



The implementation of ecopedagogy in school education: A systematic literature review emphasizing elementary level contexts

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ABSTRACT

Background: The increasing degradation of ecosystems and climate change underscores the importance of implementing ecopedagogy in elementary education to foster students' ecological awareness. However, based on similar literature reviews, research on ecopedagogy at this educational level remains limited compared to studies conducted at the secondary school level. **Methods:** The method employed is an SLR using the PRISMA approach. Articles and journals were collected using tools such as Watase UAKE and Harzing's Publish or Perish, which are integrated with the Scopus API to assist in retrieving indexed literature (Q1-Q4) from databases including ERIC, Elsevier, Emerald, MDPI, ScienceDirect, Springer, Taylor & Francis, and Wiley Online Library. The critical analysis drew exclusively on articles published in peer-reviewed journals. The researcher also ranked and selected the top 10 most-cited and relevant articles for further analysis. **Findings:** The effective implementation of ecopedagogy through appropriate strategies offers several advantages in enhancing elementary students' environmental literacy and strengthening collaboration among teachers and school stakeholders by integrating local cultural values and technology, involving school organizations, applying storytelling-based approaches, and enhancing digital STEAM practices. These competencies are essential to equipping students with the skills they need to face future challenges. **Conclusion:** Environmental education in elementary schools can serve as a crucial foundation for developing sustainability competencies among Indonesia's younger generation when designed through the integration of direct experiences and strong education policy. However, this sector continues to face several constraints, including conceptual and methodological gaps, geographical disparities, and limitations in human resource capacity. **Novelty/Originality of this article:** Based on previous relevant literature, there is still a limited number of studies that have applied the SLR method to examine ecopedagogy in elementary education, especially in Indonesia. Thus, this study employs an SLR approach to expand future methodological perspectives and to discuss the implementation of ecopedagogy within the global elementary education context.

KEYWORDS: ecopedagogy; elementary education; environment; sustainability.

1. Introduction

The issue of the environmental crisis has become a complex global challenge that requires an educational approach capable of fostering ecological awareness from an early age (Ardoin & Bowers, 2020). Environmental education is no longer sufficient if it merely emphasizes factual knowledge about nature; instead, it must transform into an education that cultivates values, attitudes, and behaviors that reflect care for the sustainability of

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life (Ardoin et al., 2020). In this context, ecopedagogy emerges as a critical educational paradigm that emphasizes a harmonious relationship between humans and the environment within the framework of social and ecological justice (Hindhede, 2024).

The concept of ecopedagogy is rooted in the ideas of critical pedagogy developed by Paulo Freire, which were later adapted to address contemporary ecological challenges (Jones, 2023). This approach not only emphasizes the transfer of information about environmental issues but also the development of critical consciousness toward social inequality and the exploitation of nature (Hjorth Warlenius, 2022). Therefore, ecopedagogy is highly relevant to be integrated into the education system, particularly at the elementary school level, where the formation of environmental values and character begins to take shape (Korsant, 2024).

In Indonesia, the implementation of ecology-based education in elementary schools has been pursued through various programs, such as the *Adiwiyata School Program* and environmentally themed curricula since 2006 (Megawati et al., 2022). This condition is undoubtedly driven by the low level of environmental awareness among students, which has become a matter of public concern. This issue often arises because many schools have not been able to anticipate the emergence of such student behaviors, even though schools and the quality of students' surrounding environments are the primary determining factors (Rahmania, 2024). However, in practice, most schools have not prioritized environmental education issues (Husin et al., 2025).

Based on the findings of a study conducted by Sumirat et al. (2023), the low level of environmental literacy among elementary school students, particularly in public schools located in rural areas is influenced by several factors. These factors include the limited availability of learning resources for students, the suboptimal approaches and strategies employed by teachers in integrating environmental education, and the low level of students' awareness and concern toward environmental issues. According to the findings of a study conducted by Ainin & Asafri (2023), several factors contribute to the low level of environmental literacy among students in Indonesia. One of the primary factors is the limited understanding and knowledge students have about environmental issues. This condition may result from a curriculum that has not yet fully integrated environmental topics in a comprehensive manner, as well as from students' limited access to adequate information sources and educational resources. In addition, the low level of students' environmental awareness and concern highlights the urgent need for more intensive educational interventions. Many students still lack a holistic understanding of the importance of environmental preservation and the negative consequences that may result from environmental degradation.

