading observatio n & interview session	Effective use of online resources helps students overcome learning difficulties.

			learning difficulties.			
3	Elementary School Teacher Competencies cities	Identifying Challenges and Opportunities Perceived by Rural Elementary School Teachers in Integrating Artificial Intelligence into Teaching Practices (Castro et al., 2025)	Assessing rural teachers' views on AI	Survey / Rural teachers	Questionnaire & interview	Teachers see AI as an opportunity bond, but requires training and resources
4	Elementary School Teacher Competencies cities	Digital technology literacy profile of prospective elementary school teacher students (Ma'rufah Rohmanurmeta et al., 2024)	Assessing the digital literacy of prospective elementary school teachers	Survey / Prospective Elementary School Teachers	Digital literacy test & questionnaire	The digital literacy of prospective teachers is still low and needs to be improved. government
5	Elementary School Teacher Competencies cities	Improving Digital Literacy of Prospective Elementary School Teachers Through the Digital-Based RADEC	Testing effectiveness advantages of the RADEC digital learning model	Experimental / Prospect primary school teachers	Digital literacy test before & after	RADEC effectively improves digital literacy of prospective teachers

		Learning Model (Maspiroh et al., 2025)				
6	Elementary School Teacher Competencies Cities	Implementation of adaptive literacy games in German primary school classrooms (Pflaumer et al., 2021)	Understanding teacher adaptation to technology and its barriers	Qualitative study / Elementary school teachers	Interview & observation	Teachers face technical & pedagogical barriers in adapting technology
7	Elementary School Teacher Competencies Cities	Exploring Teachers' Digital Literacy Experiences (Jung et al., 2024)	Analysis of Elementary School Teachers' Digital Literacy Problems and Their Development plan development	Survey & case study / Elementary School Teachers	Questionnaire & interview	Teachers need a systematic digital literacy development strategy
8	Elementary School Teacher Competencies Cities	Understanding and practicing with TIC: instrumentalism or completion? A studio with the maestro de primaria argentinos (Monjelat et al., 2020)	Identifying elementary school teachers' ICT knowledge and practices	Survey / Elementary School Teachers	Questionnaire & Observation	Levels of ICT knowledge and practice vary among teachers.

9	Elementary School Teacher Competencies Cities	Identifying Challenges for Elementary School Teachers in Building Digital Games through Workshops (Souza & Prates, 2024)	The role of elementary school teachers' digital literacy in distance learning	Survey / Elementary School Teachers	Questionnaire & interview	Teachers' digital literacy plays a vital role in the success of online learning.
10	SD Technology Integration	Literacy skills through the use of digital STEAM-inquiry learning modules: A comparative study of urban and rural elementary schools in Indonesia (Susanta et al., 2025)	Effective the use of the STEAMIL digital module for mathematical literacy	Experiment / Elementary School Students	Mathematical literacy test	STEAMIL digital modules are more effective than conventional methods
11	SD Technology Integration	Methodological approach to evaluating the DreamBox Reading Plus intervention: a cluster randomized trial (Gellen et al., 2025)	DreamBox Reading Plus to improve reading skills	Experiment / Elementary School Students	Reading & observation test	DreamBox Reading Plus improves elementary school students' reading skills

12	SD Technology Integration	Transition from Paper to Touch Interface : Testing Phoneme-Grapheme Recognition and Gamification in an Elementary School Classroom (Liang et al., 2024)	Compare the test results of touch and paper-based interfaces.	Experiment / Elementary School Students	Digital & paper tests	different outcomes , important for modern evaluation.
13	SD Technology Integration	Realistic Mathematics Education in Elementary Schools in the Digital Era: A Systematic Literature Review (Listyaningrum et al., 2025)	RME with digital media for higher level thinking	Experiment / Elementary School Students	Test of higher level thinking & observation	RME digital media improves mathematical literacy and critical thinking
14	SD Technology Integration	Digital Learning-Based Science-Mathematics Stories: Digital Literacy Innovation in Improving Problem-Solving Skills	The effective one digital science Mathematics tics story	Experiment / Elementary School Students	Problem solution testing & observation tions	Digital stories improve elementary school students' problem-solving skills

