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Opportunities and challenges of implementing ecoliteracy in Indonesian elementary schools: A systematic review

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Abstract

The ecological crisis is a matter of concern for everyone and cannot be ignored. To address the ecological crisis, ecological literacy is being considered for teaching children as early as elementary school. Ecoliteracy is crucial from the elementary education level, as it lays the foundation for future life. However, to date, there has been no clear picture of the appropriate implementation of ecoliteracy in the context of elementary education in Indonesia, as well as the opportunities and challenges that may arise in the future. This study aims to identify the opportunities and challenges of implementing ecoliteracy in elementary schools through the Systematic Literature Review (SLR) method of various Scopus-indexed articles published between 2020 and 2025. The findings indicate that ecoliteracy has significant potential for implementation in Indonesian elementary schools due to its flexibility, support from a wealth of natural resources, and the integration of local wisdom. Ecoliteracy implementation can be integrated through the Pancasila Student Profile Strengthening Project, nature-based learning activities, and cross-sector collaboration. Furthermore, the potential for cross-sector collaboration and the use of the surrounding environment as a living laboratory also enrich students' learning experiences. However, the main challenges lie in a weak culture of discipline, teachers' limited understanding of the holistic concept of ecoliteracy, and the absence of curriculum policies that explicitly prioritize ecoliteracy. Therefore, implementing ecoliteracy in Indonesian elementary schools requires consistent policy support, improved teacher competency, and strategic partnerships with various stakeholders to serve as the foundation for sustainable education in the future.

Introduction

Ecoliteracy, or ecological literacy, is the ability to understand, internalize, and apply sustainable ecological relationships in everyday life. It concept encompasses ecological knowledge, awareness, ethics, emotions, and behaviors that support environmental sustainability (Ha & Dong, 2023; Pitman et al., 2018; Pitman & Daniels, 2020). In the current context, ecoliteracy is increasingly important because it helps

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individuals understand the systemic connections among environmental problems such as climate change, resource scarcity, and ecosystem degradation (Naila et al., 2025).

Since ecoliteracy is important for individuals to have, it is appropriate that ecoliteracy is taught as early as possible, for example to elementary school students. Improving ecoliteracy is important to be done from the elementary education level, which is the initial foundation for future life. Susilawati et al (2025) presented that one of the best ways to solve the ecological crisis is by fostering ecoliteracy among citizens, especially students, as they are the future transformers of society. These ecoliteracy-enhancing activities are carried out in schools as formal educational institutions for children. A high level of ecoliteracy can enable individuals and groups to make better decisions regarding sustainability and natural resource management (Pitman et al., 2018; Pitman & Daniels, 2020). In addition, ecoliteracy also plays a role in forming responsible behavior and attitudes towards the environment (Sarbassova et al., 2021; Tomás et al., 2022).

The implementationf of ecoliteracy is essential to elementary school students in Indonesia because Indonesia faces various environmental problems. Some examples of concerning environmental issues that students need to learn about include environmental pollution, such as air, water, and soil pollution. PM10 (particulate matter) is one of the causes of respiratory tract infections as a result of air pollution in Indonesia (Gusti, 2017). Apart from air pollution, Indonesia also has industries that have an impact on the amount of industrial waste and plastic that pollutes marine and terrestrial ecosystems, and threatens human health and biodiversity (Unsworth et al., 2018; Zahroh & Najicha, 2022). In addition, there is massive deforestation in Indonesia which occurs due to the expansion of agricultural land, logging, and mining activities which have an impact on the loss of animal habitat, decreased biodiversity, and greenhouse gases (Hidayat, 2016; Zahroh & Najicha, 2022). Base on stated Jambeck et al., (2015) Indonesia is the second-largest contributor of plastic waste to the ocean. Human relationships also impact the environment in which people live and operate. Environmental damage can be caused by various human activities that disregard the balance of nature. This behavior demonstrates a lack of public awareness of environmental values. The ecological crisis cannot be ignored. The level of human response to this issue will determine the sustainability of the Earth's ecosystem in the future. The ecological crisis can be defined as a lack of individual awareness of the importance of environmental protection, making it a serious problem requiring significant human attention. To address this issue, one effort is to develop and optimize citizen ecoliteracy from an early age.