Therefore, it is essential to equip students with knowledge and understanding from the moment they begin formal education and to ensure its application in real-life contexts (Kong, 2021). The attitude of environmental awareness must be cultivated from an early age, as human life and daily activities are inherently connected to the environment, which consequently must be protected and preserved continuously (Whitburn et al., 2023).

Furthermore, elementary education represents the most strategic phase for instilling the values of sustainability. Children at this age have a high potential to develop empathy and environmentally friendly habits when the approaches used are participatory and contextually relevant (Ardoin & Bowers, 2020). Considering this issue, there is a strong need for extensive literature studies on environmental education in elementary schools, particularly research on ecopedagogy based on the Systematic Literature Review (SLR) approach. Such studies are essential for enabling educators and school stakeholders to gain broader insights into this topic and to facilitate its practical implementation.

However, based on previous relevant literature especially within the Indonesian context, research on ecopedagogy at the elementary school level using the SLR method remains relatively scarce compared to other research methodologies applied to similar topics (Amaliati et al., 2024). Therefore, the researcher is interested in examining the topic of ecopedagogy through an SLR approach that also includes an analysis of international

journal articles. It is expected that the findings of this study will serve as a valuable reference for educators to consider and apply in their teaching practices.

Several global studies have shown that ecopedagogy is effective in fostering ecological empathy, enhancing social awareness, and strengthening students' critical thinking skills (Monte & Reis, 2021). Nevertheless, its effectiveness is highly influenced by cultural contexts, educational policies, and teachers' approaches to integrating ecological values into the learning process (Korsant, 2024). This condition underscores the importance of thoroughly reviewing international literature to understand how successful strategies have been implemented (Mielke et al., 2021).

A number of recent international studies provide preliminary insights into ecopedagogy practices that hold potential for transfer or adaptation within other educational contexts. Empirical findings indicate that the implementation of project-based learning models and outdoor learning activities can serve as effective means to foster ecological empathy while simultaneously enhancing students' critical thinking skills (Blades & Blades, 2021; Geo & Journal, 2024; Pirchio et al., 2021).

Nevertheless, several studies also emphasize that the desired behavioral changes are often influenced by the level of family and community involvement, as well as the sustainability of program implementation. Furthermore, the literature highlights the importance of avoiding approaches that focus solely on content delivery, instead advocating for participatory learning processes and collective actions that link knowledge with social transformation. In many cases, the successful implementation of ecopedagogy is characterized by the integration of local values and cultural practices that strengthen the meaning and relevance of learning experiences for students (Darracott, 2024).

Meanwhile, a similar study on the implementation of ecopedagogy within the context of elementary education in Indonesia was previously conducted by (Mohamad Sabilli Firman Syah, 2022) using a qualitative approach, and the findings indicate that the concept of ecopedagogy was implemented through eco-green programs, which successfully fostered students' ecological awareness and skills in environmental conservation. However, this study has a notable limitation, as its implementation was confined to a specific cultural context (Sukosewu Village), which may not reflect the experiences of communities with different cultural and educational backgrounds. Another related study was carried out by by Setiadi et al. (2023) using a quantitative approach. The findings of that study indicated a positive relationship between ecoliteracy competence and environmental conservation efforts. These results underscore the importance of fostering an understanding of ecoliteracy competencies beginning at the elementary education level. However, the study had several limitations, particularly regarding its geographic scope, which was restricted to only five districts/cities in Indonesia. For this reason, the researchers recommended expanding the research coverage to obtain a broader and more comprehensive perspective.

