

21st Century Digital Literacy Transformation: The Role of Generation Z Teachers and Artificial Intelligence Technology in Improving the Quality of Student Learning

Yayang Karlina¹, Dede Margo Irianto²

¹Magister Pendidikan Guru Sekolah Dasar, Universitas Pendidikan Indonesia, Bandung, Indonesia

²Magister Pendidikan Guru Sekolah Dasar, Universitas Pendidikan Indonesia, Bandung, Indonesia

Corresponding author: yayangkarlina@upi.edu

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Abstract

The development of 21st-century digital literacy demands that the world of education adapt to increasingly rapid technological changes, particularly through the use of artificial intelligence (AI) in the learning process. This study aims to analyze the role of Generation Z teachers and artificial intelligence technology in improving the quality of student learning in the digital era. The research method used is a qualitative approach with a literature study (library research) through the analysis of various scientific journals, books, and relevant academic sources regarding digital literacy, the characteristics of Generation Z teachers, and the implementation of AI in education. The results show that Generation Z teachers have a high technological adaptability, are creative, and innovative in utilizing digital platforms and AI technology to create interactive, collaborative, and student-centered learning. In addition, the use of artificial intelligence technology can help personalize learning, increase the effectiveness of evaluation, and expand access to information and learning resources. However, challenges such as the gap in technology access, unequal digital competencies, and the ethics of AI use remain concerns in its implementation. This study concludes that the synergy between Generation Z teachers and artificial intelligence technology plays a crucial role in supporting digital literacy transformation and improving the quality of student learning effectively and sustainably in the modern education era..

Keywords: digital literacy, Generation Z teachers, artificial intelligence, learning quality, 21st century education

1. INTRODUCTION

The development of digital technology in the 21st century has brought about significant transformations in various aspects of life, including the world of education. Advances in information and communication technology have driven major changes in patterns of interaction, information management, and learning methods used by both educators and students (Kudriani et al., 2023). In this context, digital literacy has become a crucial competency that every individual must possess, encompassing the ability to access, evaluate, and utilize information wisely, think critically, collaborate, and communicate effectively amid the overwhelming flow of digital information (Cynthia & Sihotang, 2023). Unfortunately, digital literacy competencies among teachers particularly elementary school teachers remain relatively low, especially regarding the use of interactive technology to support the learning process. Teachers tend to use technology only for administrative and assessment purposes, rather than as a tool for developing students' critical and creative thinking (Handiyani & Abidin, 2023, as cited in a study on elementary school teachers' digital literacy).

On the other hand, the emergence of artificial intelligence (AI) opens up new opportunities for creating a more personalized, interactive, effective, and efficient learning experience. AI enables the adaptation of instructional materials to the needs and learning pace of each student, allowing the learning process to be more contextual and relevant to the demands of the times (Agustina & Suharya, 2024; Zhang & Zhang, 2024). The synergy between teachers particularly Generation Z teachers and AI technology is believed to enhance the quality

of learning through personalized instruction, more effective assessment, and increased student engagement in the learning process (Zhang & Zhang, 2024). Generation Z teachers themselves are characterized by being adaptable, creative, and innovative, and have been familiar with digital technology from an early age; thus, they have great potential to optimize the use of AI in classroom teaching practices (Ervianti et al., 2023).

Nevertheless, optimizing the synergy between Generation Z teachers and AI in learning still faces a number of challenges. First, the digital divide across regions particularly between urban and rural areas remains a serious issue that hinders the equitable distribution of digital-based education (Koswara, 2024). Second, the uneven digital competencies of teachers and students also affect the quality of learning in the digital age, as it has been found that digital literacy levels have a significant impact on the quality of learning (Judijanto, 2024). In fact, the majority of elementary school teachers are reported to lack adequate digital competencies, particularly in the use of technology-based learning platforms (Hansa et al., 2025). Third, ethical issues surrounding the use of AI in education are also a major concern, given that the implementation of smart technologies without clear ethical guidelines has the potential to cause negative impacts, both on data privacy and the sustainability of their use (Wynsberghe, 2021). These challenges are compounded by the finding that the implementation of AI in education in Indonesia still faces limitations in digital infrastructure, low technology literacy among educators, and resistance to change—although significant opportunities remain through the development of technology-based curricula and the equitable distribution of access to education (Kudriani et al., 2023).

