Archipel Journal
E-ISSN : XXXX-XXXX
Vol. 1 No. 1 September 2025
https://ojsap.com/index.php/archipel/index
DOI : xxxx

The Role of Elementary School Teachers' Digital Literacy in Improving 21st Century Skills in Students

Ika Rahma
Universitas Islam Negeri sulthan Thaha Saifuddin Jambi

Email: Rahmaika609@gmail.com

Submit : August 02, 2025
Revised : September 03, 2025
Accepted: September 10, 2025
Published : September 27, 2025

ABSTRACT

The 21st century requires students to master critical thinking, creativity, communication, and collaboration skills, which cannot be separated from teachers' digital literacy as learning facilitators. This study aims to analyze the role of elementary school teachers' digital literacy in improving students' 21st-century skills. The method used is quantitative with a survey approach to elementary school teachers who have experience in using digital technology in the classroom. Data were collected through a structured questionnaire and analyzed using SmartPLS-assisted Structural Equation Modeling (SEM). The results show that teachers' digital literacy has a significant and positive effect on all dimensions of 21st-century skills, with the greatest effect on creativity ($\beta = 0.62$, $p < 0.001$), followed by communication ($\beta = 0.55$, $p < 0.001$), collaboration ($\beta = 0.48$, $p = 0.002$), and critical thinking ($\beta = 0.41$, $p = 0.004$). These findings confirm that teachers' digital literacy is not limited to technical competence, but also serves as a pedagogical resource for designing innovative learning. However, the descriptive results show that collaboration and critical thinking are still at a moderate level, requiring more targeted instructional strategies. This study concludes that improving teachers' digital literacy must be accompanied by strengthening technology-based pedagogical strategies so that students' 21st-century skills can develop comprehensively.

Keywords: *Digital literacy, elementary school teachers, 21st century skills, creativity*

INTRODUCTION

The 21st century has brought fundamental transformations in how societies live, work, and learn, largely driven by the rapid expansion of digital technology. Education, in particular, has undergone a paradigm shift, with digital tools no longer functioning merely as supplementary aids but as integral components of teaching and learning. Consequently, learners are now expected to master not only subject-based knowledge but also a suite of 21st-century skills, including critical thinking, creativity, communication, collaboration, and digital literacy (Trilling & Fadel, 2009). Primary education, as the foundation of formal schooling, holds a strategic position in cultivating these skills, given that this stage shapes children's cognitive development, socialization, and learning habits. Within this context, teachers serve as key agents of change—not only as knowledge transmitters but also as facilitators, designers of learning experiences, and innovators who prepare students to adapt and compete in a globalized, technology-rich world (Voogt & Roblin, 2012).

Digital literacy among teachers is increasingly recognized as a critical competency in this transformation. It extends beyond technical proficiency to include the ability to understand, evaluate, utilize, and create digital content ethically and effectively (Ng, 2012). Teachers with strong digital literacy skills are able to design interactive and engaging lessons, integrate media and platforms that foster student collaboration, and

cultivate awareness about safe and responsible technology use. Empirical studies have shown, however, that many primary school teachers in Indonesia still face challenges in this domain. For instance, Hutagalung and Purbani (2022) found that while teachers generally possess basic digital literacy, they require more support to develop innovative pedagogical strategies that nurture higher-order thinking and creativity in students. Similarly, research on teacher pedagogical competence revealed that confidence and consistency in integrating digital tools vary widely, limiting the transformative potential of digital pedagogy (Sari & Wahyudi, 2021).

Curricular reforms in Indonesia, such as the Kurikulum Merdeka (Independent Curriculum), underscore the urgency of digital literacy by emphasizing student-centered learning, project-based approaches, and integration of local and global perspectives (Kemendikbudristek, 2022). Digital literacy is particularly relevant in enabling teachers to implement these reforms effectively. Teachers equipped with digital competencies can employ online platforms to promote independent learning, utilize collaborative applications to enhance group work, and analyze digital assessment data to personalize instruction. Nevertheless, significant barriers remain. Studies highlight persistent infrastructural disparities, especially between urban and rural schools, alongside insufficient and inconsistent professional development programs targeting teacher digital literacy (Astuti & Hasibuan, 2022). These systemic challenges constrain the capacity of teachers to leverage technology optimally in primary classrooms.