Therefore, to address the limitations found in previous similar studies, the researcher expanded the scope of the literature by including reputable international journals to ensure the validity of the findings. Considering that research on ecopedagogy in Indonesian elementary schools is still rarely published in reputable Scopus-indexed international journals, the researcher broadened the literature review to a global context. By examining global literature on ecopedagogy in elementary education, this study aims to identify trends and the implementation of the ecopedagogy approach that has been developed in various countries through the synthesis of findings from each study in order to determine its relevance and potential adaptation within the Indonesian education system. The Systematic Literature Review (SLR) approach was chosen because it enables the synthesis of various research findings in a systematic, transparent, and replicable manner (Shaheen et al., 2023). Through the SLR, this study maps existing empirical findings with the expectation that the results will serve as a foundation for future research in Indonesia. This approach also allows for the development of a robust conceptual framework to adapt ecopedagogy within the local context.

This systematic review is expected to provide two primary forms of contribution. First, it seeks to fill the existing academic gap by mapping empirical findings related to the

implementation of ecopedagogy at the elementary school level within the 2020–2025 timeframe. Second, it aims to offer an evidence-based foundation that can be utilized to inform the development of adaptive practices and policies in Indonesia particularly those intended to enhance environmental literacy that is locally relevant, participatory in nature, and oriented toward concrete action. A comprehensive understanding of the range of effective interventions, their supporting and inhibiting factors, as well as strategies for local adaptation, serves as a key element in transforming policy objectives such as the *Adiwiyata* program and sustainability-oriented curricula into meaningful and sustainable educational practices within the school environment.

2. Methods

This study aims to explore research trends and examine the implementation of the ecopedagogy approach through various learning strategies that have the potential to enhance elementary school students' problem-solving skills through environmentally based learning activities. The study employs a qualitative approach with the primary goal of gaining an in-depth understanding of the phenomenon under investigation, while also providing new perspectives on existing knowledge related to the discussed topic.

To ensure the accuracy and relevance of the study, the selection of literature sources was carried out by applying the following inclusion and exclusion criteria. The inclusion criteria covered the studies discussed include research focusing on strategies for implementing ecopedagogy at the elementary school level; environmentally based learning models and approaches in primary education; the values promoted and the impacts of ecopedagogy implementation; the role of teachers and curriculum integration; as well as the challenges encountered and corresponding solutions. Only scholarly articles published in reputable, Scopus-indexed journals (Q1–Q4) employing qualitative, quantitative, or mixed-methods approaches were included in this review. Meanwhile, the exclusion criteria comprised studies that do not specifically focus on the ecopedagogy approach at the elementary school level; non-empirical articles; research with a scope that extends beyond the context of environmental-based education; and manuscripts available only in abstract form were excluded from the analysis.

For the next procedures related to searching and filtering, the literature search was conducted through several systematic stages. The first stage was the initial search, in which pre-determined keywords were entered into the Scopus database to obtain a list of potential studies. Following this step, a preliminary selection was carried out by screening the titles and abstracts of the identified studies to assess their initial alignment with the established inclusion criteria. The next stage involved a Full review of the Articles that passed the preliminary screening were read in full to ensure their relevance and contribution to the research focus. Afterward, thematic categorization was conducted by classifying the selected studies into several key themes related to ecopedagogy in elementary education, including implementation strategies, learning models or approaches, impacts and developed values, the role of teachers and curriculum integration, as well as challenges and proposed solutions. Finally, a comprehensive evaluation of the titles, abstracts, and full texts was undertaken during the final screening stage to identify and retain only those studies that fully satisfied all inclusion criteria.

The data sources for this research were obtained from a range of open-access scientific journal articles relevant to the research focus. The type of research used is a Systematic Literature Review (SLR), following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The research stages include defining eligibility criteria, identifying data sources, selecting relevant literature, extracting information, and categorizing the collected data. The review process was carried out through four main stages identification, screening, eligibility, and inclusion allowing the researcher to trace various literature sources to support the analysis and synthesis process of findings before finally reselecting articles based on the ranking of the top 10 most-cited and relevant studies for further examination.