In the context of Indonesian education, ecoliteracy, has significant relevance to the formation of the Pancasila Student Profile.The Pancasila Student Profile is a framework of character and competencies expected of Indonesian students, based on the noble values of Pancasila. This profile is designed to shape students as lifelong learners with a strong national identity and the ability to adapt to global challenges (Zein et al., 2023). The components of the Pancasila Student Profile are regulated in the Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia Number 17 of 2021 concerning National Assessment Article 3 paragraph 7, namely: (1) believing in and being pious to God Almighty and having noble morals; (2) critical reasoning; (3) independent; (4) creative; (5) working together; and (6) being globally diverse. This principle emphasizes values such as responsibility, tolerance, and national identity, which can be strengthened through ecoliteracy (Minsih et al., 2025; Muhdhar et al., 2024). In line with Pancasila Profile Student Principle, specifically dimensions 1, 2, 4, and 5, ecoliteracy can also help students develop awareness and responsibility towards the environment. In addition, ecoliteracy is also related to character education which is oriented towards developing good social attitudes and responsible behavior towards the environment in students (Kholifaturrohmah et al., 2023). For example, the Adiwiyata program, a environmental care school program, in schools in Indonesia has been proven to increase students' ecological literacy by instilling an attitude of environmental concern through activities such as waste recycling and composting (Febriani et al., 2020).

Several previous studies have highlighted the importance of ecoliteracy in elementary schools. First, the study focused on environment-based learning models, which were deemed effective in improving elementary school students' ecoliteracy, with a very high success rate of 94.8%, and successfully engaging

and engaging students (Anasta et al., 2025). These findings confirm that environment-based learning can foster more meaningful learning experiences. Other research highlights the environmental awareness of school students. Febriasari & Supriatna (2017) shows that elementary school students' environmental literacy can be improved through the Problem-Based Learning model, with careful planning to achieve maximum results. However, research also shows that environmental education in green schools and regular schools does not significantly differ in students' environmental behavior, as other factors play a role in modifying students' environmental behavior (Tavakoli et al., 2019).

Although previous studies have examined environmental education in schools, few studies have systematically synthesized the opportunities and challenges of implementing ecoliteracy specifically in Indonesian elementary schools. Despite their significant contributions, these previous studies have limitations, such as their emphasis on general environmental education, without specifically prioritizing ecoliteracy as an integrated competency encompassing ecological knowledge, attitudes, and skills. First, previous studies have tended to focus on specific aspects in isolation, such as learning models or improving environmental awareness, without linking ecoliteracy to the dimensions of knowledge, attitudes, and skills as a unified concept. Furthermore, some studies were conducted in limited and partial contexts, thus failing to provide a comprehensive picture of the opportunities and challenges of ecoliteracy implementation, particularly at the elementary school level in Indonesia. Furthermore, existing research findings are still narrative in nature and have not utilized a Systematic Literature Review (SLR) approach, which allows for a more structured and transparent synthesis of evidence. Therefore, this study offers a distinct contribution by systematically synthesizing the literature found to identify patterns, gaps, and relationships between various factors influencing ecoliteracy implementation in elementary schools.

In simple terms, the opportunities that can be applied from ecoliteracy in Indonesian elementary schools, namely by integrating environmental issues based on local wisdom in the elementary school curriculum, can help students understand ecological issues from a local perspective, which in turn can improve environmental management in the future (Sarbaini et al., 2022). However, simultaneously the challenges that arise are that many teachers still do not understand ecological education and face limited resources and policy support in implementing environmental education (Farahiba et al., 2025).

Based on the preceding discussion, this study addresses the following research question: What patterns of opportunities and challenges emerge from existing literature on the implementation of ecoliteracy in Indonesian elementary education? Accordingly, the study aims to systematically indentify, analyze, and synthesize the existing studies in order to reveal patterns of opportunities and challenges implementation of ecoliteracy at the elementary school level in Indonesia. It seeks to provide an evidence-based overview that may inform future research and support teachers, schools, and policymakers in developing more environmentally responsive educational practices. Furthermore, this study contributes to the field by addressing the current fragmentation of the literature and offering a more coherent understanding of the issue. Therefore, this study contributes by providing a comprehensive synthesis of global research findings and contextualizing them within the Indonesian elementary education system.