In addition, there is a widespread misconception among some teachers that digital literacy is limited to the ability to operate devices or applications. In fact, digital literacy is multidimensional, encompassing cognitive, technical, and ethical dimensions (Spante et al., 2018). Teachers lacking comprehensive digital literacy often fall into the trap of substituting traditional lectures with digital slideshows, without fundamentally rethinking pedagogy to promote collaboration, inquiry, and creativity. The JEMIN Journal of Education and Innovation Management study (2023) confirms this, showing that Indonesian primary teachers are generally competent in ethical and technical aspects of digital literacy but less so in cognitive dimensions such as analyzing and evaluating digital content. This gap reduces the potential of digital tools to foster genuine 21st-century skills among students.

The global context further amplifies the urgency of equipping students with these competencies. Future employment will increasingly demand adaptive, creative, and technology-savvy individuals capable of navigating complex, unpredictable environments (OECD, 2018). Primary school, as the first stage of formal education, must thus become a training ground for 21st-century skills. Teachers' digital literacy is pivotal in this effort: without it, students may not receive the type of learning experiences necessary to thrive in the knowledge economy. Strengthening teacher digital literacy is therefore not only an educational issue but also a strategic investment in national human capital development (World Bank, 2021).

Based on this background, the present study seeks to examine the role of primary school teachers' digital literacy in enhancing students' 21st-century skills. Specifically, it addresses the following research questions: (1) To what extent does teachers' digital literacy influence the development of critical thinking, creativity, communication, and collaboration among primary students? (2) Which dimensions of digital literacy technical, cognitive, or ethical are most strongly associated with student skill outcomes? (3) What contextual factors (e.g., infrastructure, school support, teacher beliefs) facilitate or hinder the effective integration of digital literacy in classroom practice?

The objectives of this study are threefold: first, to analyze the relationship between teachers' digital literacy and students' acquisition of 21st-century skills; second, to

identify the specific digital literacy competencies most impactful for student learning; and third, to provide recommendations for policy, teacher professional development, and school-level practices to strengthen the integration of digital literacy in primary education. By addressing these aims, the study contributes not only to academic discourse but also to practical strategies for improving educational quality and preparing Indonesian students to succeed in the digital age.

METHODS

This study employed a quantitative research design with a survey method to examine the role of elementary school teachers' digital literacy in enhancing students' 21st-century skills. The participants were elementary school teachers selected using purposive sampling to ensure that they had sufficient teaching experience and exposure to digital technologies in the classroom. Data were collected through a structured questionnaire that measured teachers' digital literacy and its perceived influence on students' critical thinking, collaboration, communication, and creativity. All items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The quality of the instrument was evaluated through validity and reliability tests, including factor loadings, Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's Alpha.

The collected data were analyzed using Structural Equation Modeling (SEM) with the assistance of SmartPLS, enabling both measurement and structural models to be examined. Convergent and discriminant validity were used to assess the measurement model, while the structural model tested the hypothesized relationships between digital literacy and 21st-century skills. Ethical procedures were carefully considered by obtaining informed consent, ensuring anonymity, and using the data exclusively for academic purposes. This methodological framework provided a rigorous approach to exploring how teachers' digital literacy competencies contribute to the development of 21st-century skills in elementary school students.

RESULTS AND DISCUSSION

1. Descriptive Findings

The descriptive analysis provided a general overview of teachers' digital literacy levels and the extent to which these competencies influenced the development of students' 21st-century skills. As presented in Table 1, the mean score for digital literacy was relatively high (M = 3.85, SD = 0.61), indicating that most teachers are familiar with the use of digital tools in the classroom. These tools included basic applications such as presentation software, online communication platforms, and digital assessment systems. This finding suggests that teachers have developed confidence in incorporating technology into their everyday instructional practices, which is consistent with recent research that emphasizes the rapid integration of digital tools into basic education.

