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Fostering digital literacy awarness in support of suistanable development goals (SDGs) among elementary school student: A literature review

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ABSTRACT

In today's increasingly digital society, the ability to navigate, evaluate, and effectively use digital information known as digital literacy had become an essential skill for students, including those at the elementary school level. However, fostering digital literacy awareness among elementary school students presented unique challenges, particularly due to developmental, pedagogical, and contextual factors. This study aimed to explore the state of digital literacy among elementary students and examine various strategies for building awareness and foundational skills in this area. This review synthesized findings from recent empirical and theoretical studies, focusing on the integration of digital tools, the role of teachers, curriculum design, and parental involvement. It highlighted the importance of age-appropriate learning approaches that combined guided exploration with the development of critical thinking. Furthermore, it emphasized the need for a comprehensive approach to digital literacy in schools, including consistent education on digital ethics and safety across all subjects. The main findings showed that early and structured exposure to digital media, when guided by competent educators and supported by inclusive policies, significantly enhanced students' digital literacy awareness. The literature also indicated that teacher professional development and collaboration with families were crucial to sustaining effective practices. In conclusion, fostering digital literacy awareness in elementary education required a multi-dimensional approach involving teachers, parents, curriculum innovation, stakeholder engagement, and policy alignment. Future research needed to examine context-specific interventions and long-term impacts to formulate sustainable strategies.

INTRODUCTION

In today's continuously evolving digital era, the ability to understand, use, and evaluate information through technology has become a central pillar in enhancing other 21st-century skills (Martínez-Bravo et al., 2022). Digital literacy not only encompasses technical skills in operating digital devices but also includes critical thinking, creativity, and ethical responsibility in accessing and disseminating information. At the elementary school level, developing digital literacy from an early age is crucial as a foundation for students to navigate the complex global challenges they will face (Widiyantti et al., 2024). Elementary education serves as the main foundation for shaping children's character and raising their awareness of the social, economic, and environmental issues confronting the world.

In line with this, the United Nations through the 2030 Agenda has set 17 Sustainable Development Goals (SDGs) as a global framework to achieve sustainable development. One of the goals most relevant to the educational context is SDG 4, which aims to ensure inclusive, equitable, and quality education for all learners (Saini et al., 2023). Digital literacy plays a strategic role in supporting this goal, as adequate digital skills enable students to access learning resources, understand global issues, and develop social and environmental awareness (Saini et al., 2023). In addition to SDG 4, digital literacy also supports the achievement of other goals such as SDG 5 (gender equality), SDG 10 (reducing inequality), and SDG 13 (climate action), by enabling the active participation of all stakeholders, including youth, in sustainability actions.

However, in many regions, including Indonesia, the introduction and strengthening of digital literacy at the elementary level still face various obstacles. These include a lack of understanding of digital technologies and the integration of digital literacy into the curriculum, limited access to digital tools and teacher training, and students' weak understanding of the relationship between digital literacy and sustainability issues (Adhani et al., 2024); (Bälter et al., 2022) Moreover, scientific studies specifically exploring the connection between digital literacy and the SDGs in the context of elementary education remain limited. Therefore, a comprehensive literature review is needed to explore the potential of digital literacy as a tool to foster awareness of SDG values among elementary students.

This study takes the form of a literature review aimed at identifying and summarizing findings from various scholarly sources regarding the development of digital literacy in elementary education and its connection to sustainable development goals. The review seeks to discover effective approaches to instill digital and sustainability awareness in students and to provide strategic recommendations for teachers, curriculum developers, and education policymakers. The ultimate goal is to analyze the role of digital literacy in supporting the achievement of the SDGs, particularly within elementary school settings, while offering a theoretical basis for developing more inclusive, critical, and future-oriented educational practices.

METHOD

This study employed a literature review approach aimed at exploring and analyzing previous research related to developing digital literacy awareness among elementary school students in support of the Sustainable Development Goals (SDGs). Through this literature review, the researchers synthesized a comprehensive body of knowledge to understand the extent to which digital literacy has been integrated into elementary education and how it contributes to achieving the SDGs.