		(Wangid et al., 2021)				
15	SD Technology Integration	Measuring the impact of blended learning models on early literacy growth (Wilkes et al., 2020)	Core5 mix learning program	Experiment / Elementary School Students	Reading & observation test	Core5 improves reading skills compared to traditional methods
16	SD Technology Integration	The urgency of flipped classroom learning by integrating Android-based multimedia to support the digital literacy skills of elementary school students. (Dewi et al., 2025)	Implementation of flipped classroom learning with multimedia	Experiment / Elementary School Students	Digital literacy observation & test	Improving digital literacy of elementary school students
17	SD Technology Integration	The Impact of Technology on Students' Writing Performance - in the Elementary Classroom: A Meta-Analysis (Wen & Walters, 2022)	The impact of technology on elementary school students' writing skills	Experiment / Elementary School Students	Writing and observation tests	Technology improves elementary school students' writing skills

18	SD Technology Integration	The effectiveness of Balinese culture-based digital storybooks to improve cultural-civic literacy and Pancasila education outcomes (Dharma et al., 2025)	The effective one culture-based digital storybooks	Experiment / Elementary School Students	Literacy & observation test	Culture-based digital storybooks enhance cultural literacy and awareness
19	SD Technology Integration	Multimedia-based dance learning in elementary schools (Dwidarti et al., 2025)	The use of multimedia in dance learning	Experiment / Elementary School Students	Observation & assessment the government does - mance	Effective multimedia support in dance learning in elementary schools
20	SD Technology Integration	Improving Digital Literacy and Science Understanding: The Impact of a Guided Inquiry-Based Flipped Classroom in Elementary Schools (Wijayanti et al., 2025)	STEM-based interactive video learning media	Experiment / Elementary School Students	Observation & character test	Interactive STEM videos support character development and conceptual understanding. ding.
21	SD Technology Integration	Analysis of the Needs for Developing Culturally Themed E-	Development of electronic comics	Experiment / Elementary School Students	Numeracy & observation test	E-comics improve elementary school students'

		Comic Media to Improve Elementary School Students' Numeracy Skills (Rahardjo et al., 2025)	nuanced culture			numeracy skills
22	SD Technology Integration	Thinking about the easiest analysis of the alpha generation using a digital book of social science stories (Hamimah et al., 2020)	Develop development of digital social science story books	Experience - Elementary School Students	Literacy & observation test	Effective digital storybooks for generation alpha
23	SD Technology Integration	The Impact of Wordwall Website Integration in Student-Centered Learning on Numeracy Problem-Solving Skills in Elementary Schools (Adiansha et al., 2025)	numerical problem solving skills & motivation	Experiment / Elementary School Students	Numerical & observational tests	WordWall improves problem solving skills and learning motivation
24	SD Technology Integration	From motivational experience to creative writing: A motivational	Improve writing skills, focus & creativity	Experiment / Elementary School Students	Writing and observation tests	AR MAR effectively increases students' creativity and focus

		AR-based learning approach to improve Chinese writing performance and positive writing behavior (Li et al., 2023)				
25	SD Technology Integration	21st century skills-based literacy learning guide for elementary schools (Bayu et al., 2023)	Basic reading & writing skills assistance	Experiment / Elementary School Students	Literacy & observation test	An effective guide to help elementary school students improve basic literacy
26	SD Technology Integration	Exploring the influence of story and game remixing on students' computational thinking development (Vourletsis & Politis, 2022)	Developing the CT concept of elementary school students	Experiment / Elementary School Students	CT observations & projects	Improve the ability to use and modify CT concepts
27	SD Technology Integration	Development of Augmented Reality Media Containing Grebeg Pancasila for Character Learning in Elementary	Strengthening character & cooperation, understanding local wisdom	Experiment / Elementary School Students	Character observation & testing	AR media is effective for the character and local wisdom of elementary school students

		Schools (Septinaningrum et al., 2022)				
28	SD Technology Integration	Improving creativity and writing skills of elementary school students through digital comics (Istiq'faroh et al., 2020)	Improve creativity & writing skills	Experiment / Elementary School Students	Writing and observation tests	Digital comics are more effective than traditional methods
29	SD Technology Integration	The role of feedback and guidance as intervention methods to foster computational thinking in educational robotics learning activities for elementary schools (Chevalier et al., 2022)	Developing CT competencies with delayed feedback	Experiment / Elementary School Students	Robotics & observation projects	Effective strategies to improve CT competency of elementary school students
30	SD Technology Integration	Developing Students' Second Language Writing Skills and Intercultural Awareness Through Digital Storytelling in	Improving L2 writing skills & intercultural awareness	Experiment / Elementary School Students	L2 writing & observation test	Digital storytelling improves students' engagement and writing skills