The synergy between Generation Z teachers and AI technology holds great potential to drive digital literacy transformation, but its implementation is still hampered by various structural and ethical challenges that have not yet been comprehensively resolved. Therefore, an in-depth study is needed on the role of Generation Z teachers and AI technology in supporting digital literacy transformation and improving the quality of student learning, so that appropriate strategies can be formulated to optimize this potential while addressing existing challenges.

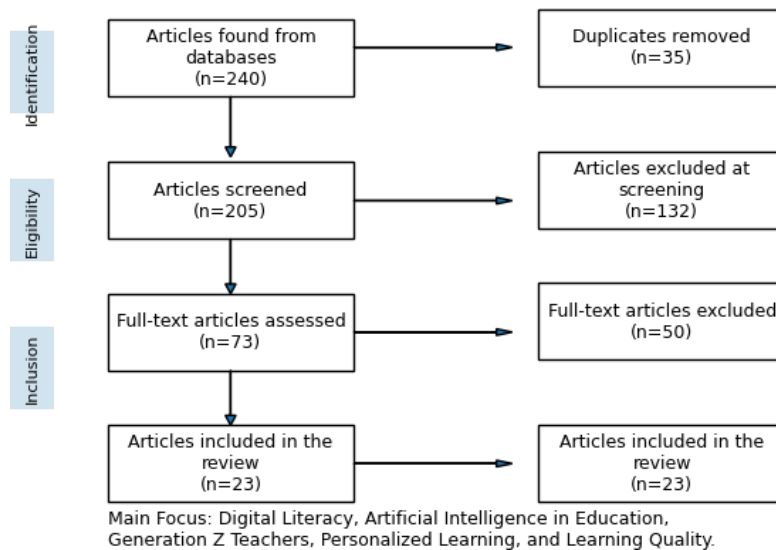
2. METHODS

This study employs a qualitative approach using a Systematic Literature Review (SLR) method based on library research to examine the synergy between Generation Z teachers and artificial intelligence (AI) in supporting the transformation of digital literacy. The research data consists of secondary data obtained from relevant journal articles and scientific publications.

The literature search was conducted systematically through the Google Scholar and Scopus databases using keywords related to Generation Z teachers, artificial intelligence, and digital literacy. The article selection process followed the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which include the identification, screening, eligibility, and inclusion stages. The retrieved articles were then screened based on predetermined inclusion and exclusion criteria, including topic relevance, availability of full-text versions, and the academic quality of the publications. The results of this screening process are presented in a PRISMA flowchart.

Data from the selected articles were analyzed using content analysis and qualitative descriptive analysis. The analysis involved identifying, grouping, and interpreting key themes to produce a comprehensive synthesis of the role of Generation Z teachers and the use of artificial intelligence in the transformation of digital literacy.

Diagram 1. Alur PRISMA



3. RESULTS AND DISCUSSION

The following review table has been compiled to provide a concise overview of research related to “21st-Century Digital Literacy Transformation: The Role of Generation Z Teachers and Artificial Intelligence Technology in Improving the Quality of Student Learning.” This table highlights the main focus and relevance of each article to the topic under study.

Table 1. Review Article

No	Article Title	Author(s)	Summary	Findings	Relevance
1	<i>Unpacking the Impact Mechanism of Generative AI-Based Learning Analytics Technology on Student Learning Engagement</i>	Hao Dong et al. (2026)	Examines AI-based learning analytics and student engagement.	Digital literacy strengthens the positive impact of AI on engagement.	Directly links AI, digital literacy, and learning quality.
2	<i>AI Literacy and Cognitive Evolution in Generation Z</i>	Eka Sudarmaji et al. (2026)	Investigates AI literacy among Gen Z learners.	AI literacy supports critical thinking and adaptive learning.	Relevant to AI literacy transformation.
3	<i>Reconstructing Gen Z Digital Historical Literacy Through AI-Based Pedagogy</i>	Agi Ma'ruf Wijaya et al. (2026)	Studies AI-supported pedagogy.	AI enhances digital literacy and source verification skills.	Shows AI-supported literacy development.
4	<i>Digital Literacy of Generation Z: Challenges for Teachers in the Era of Demographic Bonus</i>	Mukhlisa, Sulisworo, & Hidayati (2025)	Discusses digital literacy education for Gen Z.	Teacher readiness is crucial for digital literacy success.	Supports discussion of teacher roles.
5	<i>Digital and AI-Based Learning Environments for Data Literacy Development</i>	Palupi Sri Wijayanti et al. (2026)	Reviews AI-supported learning environments.	AI promotes data literacy and critical thinking.	Relevant to digital literacy transformation.