Data collection was carried out through a systematic search of relevant scholarly literature. Keywords such as "digital literacy," "elementary school students," "sustainable development goals," "SDGs," "education for sustainable development," and "ICT in primary education" were used to locate appropriate articles and documents. The sources included leading academic databases such as Google Scholar, Scopus, ScienceDirect, ERIC, and SpringerLink. In addition to journal articles, this study included conference proceedings, reports from international organizations (such as UNESCO and UNICEF), and relevant academic books.

To ensure the quality and relevance of the selected sources, inclusion and exclusion criteria were established. The inclusion criteria comprised publications from 2019 to 2024 that focused on digital literacy in elementary education and were related to SDG themes, This can be seen in Figure 1. Excluded from analysis were non-peer-reviewed literature and studies that focused exclusively on secondary or higher education without relevance to elementary education. The collected data were analyzed using qualitative content analysis. The stages included data reduction, where selected literature was filtered based on relevance and quality; categorization of findings into key themes such as the definition and conceptualization of digital literacy, strategies for developing digital literacy in elementary schools, the contribution of digital literacy to SDG achievement, and

the challenges and solutions encountered. These findings were then interpreted to provide a comprehensive overview of the strategic role of digital literacy in promoting sustainable education at the elementary level.

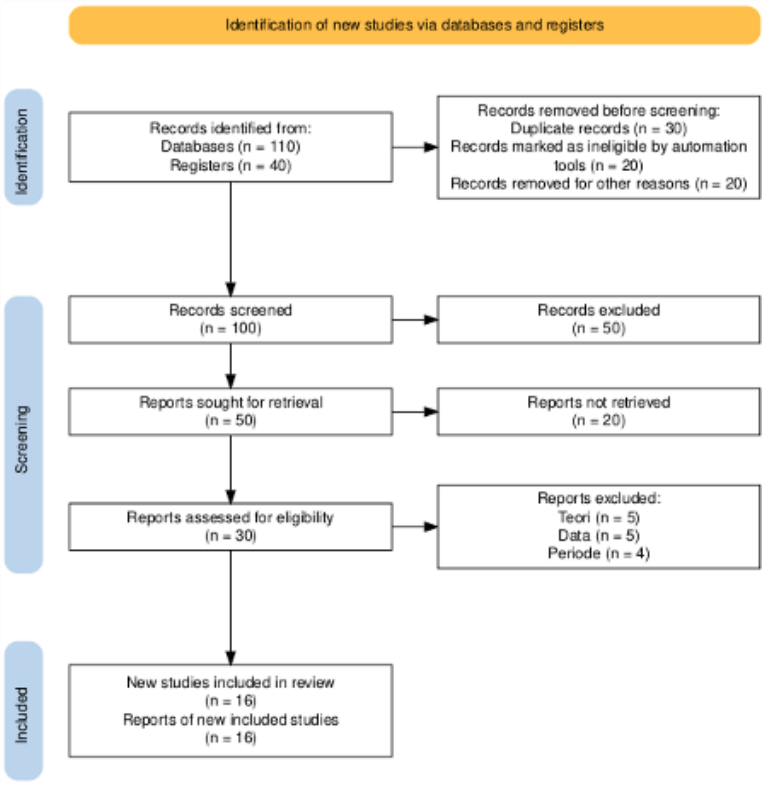

Figure 1. Flow diagram of document selection

RESULTS

This study was conducted through a literature review of 16 scholarly articles published between 2019 and 2024. These articles were analyzed to identify the relationship between digital literacy among elementary school students and the achievement of the Sustainable Development Goals (SDGs). The findings were classified into several key themes, namely: students' levels of digital literacy, instructional strategies implemented, curriculum integration and the role of teachers, as well as challenges in implementation.