The collection of journal articles and the keyword search process was carried out using the Watase Uake website (<https://watase.web.id/>) which was developed to facilitate collaboration among researchers in literature-based studies and provides several features, such as systematic literature search using the PRISMA approach, basic meta-analysis, article classification, and data visualization. In this process, the Harzing's Publish or Perish application is also used, both of which are integrated with the Scopus API to retrieve internationally indexed scientific sources within the Q1 to Q4 categories from databases including ERIC, Elsevier, Emerald, MDPI, ScienceDirect, Springer, Taylor & Francis, and Wiley Online Library.

All data used in this study were obtained exclusively from the Scopus database. The selection of Scopus was based on its reputation as one of the most multidisciplinary databases, encompassing scholarly publications in the fields of education, psychology, environmental studies, and other disciplines directly relevant to the topic of this research (Pranckutė, 2021). In addition to its broad coverage, Scopus is also recognized for the consistency of its metadata quality and its export features, which facilitate scientometric analysis (Singh et al., 2024). These characteristics ensure a high level of transparency and reproducibility throughout the scientific review process (Baas et al., 2020).

Table 1. Data retrieval strategy

Data Based	Scopus (Q1,Q2,Q3,Q4)
Keyword	"Ecological Pedagogy" OR "Environmental Pedagogy," OR "Environmental Sustainability" AND "Primary School" OR "Primary Education" OR "Elementary School" OR "Elementary Education")
Keyword Combination	TITLE-ABS-KEY ("Ecological Pedagogy in Primary School" OR " Environmental Pedagogy" OR "Environmental Sustainability") AND PUBYEAR >2019 AND PUBYEAR<2026 AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SUBJAREA, "ECO" AND "ENVI")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (EXACTKEYWORD, "Ecological Pedagogy"))
Data retrieval date: October 19th, 2025	

The analysis process also included several relevant articles published between 2020 and 2025 from other credible sources. The review included only articles published in English to maintain analytical consistency and ensure accessibility of the data, despite the inherent limitation of excluding non-English sources. The search procedure adopted a systematic approach by combining keywords with Boolean operators to retrieve a comprehensive yet targeted body of literature. The main search string used was in Table 1. To direct the focus of this literature review, the following research questions (RQs) were formulated and are summarized in Table 2.

Table 2. Research question

No.	Research Question (RQ)
RQ 1	What are the research trends regarding ecopedagogy in elementary schools within a global context?
RQ 2	How is ecopedagogy implemented in elementary schools?
RQ 3	What challenges are encountered during the implementation of ecopedagogy in elementary schools?
RQ 4	What findings emerged during the implementation process of ecopedagogy in elementary schools?
RQ 5	What are the recommended research focuses and methodological approaches for future studies on the application of ecopedagogy in elementary schools?

3. Results and Discussion

3.1 Frequency of publication every year

The annual publication frequency illustrates the intensity level of research conducted in the field of ecopedagogy or environmental sustainability at the elementary school level on a global scale. The data on the number of articles discussing ecopedagogy or environmental literacy topics during the 2020–2025 period, indexed in the Scopus database, are visually presented in Figure 1 below.