		Primary Education (Korosidou & Griva, 2024)				
31	SD Technology Integration	Developing students' digital competencies through collaborative game design (Laakso et al., 2021)	Digital skills development, collaboration & motivation	Experiment / Elementary School Students	Observations & projects	Digital games increase collaboration and learning motivation
32	SD Technology Integration	Smart Mobile Technology in Mathematics Education: Improving Elementary School Students' Mathematical Communication Skills (Pasani & Amelia, 2025)	Improve communication & understanding of mathematical concepts	Experiment / Elementary School Students	Tests & observations	More effective than conventional methods
33	SD Technology Integration	Student Literacy Through Library Visits and the Gemini AI Program at Potrobangsan 2 Public Elementary School (Yarmini et al., 2025)	Combination of traditional & digital literacy for learning motivation	Experiment / Elementary School Students	Tests & observations	Effective combination to increase learning motivation

34	Challenges and the Digital Divide	The Role of Technology in Revolutionizing SRM Practices in Primary and Secondary Education in Nagpur (Talreja & Agashe, 2024)	Identifying SRM challenges	Survey / Teachers & schools	a list of questions	Weak infrastructure & resistance to change are major obstacles
35	Challenges and the Digital Divide	Digital game addiction in elementary school students: The impact of digital literacy, parenting styles, and background variables (Mazman Akar & Özer, 2025)	The relationship between digital literacy and gaming addiction	Survey / Elementary School Students	a list of questions	Digital literacy influences gaming addiction; parenting is a key factor
36	Challenges and the Digital Divide	Bridging the digital divide in rural schools in Germany: A geographic lottery? (Rundel & Salemink, 2021)	Digital gap analysis of rural & urban schools	Survey / School	Questionnaire & statistical data	Significant digital divide between rural and urban schools
37	Challenges and the	Analysis of the need to utilize a	Utilization of digital learning	Survey / Teachers & students	Questionnaire &	The role of parents is important in

	Digital Divide	learning management system as a blended learning medium in elementary schools (Zainil et al., 2024)	during the pandemic		Observation	supporting digital learning
38	Challenges and the Digital Divide	Teacher and School Mediation for Online Risk Prevention and Management: Fostering Sustainable Education in the Digital Age (Chiner et al., 2025)	Online risk mediation by teachers	Survey / Elementary School Teachers	Questionnaire & interview	Teachers play a critical role in mediating online risks
39	Challenges and the Digital Divide	Does digital literacy influence students' online risk? Evidence from Covid-19 (Purnama et al., 2021)	Students' digital literacy and online risks	Survey / Elementary School Students	Questionnaire & interview	Digital literacy influences online risks; parental mediation is important
40	Challenges and the Digital Divide	Curating Spaces of Connection and Combating Pandemic Isolation Through Innovative	Digital spaces to address child isolation	Survey / Elementary School Children	Questionnaire & Observation	Children use digital spaces to cope with isolation during the pandemic

		Digital Practices (Gavin, 2021)				
41	Challenges and the Digital Divide	WhatsApp Remote Reading Recovery: Using Mobile Technology to Promote Literacy during COVID-19 (León et al., 2022)	Utilizing WhatsApp for Distance Learning	Survey / Elementary School Teachers & Students	Observation & interview	WhatsApp is Effective for Distance Learning
42	Challenges and the Digital Divide	The Impact of Peer Bullying and Cyberbullying on Primary School Children in the Republic of Serbia (Stošić et al., 2024)	Addressing cyberbullying	Survey / Elementary School Students and Teachers	Questionnaire & Observation	The Importance of Cyber Bullying Prevention & Mitigation Strategies
43	Challenges and the Digital Divide	Research Trends on the Digital Divide Among the Poor in South Korea: A Systematic Literature Review (Go et al., 2025)	Reviewing digital divide trend studies	Literature review / -	Questionnaire & Observation	Provide a description of research trends & strategies for reducing the digital divide
44	Challenges and the Digital Divide	Gender-specific pathways related to the outcomes of	The impact of digital media on children's psychologi	Survey / Elementary School Children	Psychological Questionnaire	The use of digital media affects children's