Table 1. Summary of Research Findings on Digital Literacy Among Elementary School Students

No	Author(s) & Year	Research Focus	Key Findings
1	(Masyhura, 2022)	Implementation of digital literacy in elementary schools	Digital literacy helps students understand and use technology wisely, while also enhancing critical thinking.
2	(Mondejar et al., 2021)	Digitalization for achieving the SDGs	Digital transformation supports the SDG agenda, particularly in education and environmental sustainability.
3	(Castro et al., 2021)	The convergence of digitalization and sustainability for SDGs	Digital literacy is essential for maximizing the benefits of digitalization in sustainable development contexts.
4	(Martínez-Bravo et al., 2022)	Dimensions of digital literacy in 21st-century competency frameworks	Digital literacy should include ethical, social, and technical dimensions in primary education.

No	Author(s) & Year	Research Focus	Key Findings
5	(Hamadeh, 2022)	The role of Gen Z in community literacy about the SDGs	Through digital literacy, young people have the potential to become change agents sensitive to global issues.
6	(Ricoy & Sánchez-Martínez, 2022)	Enhancing ecological awareness and digital literacy through gamification	Gamification effectively improves digital literacy and environmental awareness among elementary students.
7	(Aji et al., 2022)	Development of a science flipbook e-module to support the SDGs	Flipbook-based digital learning media supports students' understanding of SDG-related issues.
8	(Saini et al., 2023)	Pattern of SDG 4 indicators using a genetic algorithm	Education quality is influenced by interrelated indicators; technology assists in identifying these patterns.
9	(Shafira et al., 2024)	Digital literacy to promote inclusive progress toward the 2030 SDGs	Digital literacy fosters social and economic inclusion through equitable use of technology.
10	(Yamamoto, 2022)	Digital SDGs framework for knowledge integration	Integrating digital knowledge into education policy is essential for effective SDG implementation.
11	(Yamamoto, 2022)	The role of digital literacy in achieving the 2030 SDGs for elementary students	Digital literacy empowers students to understand and address global challenges.
12	(Yetti, 2024)	Pedagogical innovation using local wisdom for sustainable digital literacy	Incorporating local wisdom into the curriculum strengthens digital literacy and supports sustainable development.
13	(Ramadani et al., 2024)	Optimizing government support for digital literacy and SDG 17	Government policies are crucial in strengthening digital literacy through multi-stakeholder collaboration.
14	(Sari et al., 2024)	Strengthening digital literacy in Indonesia through collaboration and innovation	Collaboration between schools, government, and communities enhances digital literacy and SDG awareness.
15	(Madon & Masiero, 2025)	Digital connectivity and SDGs from an institutional resilience perspective	Strong digital infrastructure supports SDG achievement through institutional resilience in education.
16	(Koebe, 2025)	The contribution of digital technology and AI to health-related SDGs	AI and digital technologies enhance access to and quality of healthcare, aligning with SDG goals.

Overall, the linkage between digital literacy and the Sustainable Development Goals (SDGs) indicates that strengthening digital competencies among elementary school students is not merely an educational investment, but also an integral strategy for achieving inclusive and equitable sustainable development across various aspects of life.

DISCUSSION

The findings derived from the reviewed articles reveal that digital literacy at the elementary level is increasingly recognized as an essential skill to prepare younger generations for the digital era while simultaneously contributing to the achievement of several SDGs, particularly SDG 4 (quality education), SDG 9 (industry, innovation, and infrastructure), and SDG 10 (reduced inequalities).

1. Digital Literacy Review

The literature suggests that digital literacy among elementary students encompasses both basic technical skills—such as the use of devices and digital applications—and higher-order competencies such as critical thinking, collaboration, and ethical awareness in digital environments. Several studies also emphasize the importance of affective dimensions, including empathy and responsibility, in fostering meaningful and respectful digital interactions. While the explicit integration of digital literacy into the formal curriculum remains a challenge in many

educational contexts, innovative approaches such as gamification, the educational use of social media, and project-based learning have proven effective in increasing student engagement and enhancing learning outcomes.