Methods

This study uses a qualitative approach with a systematic literature review method to analyze relevant research on the implementation of ecoliteracy in elementary schools. The systematic literature review method is a research method used to analyze, evaluate, and investigate published research findings based on a specific theme or subject with a different objective than the research being studied to avoid bias and demonstrate completeness (Fauziyyah & Iswara, 2024; Sugara & Sugito, 2022). To ensure this research is organized systematically and accurately, this study followed the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) guidelines, which consist of three stages: identification, screening and eligibility, and inclusion and data extraction. In the identification stage, relevant articles were collected from the Scopus database using the following keywords: ("ecoliteracy" OR "ecological literacy" OR

"environmental education") AND ("primary school" OR "elementary school") AND ("implementation" OR "opportunities" OR "challenges" OR "barriers") AND ("green school" OR "Adiwiyata program") AND ("ecoliteracy" OR "environmental literacy") AND ("primary school" OR "elementary school").

Table 1. Keywords used in searching for articles

Keywords	Total
("ecoliteracy" OR "ecological literacy" OR "environmental education") AND ("primary school" OR "elementary school") AND ("implementation" OR "opportunities" OR "challenges" OR "barriers")	148

Table 1 displays several keywords related to ecoliteracy. The selection of these keywords refers to the equivalents of ecoliteracy and other related words. The Scopus database identified 148 articles related to ecoliteracy in elementary schools. The collected articles were then selected based on the following criteria.

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Journal Articles, Book Proceedings	Book Chapters, Book Reviews
Articles published between 2020 and 2025	Articles published before 2020
Articles in English	Articles in non-English
Full articles	Invalid articles
Related to ecoliteracy in elementary school	Related to ecoliteracy but not related to elementary school

In the identification stage, the initial search yielded 148 articles from the Scopus database based on predetermined keywords. Next, in the screening stage, the 148 articles were selected based on their titles and abstracts to ensure the content aligns with the discussion of ecoliteracy implementation in elementary schools. At this stage, 88 articles were either irrelevant to the ecoliteracy context or contained ecoliteracy applications that did not focus on elementary school levels. These 88 articles were eliminated, leaving 60 articles. The next stage involved assessing the eligibility of the 60 articles, which were thoroughly reviewed through full-text reading. Articles were eliminated based on several criteria, including: (1) articles not specifically discussing ecoliteracy implementation, (2) not within the context of elementary education, (3) solely conceptual studies without relevant empirical data, and (4) limited access to the full text.

After this process, 16 articles met all inclusion criteria and were deemed relevant for further analysis. These articles were then used as the basis for data extraction and synthesis to identify patterns of opportunities and challenges for implementing ecoliteracy in elementary schools. The entire article selection process is presented transparently through the PRISMA diagram in Figure 1.