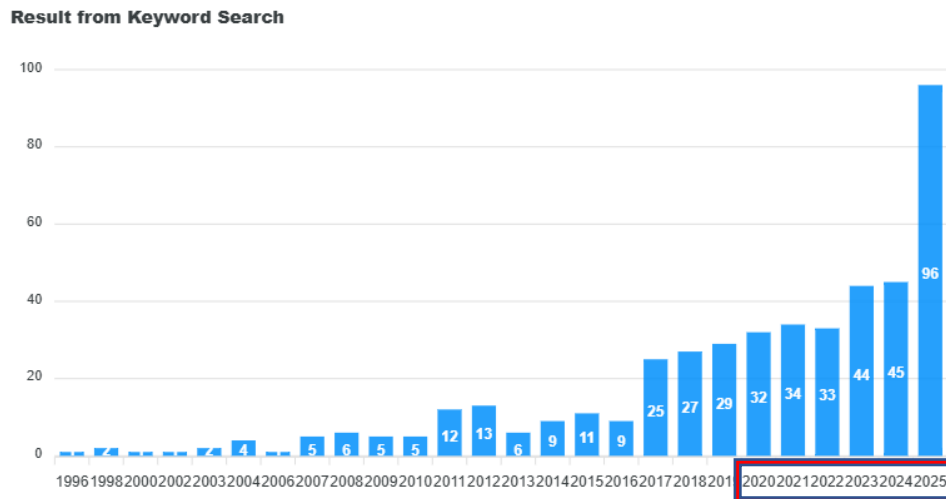


Fig. 1 Research trend from watase UAKE

Based on Figure 1, scientific studies focusing on the themes of ecopedagogy and environmental sustainability in elementary schools within the Scopus database have been identified from 2020 to 2025. During this period, publication trends indicate a consistent increase in the number of published articles. However, in 2022, there was a slight decline with 33 publications, before rising sharply in 2023 to 44 articles. The most significant increase, which also marks the highest achievement, was recorded in 2025 with a total of 96 publications. This developmental pattern suggests a continuous upward trend over the years, although fluctuations still occurred in certain periods.

The increase in the number of publications between 2023 and 2025 is estimated to be related to global government policies that encourage educational institutions to integrate environmental issues into their curricula. These curricula aim to strengthen students' awareness and understanding of environmental problems. For instance, in Indonesia, initiatives such as the *Adiwiyata* program and the implementation of the *Merdeka Belajar* curriculum—particularly within the P5 component (*Projek Penguatan Profil Pelajar Pancasila* or the Strengthening of the Pancasila Student Profile Project)—reflect this effort. The principles and practices embedded in this project are aligned with the concept of ecopedagogy, aiming to bridge gaps in environmental education practices within schools and to prepare future generations to be more conscious and responsible in managing sustainable environments (Adhani et al., 2024; Ariskayanti et al., 2024; Vioreza et al., 2023). The existence of such programs has undoubtedly contributed to the growing research trend on environmental education in schools, particularly at the elementary level. Therefore, this initiative has become one of the contributing factors driving researchers in the fields of education and environment to conduct more in-depth studies on this issue.

3.2 Testing using the PRISMA method

This study continued with testing using the PRISMA method Figure 2, the data collection process was carried out through an online search using several main keywords,

namely “Ecological Pedagogy in Primary School,” “Environmental Pedagogy,” and “Environmental Sustainability.” Based on the search results, a total of 458 articles (from 1996-2025) were identified as potentially relevant to the research topic. However, some articles did not meet the research criteria, as 147 duplicate records were found and subsequently removed prior to the screening stage. In addition, 123 articles were automatically excluded because they did not fall within the publication year range of 2020–2025. Furthermore, 19 articles were removed from the list for other reasons (Tier Q1–Q4). After the identification stage was completed, the study proceeded to the screening phase, leaving 169 articles. At this stage, 99 articles that did not meet the screening criteria were excluded, resulting in 70 articles selected for further review.