Table 2. Focus Areas of Digital Literacy Studies in Elementary Education

Focus of Digital Literacy Study	Number of Articles	Percentage (%)
Effective use of Information and Communication Technology (ICT)	10	62%
Critical and ethical evaluation of digital information	7	44%
Strengthening 21st-century competencies (critical thinking, collaboration, etc.)	6	38%
Enhancing learning motivation through digital media	5	31%
Integration of digital literacy into the elementary school curriculum	4	25%

Digital literacy has become a core competency that must be developed from an early age to prepare students for navigating an increasingly digital and complex world. The implementation of digital literacy in elementary education is essential for cultivating habits of using technology wisely, creatively, and safely (Masyhura, 2022). The dimensions of digital literacy go beyond technical skills, encompassing cognitive, social, and ethical aspects aligned with the framework of 21st-century competencies (Martínez-Bravo et al., 2022).

Game-based learning approaches (gamification) have proven effective in enhancing digital literacy while simultaneously raising environmental awareness among elementary school students (Ricoy & Sánchez-Martínez, 2022). Other innovations include the development of interactive media such as flipbook-based e-modules, which strengthen digital skills and instill understanding of sustainable development goals (Aji et al., 2022). These initiatives demonstrate that integrated digital learning strategies can positively impact students' learning experiences. Efforts to improve digital literacy must also take local context into account. Approaches grounded in local wisdom help make digital literacy more meaningful and relevant to the cultural values upheld by the community (Yetti, 2024). In this regard, the role of teachers is crucial in adapting the curriculum and implementing pedagogical innovations that reflect students' needs and social environment.

Nonetheless, the success of digital literacy development is also significantly influenced by parental involvement. In the context of elementary education, parents play a vital role in supervising and guiding children's technology use outside the classroom. Digital literacy among students can develop more effectively when parents also possess basic knowledge of responsible digital practices. With active parental engagement, values such as digital ethics, cybersecurity, and responsible social media use can be instilled early at home and reinforced in school settings (Sari et al., 2024).

2. Distribution of Associated SDG Goals

The majority of reviewed articles link digital literacy primarily to SDG 4 (quality education), followed by SDG 9 (industry, innovation, and infrastructure), SDG 10 (reduced inequalities), SDG 1 (no poverty), and SDG 13 (climate action). This distribution highlights that digital literacy contributes not only to improving educational quality but also serves as a powerful tool for promoting social inclusion and advancing sustainable development.

Digital literacy has both direct and indirect associations with various goals outlined in the Sustainable Development Goals (SDGs) framework. The most frequently linked goal is SDG 4 (Quality Education), which emphasizes the importance of inclusive and equitable access to education and the promotion of lifelong learning opportunities. Digital literacy serves as an integral component of educational transformation by providing access to digital learning resources, expanding open learning opportunities, and reducing information inequality among students from diverse backgrounds (Widiyantti et al., 2024).

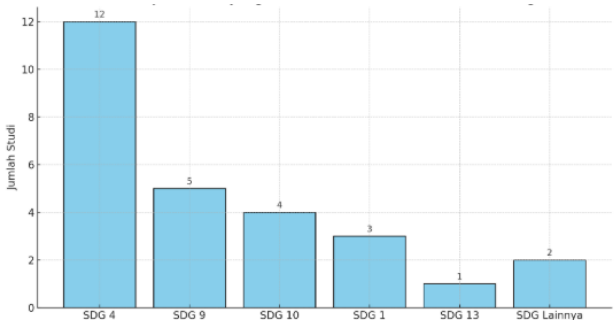

Figure 2. Distribution of SDGs Objectives Linked to SD Digital Literacy Research

In addition to SDG 4, digital literacy is closely related to SDG 9 (Industry, Innovation, and Infrastructure). Developing digital competencies from an early age enhances the future generation's innovation capacity while also supporting inclusive digital infrastructure. These skills form the foundation for a technology-driven society and a competitive digital economy (Castro et al., 2021). The integration of digital tools and systems into education also fosters opportunities to strengthen local technologies and community-based innovation.

Comprehensive digital literacy also contributes to the achievement of SDG 10 (Reduced Inequalities), particularly in terms of narrowing the gap in access to information and education. Technological support provides students in underserved or remote areas with equitable opportunities to learn and grow, comparable to their peers in urban environments. Nonetheless, the digital divide remains a significant challenge that demands serious attention from governments and other relevant stakeholders (Ramadani et al., 2024).