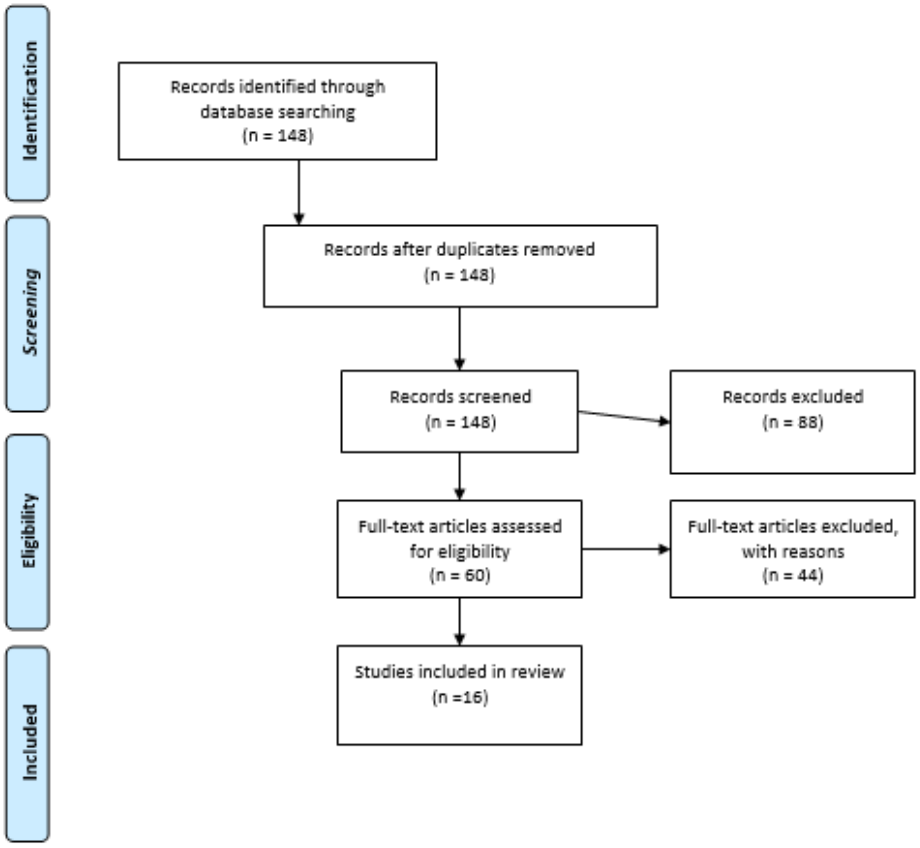

Figure 1. PRISMA diagram of the article selection process

Results

The results of this study are in the form of two tables containing articles that have been reviewed in depth. Table 3 shows the results of the study, including the year of publication of the articles and the publication ranking. Based on the findings, it is known that ecoliteracy is a fresh topic for discussion. This is known from the findings that show 148 articles on the opportunities and challenges of implementing ecoliteracy in elementary schools in reputable Scopus journals published in the past five years. Based on the findings, it is known that 11 of the 16 manuscripts that have been reviewed are Q1 accredited articles. This indicates that the theme of ecoliteracy in elementary schools has an urgency to be researched. The following is the result of the research mapping on the opportunities and challenges of implementing ecoliteracy in elementary schools conducted by researchers based on publisher and journal ranking.

Table 3. Indexed Journal Publication

Years	Publisher	Total	Rank
2020	E3S Web of Conferences 202	1	Non Q
2021	Environmental Educational Research	1	Q1
2021	Education Policy Analysis Archives	1	Q2
2021	IOP Conference Series: Earth and Environmental Science	1	Non Q
2022	Sustainability	1	Q1
2022	International Journal of Environmental Research and Public Health	1	Q2
2023	International Journal of Educational Development	1	Q1
2023	Sustainability	1	Q1

Years	Publisher	Total	Rank
2023	Journal of Outdoor and Environmental Education	1	Q2
2023	European Journal of Science and Mathematics Education	1	Q2
2023	Kasetsart Journal of Social Sciences	1	Q3
2024	Discover Sustainability	1	Q1
2024	International Research in Geographical and Environmental Education	1	Q1
2024	European Journal of Educational Research	1	Q3
2025	Geographical Research	1	Q1
2025	Marine Policy	1	Q1

Following the presentation of Table 3, which details the year of publication, publisher, and journal ranking, Table 4 presents the authors' names, research methods used, and findings regarding the opportunities and challenges of implementing ecoliteracy in elementary schools in various countries. The following are findings regarding the opportunities and challenges of implementing ecoliteracy in elementary schools based on the results of the researchers' review.

Table 4. Indexed Journal Publication

Authors	Type	Findings
Mulyadi	Qualitative	Ecoliteracy can be integrated with other subjects and can be carried out through field practice.
Gan	Qualitative	Many school principals have not prioritized ecoliteracy in learning in elementary schools.
Utaya & Wafaretta	Qualitative	Ecoliteracy is allocated specifically for 1 hour in environmental learning.
Gan	Qualitative	Ecoliteracy is integrated with democracy and citizenship education because social issues are always related to power which has an impact on justice.
Valenzuela-Morales dkk	Quantitative	Ecoliteracy is difficult to implement for students who have easy access to water and resources compared to students who have to pay for water and resources.
Yang, dkk	Quantitative	Narrative-based education can effectively increase ecoliteracy as reflected in environmental knowledge and attitudes, but is not significant in pro-environmental attitudes.
Piscova, dkk	Evaluation	Ecoliteracy is not taught as a standalone subject in elementary school, but is integrated into other subjects. However, ecoliteracy is considered important to be taught separately from other subjects.
Suarez, dkk	Quantitative	The inclusion of educational topics for sustainable development in primary and secondary education institutions in Colombia is in line with the country's laws governing education, especially the issues of water resource conservation and the protection of fauna and flora which are crucial for promoting sustainable practices.
Gugssa	Qualitative	Ecoliteracy must be hands-on, place-based, and involve students taking local action. Challenges in implementing ecoliteracy include class size, teacher capacity, and safety.
Vioreza, dkk	Quantitative	Eco-literacy can be enhanced through the Pancasila Student Profile Strengthening Project by utilizing local Betawi food.
Balazova, dkk	Qualitative	There are misperceptions about ecoliteracy among primary school students in Slovakia.
Gal	Qualitative	Ecoliteracy has the potential to contribute to the preservation of endangered species and increase students' opportunities to live in nature and lead positive changes to the natural environment.
Zhou	Qualitative	Ecoliteracy can be integrated with classroom learning and extracurricular activities, but the implementation of ecoliteracy faces