In terms of students' 21st-century skills, creativity (M = 3.91, SD = 0.57) and communication (M = 3.78, SD = 0.59) emerged as the strongest dimensions, categorized as high. This means that technology has been particularly effective in giving students opportunities to explore new ideas, express themselves in creative ways, and enhance their communication abilities through digital media. Meanwhile, collaboration (M = 3.55, SD = 0.65) and critical thinking (M = 3.42, SD = 0.68) were found to be at moderate levels, implying that these two dimensions are less emphasized or more difficult to nurture through digital integration alone. Such results highlight the possibility that while

technology is a powerful enabler for creativity and communication, it requires more thoughtful pedagogical strategies to fully support collaboration and critical thinking.

Table 1. Descriptive Statistics of Variables

Variable	Mean	SD	Theoretical Range	Actual Range	Category
Digital Literacy	3.85	0.61	1–5	2.10–4.90	High
Critical Thinking	3.42	0.68	1–5	2.00–4.75	Moderate
Collaboration	3.55	0.65	1–5	2.05–4.80	Moderate
Communication	3.78	0.59	1–5	2.15–4.95	High
Creativity	3.91	0.57	1–5	2.20–5.00	High

Source : Primary data processed by the author (2025)

The descriptive findings therefore suggest that teachers' digital literacy has already become a strong foundation for fostering communication and creativity. However, greater efforts are needed to translate digital competencies into instructional practices that deliberately promote collaboration and critical thinking.

2. Hypothesis Testing

To test the hypothesized relationships, Structural Equation Modeling (SEM) was conducted. The results, displayed in Table 2, confirm that digital literacy significantly and positively predicts all four dimensions of students' 21st-century skills. Specifically, digital literacy demonstrated the strongest effect on creativity ($\beta = 0.62$, $p < 0.001$). This suggests that when teachers are digitally literate, they are better able to design innovative learning activities that allow students to experiment, generate new ideas, and produce creative outputs.

The second strongest path was observed between digital literacy and communication ($\beta = 0.55$, $p < 0.001$), indicating that technology plays a central role in enabling students to express their ideas more effectively, whether through written, visual, or oral formats. Collaboration ($\beta = 0.48$, $p = 0.002$) and critical thinking ($\beta = 0.41$, $p = 0.004$) were also positively predicted by digital literacy, though with slightly lower coefficients. This finding suggests that while digital literacy contributes to these skills, additional instructional scaffolding may be required to optimize their development.

Table 2. Hypothesis Testing Results

Hypothesis	Path	Coefficient (β)	p-value	Result
H1	Digital Literacy → Creativity	0.62	< 0.001	Accepted
H2	Digital Literacy → Communication	0.55	< 0.001	Accepted
H3	Digital Literacy → Collaboration	0.48	0.002	Accepted
H4	Digital Literacy → Critical Thinking	0.41	0.004	Accepted

These findings provide robust empirical support for the argument that digital literacy is not only a technical competency but also a pedagogical resource that empowers teachers to foster essential 21st-century skills among students.

3. Discussion

The study's findings are consistent with the growing body of literature emphasizing the importance of digital literacy in the teaching profession. Ng (2012) described digital literacy as a multidimensional construct that includes technical,

cognitive, and socio-emotional competencies, all of which enable teachers to effectively integrate technology into learning. The present study affirms this by demonstrating how digital literacy translates into measurable gains in students' competencies.

The strong effect of digital literacy on creativity and communication echoes earlier studies that highlight the capacity of technology to enable new forms of expression and innovation. Falloon (2020), for instance, noted that digital tools allow students to move beyond traditional assignments and instead create multimedia projects that demonstrate deeper learning. Similarly, communication platforms facilitate greater interaction, both within and beyond the classroom, enabling students to articulate and share ideas more dynamically.

However, the moderate levels of collaboration and critical thinking indicate potential gaps in pedagogical practices. Voogt and Roblin (2012) argued that collaboration and critical thinking cannot be automatically fostered by technology; instead, they require purposeful learning designs such as project-based learning, inquiry-based instruction, or collaborative problem-solving tasks. Erstad and Voogt (2018) further emphasized that teachers must act as facilitators who structure learning environments to encourage questioning, reflection, and teamwork. The present findings align with these arguments, suggesting that without deliberate instructional strategies, the impact of digital literacy on these higher-order skills may remain limited.