		educational programs for adolescent victims of cyberbullying (Kapitány-Fövény et al., 2022)	cal well-being			psychological well-being
45	Challenges and the Digital Divide	Development of Digital Literacy Practices in Yogyakarta Elementary Schools (Suwarto et al., 2022)	Digital literacy practices in private elementary schools	Survey / Elementary School Teachers & Students	Observation & questionnaire	Digital literacy is implemented in various ways in private schools.
46	Understanding Elementary School Digital Literacy	Longitudinal assessment of digital literacy in children: Findings from a large-scale Dutch single-school study (Lazonder et al., 2020)	Developing children's digital literacy skills	Longitudinal study / Elementary school children	Tests & observations	Children show digital literacy development over 3 years
47	Understanding Elementary School Digital Literacy	Digital Literacy in Education: Navigating Reading and Writing Skills Among Students in the 21st Century (Septiari et al., 2025)	Digital writing connection style with digital literacy performance	Survey / Elementary School Students	Questionnaires & tests	Digital writing style is related to digital literacy performance

48	SD Technology Integration	Enhancing digital citizenship education in Saudi Arabian primary schools: designing effective activities for curriculum integration (Alenezi & Alfaleh, 2024)	Digital Citizenship Education in Elementary Schools	Experiment / Elementary School Students	Literacy & observation test	DCE is implemented effectively in elementary schools for digital citizenship literacy.
49	SD Technology Integration	A study on blended learning to support reading learning in elementary schools (Macaruso et al., 2020)	Blended learning for teaching reading	Experiment / Elementary School Students	Reading & observation test	Effective blended learning improves reading skills
50	Understanding Elementary School Digital Literacy	Cultural background in digital literacy of elementary and secondary school students: Self-assessment versus actual performance (Hadad et al., 2023)	Analysis of the context of minority digital culture & literacy	Survey / Minority Students	Questionnaire & Observation	Understanding minority students' perceptions and performance on digital literacy

51	Understanding Elementary School Digital Literacy	Application of cluster analysis to identify distinct reader groups through their engagement with digital reading supplements (Ma et al., 2024)	Identifying reader profiles in digital literacy applications	Survey / Elementary School Students	Questionnaire & Observation	Identifying reader profiles helps digital literacy strategies
52	Challenges and the Digital Divide	When There Is No Playbook: COVID-19 Crisis Response in One Urban Elementary School (Hungerford-Kresser et al., 2023)	Urban school responses to COVID-19	Case Study / Elementary School	Observation & interview	Schools adapt emergency distance learning effectively
53	Challenges and the Digital Divide	Burnout syndrome at different levels of teaching during the covid-19 pandemic in Brazil (Ramos et al., 2023)	Comparison of teacher burnout levels in Brazil during the pandemic	Survey / Brazilian Teachers	a list of questions	Different fatigue indicators based on teaching level
54	Elementary School Teacher	Investigating the correlation of digital	The influence of digital literacy,	Survey / Elementary School Teachers	Questionnaire & Observation	the influence of literacy and intelligence

Competencies	literacy, instructional leadership, and intelligence on job performance (Tongli et al., 2024)	leadership, and intelligence on the performance of elementary school teachers	on the performance of elementary school teachers

Elementary School Digital Literacy Research Results

English: This study shows that there are 6 articles discussing the understanding of (Krueger, 2022); (Seong & So, 2024); (Lazonder et al., 2020); (Septiari et al., 2025); (Hadad et al., 2023); (Ma et al., 2024), 8 articles discussing the competencies of elementary school teachers and prospective teachers (Castro et al., 2025); (Ma'rufah Rohmanurmeta et al., 2024); (Maspiroh et al., 2025); (Pflaumer et al., 2021); (Jung et al., 2024); (Monjelat et al., 2020); (Souza & Prates, 2024); (Tongli et al., 2024)), 26 articles discussed technology integration in elementary school learning (Susanta et al., 2025); (Gellen et al., 2025); (Liang et al., 2024); (Listyaningrum et al., 2025); (Wangid et al., 2021); (Wilkes et al., 2020); (Dewi et al., 2025); (Wen & Walters, 2022); (Dharma et al., 2025); (Dwidarti et al., 2025); (Wijayanti et al., 2025); (Rahardjo et al., 2025); (Hamimah et al., 2020); (Adiansha et al., 2025); (Li et al., 2023); (Bayu et al., 2023); (Vourletsis & Politis, 2022); (Septinaningrum et al., 2022); (Istiq'faroh et al., 2020); (Chevalier et al., 2022); (Korosidou & Griva, 2024); (Laakso et al., 2021); (Pasani & Amelia, 2025); (Yarmini et al., 2025); (Alenezi & Alfaleh, 2024); (Macaruso et al., 2020)and 14 articles discussing digital challenges and gaps (Talreja & Agashe, 2024); (Mazman Akar & Özer, 2025); (Rundel & Salemink, 2021); (Zainil et al., 2024); (Chiner et al., 2025); (Purnama et al., 2021); (Gavin, 2021); (León et al., 2022); (Stošić et al., 2024); (Go et al., 2025); (Kapitány-Fövény et al., 2022); (Suwarto et al., 2022); (Hungerford-Kresser et al., 2023); (Ramos et al., 2023))

This entire article discusses digital literacy in elementary schools from various perspectives, including student understanding, teacher competency, technology utilization, and the challenges of the digital divide that affect learning effectiveness.