Authors	Type	Findings
		challenges such as academic pressure, consistency, and low professionalism.
Gugssa	Qualitative	Teachers encounter obstacles in teaching ecoliteracy such as competency, administration and logistics, safety, and attitude.
Satchwell, dkk	Qualitative	Ecoliteracy can be applied to elementary school students across countries simultaneously, such as in England and Fiji.
Lee & Liu	Qualitative	There is a certain amount of resistance to ecoliteracy from some teachers, a lack of professional competence among teachers, and limited teaching time.

Table 4 presents a pattern of opportunities and challenges that emerged in the literature on ecoliteracy implementation in Indonesian elementary schools. Research findings indicate that one of the main opportunities for ecoliteracy implementation lies in its flexible and contextual nature, allowing for the integration of ecoliteracy with various elementary school subjects. Based on the findings from various studies in Table 4, it is known that ecoliteracy is not simply understood as supplementary material, but rather functions as a cross-disciplinary approach that connects environmental issues to students' daily experiences and local contexts. The findings in Table 4 also indicate that ecoliteracy implementation has significant opportunities for development through collaboration between schools, communities, governments, and international cooperation. These findings indicate that ecoliteracy has the potential to go beyond classroom learning activities and become part of social engagement and sustainability practices in the community.

However, based on the findings in Table 4, it is also known that there are patterns of challenges that could arise in implementing ecoliteracy in Indonesian elementary schools. One challenge that is likely to arise is the tendency of schools to view ecoliteracy as merely a temporary program, rather than as an ecological culture integrated into daily school practices. These results indicate that the internalization of ecological values within the school system and culture is still less than optimal. Furthermore, the literature consistently shows that limited teacher competency, a lack of school leadership, and low administrative readiness are the main obstacles to ecoliteracy implementation. These conditions indicate that the success of ecoliteracy implementation is not solely determined by the existence of an environmental curriculum or program, but is also greatly influenced by the capacity of human resources and the school's institutional environment.

Discussion

Opportunities for Implementing Ecoliteracy in Indonesian Elementary Schools

The implementation of ecoliteracy in elementary schools has significant potential for development in Indonesia. Experiences from various countries, such as Japan and China, demonstrate that ecoliteracy can be integrated with other subjects, such as Natural Sciences (IPA), Social Sciences (IPS), and Seikatsu (daily life) (Mulyadi, 2020; Zhou, 2024). This clarifies that ecoliteracy should not be positioned as a standalone discipline, but rather as a contextual, cross-curricular approach. In the context of Indonesian education, this flexibility becomes even more relevant with the introduction of the Independent Curriculum, which grants teachers the autonomy to design adaptive, student-centered learning. This is reinforced by the nature of the Kurikulum Merdeka, which provides flexibility for teachers to develop more contextual learning, such as linking subjects to Ecoliteracy. In addition, Indonesian schools can provide special guidance for teachers (such as the Teacher's Guide to Environmental Education in Japan) so that implementation is consistent.