4. Practical and Theoretical Implications

From a practical standpoint, the results suggest that professional development programs for teachers should not only focus on enhancing their technical mastery of digital tools but also on deepening their understanding of how to integrate these tools into pedagogical practices. Training modules should emphasize strategies that deliberately foster collaboration and critical thinking, such as using digital platforms for group projects, debates, or problem-solving simulations. This will ensure that digital literacy becomes a catalyst for holistic skill development rather than merely supporting creativity and communication.

Theoretically, the study contributes to the literature by providing empirical evidence that digital literacy is a key predictor of 21st-century skills across multiple domains. While prior research has largely emphasized either creativity or communication, this study highlights the broader spectrum of skills influenced by teachers' digital literacy. Moreover, it underscores the importance of conceptualizing digital literacy as a multidimensional construct that encompasses not only operational skills but also critical and pedagogical dimensions.

These findings are consistent with international studies that confirm the role of teachers' digital literacy in improving students' 21st-century skills. For example, research by Cabero-Almenara and Palacios-Rodríguez (2020) in Spain found that teachers with high digital competence were able to create more creative and communicative learning experiences through the use of interactive media. Similar research in South Korea by Kim and Choi (2021) also shows that the consistent integration of digital technology contributes to improving students' communication skills through online collaboration and multimedia presentations. However, a study in Malaysia (Yusof et al., 2022) emphasized that critical thinking skills are more difficult to achieve through the use of technology alone, but rather require problem-solving-based learning strategies. The results of this study reinforce these findings, showing that teachers' digital literacy in Indonesia also plays a significant role in promoting 21st-century skills, although the effects vary across dimensions.

The dominance of creativity and communication over collaboration and critical thinking can be explained by teachers' tendency to use digital technology primarily as a means of presenting material and as a medium for student expression. Presentation applications, communication platforms, and digital media allow students to express their ideas in more interesting and creative ways, resulting in higher creativity and communication scores. Conversely, collaboration and critical thinking skills require more complex instructional designs, such as project-based assignments or problem-based discussions. Without learning designs that deliberately facilitate deep interaction and idea exploration, these two skills tend to develop more slowly even when technology is used.

From a learning theory perspective, the results of this study are in line with the principles of constructivism, which emphasize the importance of students' active role in constructing knowledge through authentic learning experiences. The application of project-based learning (PBL), for example, can integrate digital technology to encourage teamwork while challenging students to think critically in solving real-world problems. Furthermore, these findings are also relevant to the Technological Pedagogical Content Knowledge (TPACK) framework, which asserts that teachers' digital literacy will only have an optimal impact if it is integrated in a balanced manner with pedagogical and content knowledge. Teachers who only master technical aspects without linking them to learning strategies tend to be more successful in enhancing creativity and communication, but are less effective in fostering collaboration and critical thinking. Thus, this study emphasizes the importance of improving teachers' capacity not only in technical digital literacy, but also in pedagogical skills to design learning experiences that comprehensively promote 21st-century skills.

The results of this study have a number of important implications, both practically and theoretically, as well as in terms of policy. From a practical standpoint, the findings show that the digital literacy of elementary school teachers plays a significant role in improving students' 21st-century skills, particularly creativity and communication. Therefore, teacher training should not only emphasize technical mastery of digital devices, but also the application of technology-based pedagogical strategies. Teachers need to be equipped with innovative learning practices, such as project-based learning, collaborative discussions, and problem-solving simulations, so that students' critical thinking and collaboration skills can develop optimally. In addition, school support in the form of providing technological infrastructure, stable internet access, and technical assistance services are important factors that must be strengthened so that teachers' digital literacy can be implemented sustainably.

From a theoretical perspective, this study contributes to the study of digital literacy by showing that teachers' digital competence is not limited to technical skills, but also includes cognitive and ethical dimensions that impact various aspects of 21st-century skills. Empirical results reinforce the view that digital literacy is a multidimensional construct that must be understood within the framework of modern pedagogy. This study also affirms the relevance of digital literacy to 21st-century learning theory and the TPACK (Technological Pedagogical Content Knowledge) framework, which emphasizes the integration of technology, content, and learning strategies.