Results That Discuss the Understanding of Elementary School Digital Literacy

Elementary school students need the ability to evaluate information sources and think critically when accessing digital media (Krueger, 2022). The use of hyperlinked online resources has been shown to help students understand texts and overcome learning difficulties (Seong & So, 2024). Digital literacy development increases with time and children's digital experiences (Lazonder et al., 2020). Digital writing style is positively correlated with students' digital literacy performance (Septiari

et al., 2025). Cultural background factors influence minority students' digital literacy perceptions and performance (Hadad et al., 2023). Through digital reader profile analysis, teachers can tailor learning strategies to suit student groups (Ma et al., 2024)

Research results that discuss the competencies of elementary school teachers

Teachers in rural areas see AI as a new learning opportunity but require training and resources (Castro et al., 2025). The digital literacy of prospective teachers is still low but can be improved through the digital-based RADEC model (Maspiroh et al., 2025); (Ma'rufah Rohmanurmeta et al., 2024). Teachers face technical and pedagogical barriers when using adaptive technology, especially digital games (Pflaumer et al., 2021). Teachers' ICT knowledge and practices vary, influenced by the school environment (Monjelat et al., 2020). Teachers' experiences in digital literacy are diverse and require systematic development strategies (Jung et al., 2024). Training in digital game creation improves elementary school teachers' confidence and technological competence (Souza & Prates, 2024). Teachers' digital literacy and intelligence influence performance (Tongli et al., 2024)

Results discussing technology integration in elementary school learning

STEAM models, flipped classrooms, and blended learning improve critical thinking skills, character, and digital literacy (Susanta et al., 2025); (Dewi et al., 2025); (Wilkes et al., 2020). Digital storybooks, cultural e-comics, and STEM-based interactive videos foster creativity and cultural awareness (Dharma et al., 2025); (Rahardjo et al., 2025); (Wijayanti et al., 2025). Augmented Reality and collaborative digital games enhance character values, collaboration skills, and computational thinking competencies (Septinaningrum et al., 2022); (Laakso et al., 2021). Culture-based digital media and applications such as Wordwall and DreamBox improve numeracy and learning motivation (Adiansha et al., 2025); (Gellen et al., 2025). Digital dance and comic multimedia support art learning and creative writing (Dwidarti et al., 2025); (Istiq'faroh et al., 2020).

Results that address digital challenges and divides

Weak infrastructure and resistance to change are major barriers to technology integration (Talreja & Agashe, 2024). Digital literacy influences the risk of game addiction in elementary school students (Mazman Akar & Özer, 2025). The digital divide is significant between rural and urban schools (Rundel & Salemink, 2021)). Parents play a crucial role in supporting digital learning (Zainil et al., 2024); (Purnama et al., 2021). Teachers play a key role in mediating online risks and prevention bullying cyber (Chiner et al., 2025); (Stošić et al., 2024); (Kapitány-Fövény et al., 2022). Digital literacy is implemented in various ways in private schools (Suwarto et al., 2022). Schools were able to adapt to emergency distance learning during the pandemic (Hungerford-Kresser et al., 2023). Teacher burnout levels vary depending on the teaching level (Ramos et al., 2023).

Discussion

A thorough synthesis across categories shows that students' low understanding of critical thinking and digital ethics is not an isolated issue but rather strongly correlates with teachers' limited pedagogical and technical competencies. Teachers facing technical barriers tend to fail to integrate higher-level critical thinking competencies into the curriculum. Therefore, it can be concluded that improving teachers' professional digital literacy is a fundamental prerequisite for addressing students' cognitive and behavioral vulnerabilities in the digital environment.