In light of the aforementioned discussion, digital literacy among elementary school students goes beyond basic technical skills such as operating devices and digital applications. It also includes higher-order competencies like critical thinking, collaboration, and ethical awareness in digital environments. Affective dimensions, including empathy and responsibility, are considered essential for fostering meaningful and respectful digital interactions. While integrating digital literacy explicitly into formal curricula remains challenging, innovative approaches such as gamification, educational use of social media, and project-based learning have proven effective in enhancing student engagement and learning outcomes.

Game-based learning approaches (gamification) have demonstrated success in not only improving digital literacy but also increasing environmental awareness among students. Other innovations, such as flipbook-based interactive e-modules, support the development of digital skills and promote understanding of the Sustainable Development Goals (SDGs). Furthermore, interactive e-modules based on local sustainable development goals reinforce digital skills and environmental literacy in elementary education contexts (Wijayanti et al., 2024). These strategies highlight the potential of integrated digital learning methods to create meaningful and contextually relevant learning experiences for elementary school students.

Efforts to promote digital literacy must also consider local contexts, ensuring that cultural values are reflected and preserved. In this regard, teachers play a vital role in adapting the curriculum and implementing pedagogical innovations that align with students' needs and social environments. One study on Balinese e-books shows that combining local wisdom with interactive digital content can enhance student inclusion and engagement in social studies (Dewi & Agung, 2021). By integrating local wisdom, digital literacy can become more relevant and grounded in the everyday experiences of students.

Beyond the role of teachers, parental involvement is also crucial for the successful development of digital literacy. Outside the classroom, parents serve as guides and supervisors of children's technology use. When parents possess basic knowledge of responsible digital practices, values such as digital ethics and cybersecurity can be introduced early at home and reinforced through school instruction. Digital inclusion research also emphasizes that parents with access to

devices, connectivity, and basic digital skills can better support their children's online learning and contribute to more equitable outcomes (Owens et al., 2023). Active parental engagement supports the holistic formation of children's digital character.

Digital literacy directly and indirectly contributes to several Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 10 (Reduced Inequalities). By broadening access to digital learning resources and open education opportunities, digital literacy helps reduce information gaps and strengthen local innovation. However, the persistent digital divide remains a serious challenge that must be addressed by governments and relevant stakeholders to ensure the equitable benefits of digital literacy for all students.

CONCLUSION

Based on a review of 16 scholarly articles discussing the implementation of digital literacy in elementary schools, it can be concluded that digital literacy plays a strategic role in supporting the achievement of the Sustainable Development Goals (SDGs), particularly SDG 4 (quality education), SDG 9 (infrastructure and innovation), and SDG 10 (reduced inequalities). Elementary school students generally possess basic skills in using information and communication technologies; however, they continue to face challenges related to digital safety, critical thinking, and ethical behavior in digital environments. The role of teachers is central to the integration of digital literacy into the learning process. Nevertheless, this role is often constrained by the lack of professional training, inadequate infrastructure, and the absence of strong policy support. Several innovative learning approaches such as digital storytelling, gamification, and the use of collaborative platforms have been shown to be effective in enhancing student engagement in digital learning. Therefore, digital literacy should not be viewed merely as a technical skill, but as a multidimensional construct encompassing cognitive, affective, and social dimensions, all of which are interwoven in the development of students' character and 21st-century competencies.

Based on these findings, this study proposes the following recommendations: (1) teachers and schools should enhance their professional capacities through ongoing training programs that focus on mastering contextual and adaptive digital pedagogy tailored to student needs; (2) Governments, as policymakers, are expected to provide regulatory support and equitable technological infrastructure, particularly in underdeveloped regions; (3) parents must be actively involved in guiding their children's use of digital media to reinforce values such as responsibility, discipline, and empathy in the online environment; and (4) researchers and curriculum developers are encouraged to continuously examine, evaluate, and innovate digital literacy learning models that are responsive to rapid societal and technological changes.

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