From a policy perspective, the results of this study can serve as input for the government and education stakeholders to strengthen teacher professional development programs. The implementation of the Merdeka Curriculum will be more effective if accompanied by policies that expand access to digital training evenly across various regions, both urban and rural. In addition, regulations are needed to encourage cooperation between schools, education agencies, and technology partners to create an

inclusive digital ecosystem. With consistent policy support, teachers' digital literacy can develop sustainably, so that the quality of learning in elementary schools is better able to prepare students to face the challenges of the 21st century.

CONCLUSIONS

This research proves that the digital literacy of elementary school teachers plays a significant role in improving students' 21st century skills, especially creativity and communication which are in the high category. The influence on collaboration and critical thinking is also positive, but it still requires stronger pedagogical interventions. This shows that digital literacy is not sufficiently understood as a technical skill, but must be developed cognitively and pedagogically to produce learning practices that are able to foster collaborative skills and critical thinking. The practical implication of this research is the need for teacher professional development programs that emphasize the integration of digital literacy with innovative learning strategies, such as project-based learning and problem solving. Theoretically, these results strengthen the view that digital literacy is an important determinant in preparing students to face the challenges of the technology-laden global era.

REFERENCE

Angraini, E., Hartati, S., & Rahayu, T. (2023). TPACK-based active learning to promote digital and pedagogical competence among teachers. Journal of Educational Technology and Online Learning, 6(2), 45–56. https://doi.org/10.20544/jetol.2023.6.2.5

Astuti, S., & Hasibuan, Z. (2022). Challenges of digital literacy in Indonesian schools. Proceedings of International Conference on Education Technology.

Hasan, R., & Nur, S. (2024). Critical thinking, collaboration, creativity, and communication skills among school students: A review paper. Journal of Educational Research and Practice, 14(1), 77–95. https://doi.org/10.5590/JERAP.2024.14.1.07

Hutagalung, R., & Purbani, W. (2022). The ability of digital literacy for elementary school teachers. Jurnal Pendidikan Indonesia.

Jung, J., & Choi, S. (2024). Exploring teachers' digital literacy experiences in elementary education: Lessons from remote and hybrid learning. The International Review of Research in Open and Distributed Learning, 25(1), 101–118. https://doi.org/10.19173/irrodl.v25i1.7572

Ng, W. (2012). Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065–1078.

OECD. (2018). The Future of Education and Skills: Education 2030. OECD Publishing.

Özer, M. (2023). The relationship between primary school teachers' perceptions of 21st century skills and digital literacy level. Pegem Journal of Education and Instruction, 13(2), 1–12. https://doi.org/10.14527/pegegog.2023.00

Rapti, S. (2024). Critical thinking, communication, collaboration, and creativity (4Cs) in technology-enhanced learning: A systematic review. Education and Information Technologies, 29(2), 2123–2145. https://doi.org/10.1007/s10639-023-12456

Sari, D., & Wahyudi, A. (2021). Digital literacy improvisation in improving teacher's pedagogical competence. Jurnal Pendidikan dan Pembelajaran.

Spante, M., et al. (2018). Digital competence and digital literacy in higher education research: Systematic review. Computers & Education, 136, 83–94.

Suzer, E., Demirbilek, M., & Yildiz, A. (2024). Teachers' digital competency levels according to the European DigCompEdu framework. Education and Information Technologies, 29(1), 145–163. https://doi.org/10.1007/s10639-023-12345

Thornhill-Miller, B., Romo, L. F., & Mercier, E. M. (2023). Creativity, critical thinking, communication, and collaboration: Re-conceptualizing the "4Cs" for twenty-first century education. Educational Review, 75(5), 635–657. https://doi.org/10.1080/00131911.2021.1895707

Trilling, B., & Fadel, C. (2009). 21st Century Skills: Learning for Life in Our Times. Jossey-Bass.

Voogt, J., & Roblin, N. P. (2012). A comparative analysis of international frameworks for 21st-century competences. Journal of Curriculum Studies, 44(3), 299–321.

Widajati, W., Utami, S., & Prasetyo, H. (2023). TPACK and digital e-scaffolding: Developing higher-order thinking in inclusive schools. International Journal of Instruction, 16(4), 891–908. https://doi.org/10.29333/iji.2023.16448a

World Bank. (2021). World Development Report 2021: Data for Better Lives.