No	Article Title	Author(s)	Summary	Findings	Relevance
6	<i>Artificial Intelligence in Online Education: Impact on Learner Engagement and Satisfaction</i>	Various authors (2026)	Investigates AI in online learning.	AI increases engagement and satisfaction.	Supports AI-enhanced learning quality.
7	<i>A Systematic Review of Language Educators' Practices and Development with Gen AI</i>	Various authors (2026)	Examines teacher adoption of Gen AI.	Teacher competence affects AI integration.	Relevant to teacher preparedness.
8	<i>From Familiarity to Criticality: Cultivating EFL Teachers' AI Literacy</i>	Yuan Zhang & Mohd Ali Samsudin (2026)	Explores AI literacy among teachers.	Professional development improves AI literacy.	Directly related to teacher AI competency.
9	<i>21st-Century Digital Learning Trends and Teachers' Technology Integration</i>	Ahyani Radhiani et al. (2026)	Reviews digital learning trends.	Teacher integration determines technology effectiveness.	Supports teacher role in digital transformation.
10	<i>Digital Pedagogical Practices of Generation Z Teachers in Primary Education</i>	Arga Pradana et al. (2026)	Investigates digital teaching practices.	Gen Z teachers show creativity and adaptability.	Strong evidence for Gen Z teacher advantages.
11	<i>The AI Generation Gap</i>	Cecilia Chan & Katherine Lee (2023)	Compares Gen Z students and older teachers.	Students are more optimistic toward AI adoption.	Explains generational dynamics in AI integration.
12	<i>AI Literacy in K-12 and Higher Education in the Wake of Generative AI</i>	Xingjian Gu & Barbara Ericson (2025)	Reviews AI literacy frameworks.	AI literacy requires technical and critical dimensions.	Supports conceptual framework.
13	<i>Thematic Working Group 5: AI Literacy for Teaching and Learning</i>	Mary Webb et al. (2026)	Discusses AI literacy implementation.	Teacher AI agency is essential.	Relevant to teacher empowerment.
14	<i>The Application of Digital Technology and the Learning Characteristics of Generation Z in Higher Education</i>	Ali Alruthaya et al. (2021)	Explores Gen Z learning characteristics.	Digital technology shapes learning preferences.	Supports Gen Z teacher/student discussion.
15	<i>Generation AI: Fears of Social Divide Unless All Children Learn Computing Skills</i>	Educational analysis (2026)	Examines AI literacy in equality.	AI literacy is becoming a core competency.	Supports urgency of digital literacy.
16	<i>Schools Are Teaching AI—and Making a Massive Mistake</i>	Anderson & Winthrop (2026)	Critiques tool-focused AI education.	Critical AI understanding is more important than technical use alone.	Supports critical digital literacy.
17	<i>Pupils in England Are Losing Their Thinking Skills Because of AI</i>	NEU Survey Report (2026)	Investigates unintended consequences of AI use.	Overreliance on AI may reduce critical thinking.	Highlights ethical challenges.