One prominent opportunity is the implementation of ecoliteracy through the Pancasila Student Profile Strengthening Project (P5), particularly with themes such as sustainable lifestyles, local wisdom, and mutual cooperation. P5 aims to develop students' character in accordance with Pancasila values, including

environmental awareness, which is part of ecoliteracy. Research by Vioreza, Supriatna, & Hakam (2023) showed positive results that implementing P5 using local Betawi food can significantly increase students' ecoliteracy levels. This activity aligns with the character of Indonesian society, which is rich in local wisdom and collective social values. Ecoliteracy based on local culture has the potential to strengthen students' ecological identity while instilling moral responsibility for the sustainability of their surrounding environment. The integration of local values in the implementation of ecoliteracy in elementary schools is not merely complementary; local values also play a crucial role in building meaningful ecological awareness.

In addition to project-based learning, opportunities for ecoliteracy can also be developed through hands-on, experiential learning. Students can conduct observations, experiments, and natural activities in their surrounding environments, which serve as living laboratories, such as rice fields, rivers, and gardens (Utaya & Wafaretta, 2021). These activities allow schools to expand learning into extracurricular activities such as composting, waste processing, or plant nurseries. These practices enable students not only to cognitively understand ecological concepts but also to implement them in real-life situations. These practices also align with contextual education in Indonesia, which emphasizes the connection between knowledge and the realities of community life. These findings indicate that effective ecoliteracy learning focuses not only on the cognitive dimension but also on the affective and psychomotor dimensions. This aligns with the contextual education approach, which emphasizes the connection between knowledge and the realities of life. However, the effectiveness of this approach is likely heavily influenced by awareness of a supportive learning environment, making it highly likely that implementation will differ across regions.

Another potential development opportunity is geographic context-based learning. Schools located in coastal or riverine areas have significant potential to link ecoliteracy to the surrounding environmental conditions. For example, in coastal schools, students could investigate seawater quality and its impact on marine life, while in riverside schools, students could learn to collect rainwater for irrigation and examine the effects of aerosols on climate change (Gan, 2021b). These activities can strengthen the relevance of ecoliteracy to students' real lives and support national programs such as Adiwiyata Schools which encourage an environmentally friendly culture in schools. This suggests that the relevance of local context can increase student engagement and strengthen the meaning of learning. This finding strengthens the argument that ecoliteracy will be more effective if it is directly linked to students' lived experiences. However, on the other hand, the reliance on geographic context also indicates a gap in opportunities between schools, particularly for schools located in environments with limited natural resources available for learning.

Ecoliteracy also has the potential to be integrated with democracy and citizenship education in elementary schools. This integration has been implemented in several coastal and river schools, where students engage in dialogue with local government officials, such as the mayor, to discuss environmental issues (Gan, 2021b). This indicates that ecoliteracy is not only related to environmental awareness, but also to social participation and critical awareness of public issues. The integration of ecoliteracy with democracy and citizenship is very relevant to conditions in Indonesia, helping students understand that there is a relationship between environmental issues, social structures, and power, and fostering awareness of the importance of social and ecological justice. These findings expand on previous perspectives that ecoliteracy can be a means of developing ecological citizenship competencies. In the Indonesian context, this is particularly relevant given the importance of developing a generation that not only cares about the environment but also contributes to sustainable decision-making.

Meanwhile, from a global perspective, the inclusion of ecoliteracy in a country's curriculum significantly contributes to the sustainable development goals (SDGs) set by the United Nations, which have also been adopted by the Indonesian government. This opens up opportunities for collaborative, multi-sectoral learning to achieve these goals, such as establishing partnerships with local communities, NGOs, and stakeholders to engage students in real-world sustainable initiatives (Suárez et al., 2023). This cross-sector partnership encourages the implementation of hands-on, activity-based learning, such as

reforestation, waste management, and water conservation. This can lead to increased student engagement in community environmental programs, enabling ecoliteracy to become more than just a classroom activity but also a part of everyday Indonesian practice. This indicates that a collaborative approach can increase the relevance and impact of learning. However, implementing this collaboration requires strong structural support, so not all schools have the same capacity to develop it.

Ecoliteracy also has the potential to contribute to the preservation of endangered species and the development of ecological empathy in students. Gal (2024) argues that ecoliteracy increases students' ability to coexist with nature, fostering a sense of calm and comfort, and increasing their efficacy in recognizing that they can lead positive environmental change. This is highly relevant to the values of character education in Indonesia, which emphasizes spirituality, responsibility, and social awareness. This suggests that ecoliteracy plays a role in fostering emotional connections between humans and the environment, which is a crucial factor in driving long-term behavioral change. This reinforces previous literature emphasizing that environmental awareness alone is insufficient without an emotional connection to nature.