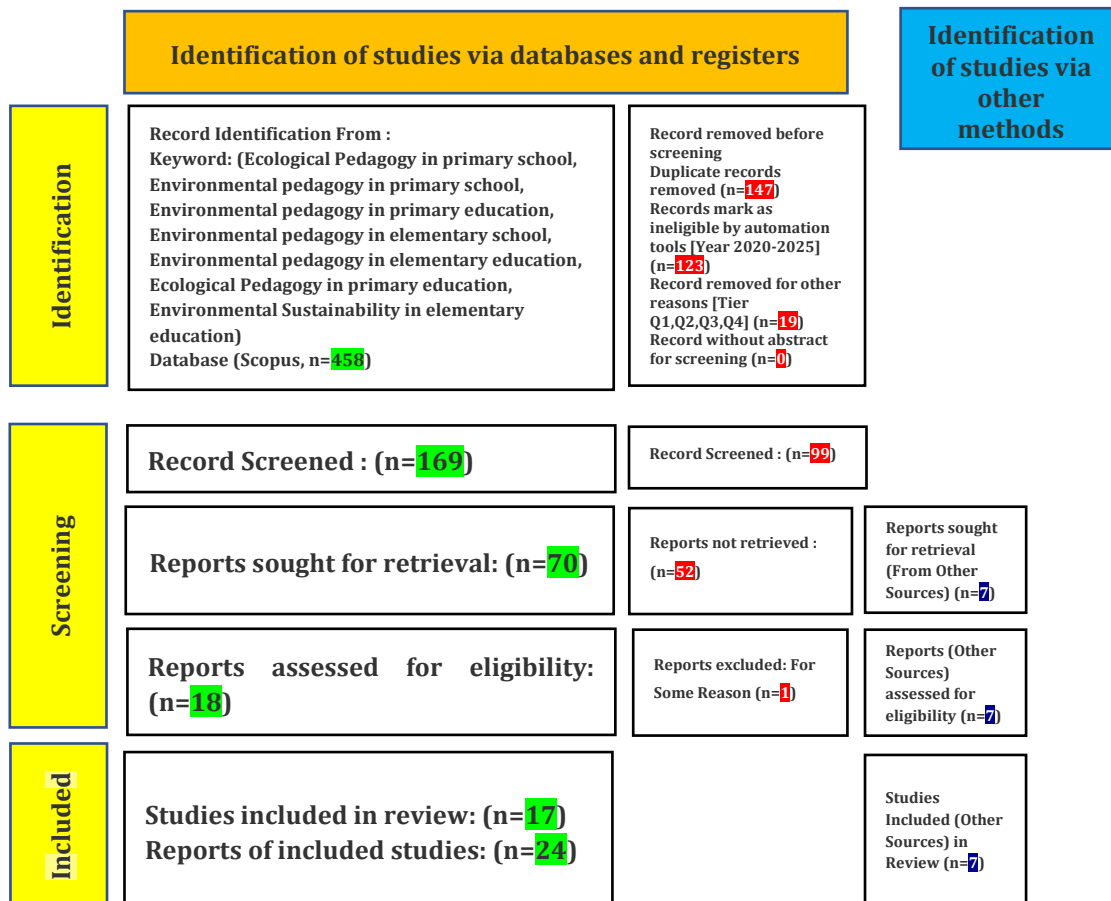


Fig. 2. PRISMA method from watase UAKE

The article selection stage involved an additional screening and refinement process focused on keywords related to “Ecological Pedagogy,” particularly in the context of implementation at the elementary school level. Based on this evaluation, 52 articles were excluded because they were not aligned with the research focus. Consequently, 18 articles were reviewed, with 1 additional article eliminated due to limited relevance, resulting in 17 eligible articles for analysis. Additionally, an extended search using alternative methods yielded 7 new articles, bringing the total to 24 articles included in the final analysis. The final stage involved a secondary screening based on the 10 most-cited articles to ensure the relevance and quality of the sources analyzed.

3.3 Final selection data based on the top 10 article citations

Based on the findings presented in Table 3, the most dominant type of research is qualitative. This condition reflects a tendency for various studies in the fields of environmental education and ecopedagogy to predominantly employ qualitative approaches. Such an approach is often chosen because of its strong capacity to examine the

complexity of the processes involved in developing ecological understanding (Caggiano & Weber, 2023). Through this method, researchers are able to explore in depth how individuals particularly students interpret and interact with various environmental issues. The focus of these studies ranges from conceptual understanding of ecosystems to practical skills in implementing sustainability principles.