No	Article Title	Author(s)	Summary	Findings	Relevance
18	<i>Artificial Intelligence Literacy Education in Primary Schools</i>	Yim & Su (2025)	Examines AI literacy education.	Early AI literacy improves digital competence.	Relevant to future-ready education.
19	<i>AI-Enhanced Digital Literacy in Science Learning</i>	Wardhani et al. (2025)	Studies AI integration in science education.	AI improves information evaluation skills.	Supports digital literacy outcomes.
20	<i>Artificial Intelligence and Machine Learning Approaches in Digital Education</i>	Muniretal. (2022)	Reviews AI applications in education.	AI supports adaptive and personalized learning.	Supports AI-based learning quality.
21	<i>Digital Literacy, Pedagogical Insight, and Self-Belief of Pre-Service Generation Z Teachers</i>	Jaya (2025)	Examines digital readiness of Gen Z teachers.	Digital competence influences pedagogical effectiveness.	Directly related to teacher role.
22	<i>AI Learning Tools in K-12 Education: A Scoping Review</i>	Yim & Su (2024)	Reviews AI learning tools.	AI supports engagement and personalization.	Supports AI implementation discussion.
23	<i>Transforming Education Through Artificial Intelligence in 21st-Century Learning</i>	Various international scholars (2024–2026)	Discusses AI-driven educational transformation.	AI enables adaptive, data-driven learning.	Supports overall conceptual framework.

The following classification table was created to summarize several studies that discuss “21st-century digital literacy transformation: the role of generation z teachers and artificial intelligence technology in improving the quality of student learning.” This table provides a brief overview of how each article relates to this topic.

Table 2. Article classification

No.	Main Theme	Number of Articles	Percentage (%)	Main Focus (Relevance to the Study Title)
1	Digital Literacy Development in 21st-Century Education	6	26%	Examines the importance of digital literacy competencies, including information evaluation, critical thinking, communication, collaboration, and responsible technology use in modern learning environments.
2	Artificial Intelligence for Learning Enhancement	5	22%	Investigates how AI improves learning quality through personalized learning, adaptive feedback, learning analytics, and student engagement.
3	AI Literacy and Digital Competence	4	17%	Focuses on the development of AI literacy and digital competencies required by teachers and students to effectively utilize AI technologies in education.
4	Generation Z Teachers and Digital Pedagogy	3	13%	Explores the characteristics of Generation Z teachers, including adaptability, creativity, innovation, and technological proficiency in digital learning environments.
5	Technology Integration and Educational Transformation	2	9%	Discusses strategies for integrating digital technologies and AI into teaching and learning processes to support educational transformation.
6	Student Engagement and Personalized Learning	2	9%	Examines the role of AI-supported learning environments in increasing student participation, motivation, and individualized learning experiences.

7	Ethical Challenges and Digital Divide in AI-Based Education	1	4%	Highlights challenges such as unequal access to technology, ethical concerns, privacy issues, and responsible AI implementation in education.
Total		23	100%	

Based on the classification of the reviewed literature, the most frequently discussed theme is the development of digital literacy in twenty-first-century education. This finding indicates that digital literacy has become an essential competency that students must possess to navigate the challenges of a knowledge- and technology-based society. Digital literacy extends beyond the ability to operate digital devices; it also encompasses the ability to access, evaluate, create, and communicate information effectively and responsibly. In educational contexts, digital literacy plays a critical role in fostering critical thinking, problem-solving, collaboration, and creativity, which are recognized as key competencies for twenty-first-century learners (Falloon, 2020; Zhao et al., 2021). Therefore, strengthening digital literacy serves as a fundamental foundation for improving student learning quality in the era of digital transformation.

The second most dominant theme identified in the literature is the application of Artificial Intelligence (AI) to enhance learning quality. Numerous studies have demonstrated that AI can facilitate more personalized learning experiences by continuously analyzing students' needs, abilities, and learning progress. AI technologies also enable real-time feedback, adaptive assessment, and personalized learning recommendations that align with individual student characteristics. According to Crompton and Burke (2023) and Ng et al. (2021), the integration of AI into educational settings has the potential to improve learning effectiveness, increase student engagement, and support more efficient instructional processes. Consequently, AI should be viewed not merely as a technological tool but as a strategic innovation capable of transforming educational practices and improving learning outcomes.