Finally, eco-literacy can also be implemented simultaneously in elementary schools across countries by connecting elementary school students, as has been done between elementary schools from England and elementary schools from Fiji. This can increase elementary school students' understanding of climate change. Elementary school students from England, who already have knowledge about climate change, deforestation, air and ocean pollution, and other issues, can build friendships with elementary school students from Fiji, whose environment is more vulnerable to disasters. In addition, elementary school students in England also learn firsthand about other extreme events in Fiji. Meanwhile, elementary school students from Fiji learn about the lives of elementary school students from England, including about the environment in England (Satchwell et al., 2025). These findings show that ecoliteracy is not only local, but also has a global dimension that is important to develop. This can be adapted in Indonesia as a model for environmental knowledge exchange. This exchange not only enables Indonesian students to understand global ecological challenges but also fosters cross-cultural solidarity and a sense of responsibility as global citizens. However, its implementation requires adequate technological and policy support.

Based on the synthesis results, it is known that ecoliteracy has unique conceptual boundaries. Ecoliteracy has a deeper and more emotional position than environmental education because it focuses more on ecological roots, compared to Education for Sustainable Development, which tends to be comprehensive because it emphasizes the socio-economic-environmental dimensions. Overall, the opportunities for implementing ecoliteracy in Indonesian elementary schools are vast. Policy support through the Independent Curriculum, the diversity of local ecosystems, and the cultural wisdom of communities provide significant capital for developing contextual, collaborative, and sustainable ecoliteracy education. Schools can synergize with the community and government, so that ecoliteracy has the potential to become a crucial foundation for developing Indonesian students who are ecologically intelligent, imbued with Pancasila character, and empowered to protect the earth in the future.

Challenges for Implementing Ecoliteracy in Indonesian Elementary Schools

While implementing ecoliteracy in elementary schools offers significant potential, it is also likely to face various challenges stemming from cultural aspects, policies, curriculum, and human resource readiness. In terms of culture and customs, Japan is often cited as an example of successful ecoliteracy implementation through instilling responsibility from an early age. Elementary school students in Japan are accustomed to cleaning their classrooms and school grounds without the assistance of janitors, as a form of discipline and environmental stewardship (Mulyadi, 2020). This indicates that the success of ecoliteracy depends not only on formal educational interventions but also on the internalization of values in everyday culture. Conversely, in the Indonesian context, environmental awareness practices tend to be incidental and have not yet become a collective habit within the school environment. The reliance on janitors indicates that ecoliteracy learning has not been fully internalized in students' daily practices. These findings highlight

that the main challenge of implementing ecoliteracy in elementary schools in the Indonesian context lies not only in the pedagogical aspect but also in the broader transformation of school culture.

In terms of teachers and their competencies, another challenge arises from teachers' limited understanding of the holistic concept of ecoliteracy. Findings from China, Ethiopia, and Taiwan indicate that teachers face academic pressure, inconsistent implementation, and a lack of professionalism, as evidenced by a lack of awareness or understanding among teachers of the ecoliteracy spectrum, which encompasses not only environmental issues but also social, economic, and cultural dimensions considered essential for a holistic approach to sustainability (Awayehu Gugssa, 2025; Lee & Liu, 2025; Zhou, 2024). This finding indicates that there is a gap between theoretical concepts and pedagogical practices in the field. A similar situation could potentially occur in Indonesia, where teachers lack the pedagogical and practical skills to integrate ecoliteracy concepts into interdisciplinary learning. Therefore, teachers' capacity to integrate ecoliteracy concepts must be enhanced to ensure effective, efficient, and contextual learning (Kosta et al., 2025).

The next challenge concerns school leadership and management. Research by Gan (2021a) and Lee & Liu (2025) shows that in several countries, such as Israel and Taiwan, principals still struggle to implement ecoliteracy-based leadership because they haven't yet integrated environmental and climate change issues into their school vision and programs. This shows that without visionary leadership, ecoliteracy risks being reduced to an unsustainable symbolic program. This situation is also relevant to the situation in Indonesia, where some principals have not yet prioritized ecological issues in school management. Without the support of visionary leadership, ecoliteracy integration efforts risk becoming symbolic activities without sustainability.