First, elementary school students' digital literacy skills still need to be strengthened. Research shows that students need critical thinking skills and the ability to evaluate information from various digital sources (Krueger, 2022); (Seong & So, 2024). Digital literacy develops through experience and cultural context (Lazonder et al., 2020); (Hadad et al., 2023), so learning needs to be tailored to student characteristics. However, prospective elementary school teachers themselves still have low levels of digital literacy (Ma'rufah Rohmanurmeta et al., 2024), so improving educator capacity is crucial.

Second, the competency of elementary school teachers and prospective teachers plays a crucial role in the success of digital literacy. Many teachers still face limitations in training, facilities, and the application of adaptive technology (Castro et al., 2025); (Pflaumer et al., 2021). Training in digital media creation, such as educational games or RADEC-based learning, has been shown to be effective in increasing teacher confidence and professionalism (Maspiroh et al., 2025); (Souza & Prates, 2024).

Third, integrating technology into elementary school learning has a positive impact on students' literacy, creativity, and collaboration skills. Digital learning models such as *STEAM* , *flipped classrooms* , e-comics, interactive videos, and educational apps can improve students' motivation and character (Dewi et al., 2025); (Wijayanti et al., 2025). Technology is not just a tool, but an integral part of innovative and enjoyable learning.

Fourth, digital challenges and gaps remain major obstacles. Differences in access to infrastructure between urban and rural schools, as well as risks such as device addiction and cyberbullying, require serious attention (Talreja & Agashe, 2024); (Purnama et al., 2021). Teachers play a crucial role as digital mentors and protectors of media ethics.

As a critical response to the challenges of holistic implementation and the digital divide, a 4-Pillar Collaborative Model for Elementary School Digital Literacy is proposed. This model is based on four interdependent pillars: Pillar 1: Equitable Infrastructure (Government Role), Pillar 2: Strengthening Digital Pedagogy (School/Teacher Role), Pillar 3: Creative and Critical Content Development (Teacher Role), and Pillar 4: Family Digital Ethics Education (Parent Role). The implementation of this model ensures that digital literacy efforts move from partial efforts to a cohesive and sustainable ecosystem.

Conclusion

Based on a literature review related to digital literacy integration in elementary schools, it can be concluded that digital literacy needs in the 21st century extend beyond reading and writing skills to encompass digital awareness, ethics, culture, and security. Digital literacy plays a crucial role in equipping students with critical, creative, communicative, collaborative, and responsible thinking skills, essential 21st-century competencies.

The challenges of implementing digital literacy in elementary schools remain suboptimal. Many students lack adequate digital literacy skills, putting them at risk of exposure to negative content and technology misuse. Furthermore, teacher competency in mastering digital learning media is uneven, and the infrastructure gap between urban and rural schools exacerbates the gap in access and quality of education.

The family's role is still limited to monitoring device and social media use, without in-depth digital ethics education. This lack of guidance can increase the risk of device addiction, cyberbullying, and personal data security breaches.

The benefits of technology integration and teacher training in the use of digital platforms, creative applications, and educational games have proven effective in improving students' digital literacy skills. Teacher training in the use of digital applications also strengthens professionalism and the quality of learning, although it is not yet evenly distributed across all elementary schools.

The urgency of collaboration in digital literacy integration requires collaboration between the government, schools, teachers, and parents to provide resources, strengthen policies, and conduct ongoing training. This is crucial for digital literacy to support the development of critical, creative, and responsible character in students.

Thus, digital literacy in elementary schools should be viewed as an important core competency, not just an additional skill, to prepare students to face global challenges and the ever-evolving digital era.

Practical Implications and Suggestions For Future Research

Practical Implications

Based on a comprehensive synthesis, this review presents several specific practical implications:

1. For Policymakers: Design budget policies that focus on equitable digital infrastructure and internet connectivity in rural schools.
2. For Teacher Education Institutions (LPTK): The curriculum must include training in creating innovative digital media and *blended learning- based learning models* as a mandatory curriculum for prospective elementary school teachers.
3. For Schools and Teachers: Schools should initiate regular digital literacy training programs involving parents, focusing on digital ethics and cyberbullying risk mediation *strategies* .

Future Research Suggestions

The results of this systematic review pave the way for future empirical research:

1. Conducting longitudinal (long-term) research to track the development of digital literacy skills (especially critical thinking and ethics) in elementary school students.
2. Conduct classroom action research to test the effectiveness and implementability of the proposed 4 Pillars of Digital Literacy Collaborative Model.
3. Explore in depth the internal psychological factors of teachers (e.g., *self-efficacy* and *technostress*) in adopting new technologies.

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