The literature also highlights the growing importance of AI literacy and digital competence among both teachers and students. As AI technologies become increasingly integrated into educational environments, users must develop not only technical skills but also a comprehensive understanding of the ethical, social, and academic implications of AI usage. AI literacy includes the ability to understand how AI systems function, critically evaluate AI-generated outputs, and utilize AI technologies responsibly and effectively (Ng et al., 2021; Long & Magerko, 2020). These findings suggest that AI literacy should be considered an integral component of digital literacy transformation and incorporated into contemporary educational curricula.

Furthermore, several studies emphasize the strategic role of Generation Z teachers in supporting digital transformation in education. As digital natives, Generation Z teachers have grown up in technology-rich environments, making them more familiar with digital innovations than previous generations. Their characteristics, including adaptability, creativity, flexibility, and technological confidence, position them as valuable agents of change within educational institutions. These attributes enable Generation Z teachers to integrate AI-based technologies and digital platforms into teaching and learning processes more effectively (Jaya, 2025). As a result, their role extends beyond knowledge transmission to facilitating students' ability to engage critically and responsibly with digital technologies.

The reviewed studies also indicate that successful educational transformation depends not only on the availability of technology but also on the effective integration of technology into pedagogical practices. Advanced technological tools alone are insufficient to improve learning quality unless they are supported by appropriate instructional strategies, adequate teacher competencies, and institutional support. Therefore, digital transformation requires a holistic approach that combines technological innovation, pedagogical development, and educational policy reform (OECD, 2023). This perspective reinforces the importance of equipping teachers with the necessary skills and resources to maximize the educational benefits of emerging technologies.

Another important finding concerns the role of AI in promoting student engagement and personalized learning. AI-powered educational systems can provide customized learning pathways, adaptive content delivery, and individualized feedback based on students' learning needs and preferences. Such personalization allows students to progress according to their own abilities and learning pace, resulting in higher levels of motivation, participation, and academic achievement. Consequently, AI contributes significantly to the creation of more inclusive, student-centered, and effective learning environments.

Despite the considerable benefits associated with digital technologies and AI, the literature also identifies several challenges that may hinder their implementation. These challenges include unequal access to technology, disparities in digital competence, data privacy concerns, information security risks, and potential algorithmic bias. Moreover, excessive dependence on AI technologies may reduce opportunities for independent thinking and critical analysis if not accompanied by appropriate pedagogical guidance (UNESCO, 2023; Holmes et al., 2022). These findings highlight the need for ethical frameworks, digital governance policies, and professional development initiatives to ensure the responsible and equitable use of AI in education.

Overall, the reviewed literature demonstrates that the transformation of digital literacy in the twenty-first century is shaped by the interaction between technological advancement and human capability. Artificial Intelligence offers substantial opportunities to enhance learning quality through personalization, efficiency, and educational innovation. At the same time, Generation Z teachers possess unique strengths that enable them to serve as effective facilitators of digital transformation. Therefore, the synergy between Generation Z teachers and AI technologies represents a strategic pathway for strengthening digital literacy and improving student learning quality in contemporary educational settings. Ultimately, the success of educational transformation depends not only on the sophistication of technology but also on educators' ability to utilize these technologies critically, ethically, and effectively

4. CONCLUSION

The transformation of digital literacy in the twenty-first century has become a crucial element in improving the quality of education and preparing students to thrive in an increasingly digital society. The findings of this study indicate that digital literacy extends beyond technical skills and encompasses critical thinking, communication, collaboration, creativity, and the responsible use of digital information. At the same time, Artificial Intelligence (AI) offers significant opportunities to enhance learning quality through personalized instruction, adaptive assessment, real-time feedback, and data-driven learning support. These developments highlight the growing importance of integrating digital literacy and AI competencies into contemporary educational practices.

Furthermore, Generation Z teachers play a strategic role in facilitating this transformation due to their familiarity with digital technologies, adaptability, creativity, and openness to innovation. Their ability to integrate AI into pedagogical practices enables the creation of more engaging, effective, and student-centered learning environments. Therefore, the synergy between Generation Z teachers and AI technology represents a powerful catalyst for strengthening digital literacy and improving student learning outcomes. To maximize these benefits, educational stakeholders must continue to invest in digital competency development, ethical AI implementation, and equitable access to technology to ensure sustainable educational transformation in the digital age.

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