If examined through the dimensions of curriculum policy, the main challenge in Indonesia is the absence of explicit guidelines on eco-leveling in formal curriculum documents (Utaya & Wafaretta, 2021). Indonesia can reflect on the education curriculum in Slovakia which has environmental standards in its curriculum that include biodiversity conservation, deforestation, soil erosion, rational use of natural resources, air pollution, groundwater, ozone layer depletion, acid rain, greenhouse effect, energy consumption, waste management, urbanization and population growth that are managed sustainably (Piscová et al., 2023).

Furthermore, social and economic contextual factors also pose challenges in developing students' ecoliteracy. Research in Colombia shows that students with access to natural resources, such as clean water, tend to have lower levels of ecoliteracy than those who struggle to obtain these resources (Valenzuela-Morales et al., 2022). These findings suggest that direct experience with resource constraints can be a crucial factor in developing ecological awareness. In the Indonesian context, this indicates a potential gap in understanding environmental issues between urban and rural students, necessitating adaptation of learning approaches to each individual's social context.

Furthermore, from a learning perspective, another potential challenge is the sustainability of ecoliteracy practices in schools. Ecoliteracy cannot be developed solely through imparting knowledge; it requires repeated practice and real-world experiences. This is because behavioral change, including pro-environmental behavior, is a slow process. Furthermore, these practices must be integrated into out-of-class learning to stimulate children's emotional attachment to the natural environment, resulting in positive interactions with the environment and encouraging changes in behavioral habits (Yang et al., 2022). This indicates that temporary learning approaches or short-term projects are less effective in forming sustainable habits. It also emphasizes the importance of repeated experiences and emotional engagement in developing ecological behavior.

Another equally important challenge is students' limited conceptual understanding of ecoliteracy terms and concepts. Research in Slovakia shows that many elementary school students still misunderstand terms related to ecoliteracy (Balážová et al., 2024). This indicates that the learning approach used is not yet fully effective in building in-depth understanding. In the Indonesian context, this situation indicates the

need for more adaptive and communicative pedagogical strategies so that students can understand the concept of ecoliteracy more contextually.

Finally, Gugssa (2023) research in Ethiopia reminds us that ecoliteracy focused solely on knowledge is insufficient to foster environmentally responsible behavior. A knowledge-based approach needs to be balanced with a participatory and contextual approach that engages students in concrete actions. This indicates a gap between "knowing" and "doing" in ecoliteracy. In the Indonesian context, these findings reinforce the need to develop a more participatory and action-based learning approach, so that students not only understand environmental issues but also actively engage in sustainable practices.

Overall, the potential challenges to implementing ecoliteracy in elementary schools in Indonesia encompass cultural aspects, curriculum, human resources, and learning approaches. To address these challenges, collaborative efforts are needed between the government, schools, teachers, and the community to build a consistent and sustainable ecological culture. Furthermore, strengthening other aspects such as teacher capacity, an explicit curriculum addressing environmental issues, and developing sustainability-based school leadership are also key to realizing effective ecoliteracy implementation in Indonesia.

Conclusion

Ecoliteracy plays a strategic role in developing empowered elementary school students with Pancasila character and environmental awareness. Ecoliteracy has significant potential for implementation in Indonesia due to its flexibility, the availability of abundant natural resources, and the richness of cultural values and local wisdom, which can serve as contextual media for ecoliteracy learning. Ecoliteracy can be integrated with the Pancasila Student Profile Project, nature-based activities, and cross-sector collaboration, giving Indonesian elementary schools significant potential for instilling ecological awareness from an early age. However, this study also shows that there are complex and multidimensional challenges in implementing ecoliteracy. Factors such as an undeveloped culture of discipline, limited teacher competency, weak sustainability-based school leadership, and the lack of explicit ecoliteracy in the curriculum are obstacles that must be considered if ecoliteracy is to be implemented in elementary schools. Furthermore, students' understanding of the concept of ecoliteracy remains superficial and has not been internalized as a daily value. This situation indicates that efforts to develop ecoliteracy in Indonesia cannot stop at the discourse level but must address the transformation of the education system as a whole, from policy and practice to school culture.

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