Table 3. Top 10 citation scores

Country	Research Methods	Journal Type	Citation Scores
Spain	Quantitative (Random experiment)	Scopus Q1 (Sustainability)	134
Taiwan	Quantitative (SEM)	Scopus Q2 (Frontiers in Psychology)	48
Indonesia	Quantitative (Descriptive Percentage)	Scopus Q3 (International Journal of Education and Practice)	31
Poland	Qualitative (Descriptive)	Scopus Q1 (Energies)	27
Sweden	Qualitative	Scopus Q1 (The Journal of environmental education)	23
England	Qualitative	Scopus Q1 (Sustainability)	18
Columbia	Qualitative	Scopus Q1 (Sustainability)	17
Finland	Qualitative (Content Analysis)	Scopus Q2 (Cogent Education)	16
Europe	Qualitative	Scopus Q1 (Cultural Studies of Science Education)	11
Ethiopia	Qualitative	Scopus Q1 (International Journal of Educational Development)	8

The qualitative approach also provides opportunities for researchers to explore how individuals or students represent the relationship between humans and nature, envision alternative solutions to environmental problems, and cultivate personal ecological awareness and ethics. Thus, qualitative research serves as an essential instrument for identifying and understanding the profound and contextual dimensions of ecopedagogical literacy. The insights generated through this approach are generally richer and more reflective compared to those obtained through quantitative methods (Pyo et al., 2023). It plays a crucial role in uncovering and understanding the deeper and often hidden dimensions of ecopedagogy literacy. Through this approach, rich and contextually grounded insights can be obtained—insights that are often difficult to achieve through quantitative research methods. Nevertheless, there remains a research gap that requires further attention, particularly concerning studies on ecopedagogy at the elementary school level that are grounded in the specific framework of ecopedagogy, encompassing its core principles, critical theory, value dimensions, and philosophical concepts.

In addition, an analysis of several publications indicates that researchers in the fields of ecopedagogy and environmental literacy particularly at the elementary school level, have also employed quantitative approaches, although qualitative methods remain the most dominant. These studies generally focus on the development and validation of measurement instruments related to ecopedagogical or environmental literacy approaches, demonstrating high levels of validity and reliability, while also evaluating the effectiveness of various environmental education programs implemented in each respective country.

Meanwhile, research trends on ecopedagogy employing the Research & Development (R&D) method were not found among the top 10 cited articles. This indicates that studies using such a methodology remain relatively rare (Amaliati et al., 2024), thereby opening

opportunities for future researchers to explore this area further, particularly with a focus on developing innovative learning media or curriculum designs.

3.4 Overall main thematic analysis data

After conducting the main thematic analysis of ten international articles, it was revealed that ecopedagogy-based learning strategies in elementary schools are primarily oriented toward experiential learning, local contexts, and cross-disciplinary integration. The most dominant strategy identified was nature-based and experiential learning, as implemented by Collado et al. (2020), in which outdoor activities and environmental exploration proved effective in enhancing students' environmental awareness and pro-environmental attitudes. Meanwhile, other studies utilized technology to increase engagement (Chappell & Hetherington, 2024; Chen, 2022). A local wisdom-based approach emerged strongly in the Indonesian context, where Ali (2022) emphasized that embedding local cultural values into environmental learning materials makes the learning process more relevant for students. At the organizational level, the whole-school model or institutional strategy (Kuzmina et al., 2020) was also identified as an effective approach, as it transforms school practices holistically rather than through isolated classroom interventions. In more specific contexts such as electric mobility, (Turoń et al., 2021) proposed a gradual thematic strategy that adjusts content according to educational levels.

Table 4. Thematic analysis (main themes)

Main Theme	Description	Reference
Ecopedagogy Learning Strategy	Project-based learning and exploration of the surrounding environment.	(Collado et al., 2020), (Chappell & Hetherington, 2024), (Chen, 2022), (Ali, 2022), (Turoń et al., 2021), (Kuzmina et al., 2020)
Ecopedagogy Learning Approach and Model	Focuses on the interaction between pedagogy and innovative learning environments.	(Collado et al., 2020), (Ali, 2022), (Häggström, 2022), (Vesterinen, 2023), (Chappell & Hetherington, 2024), (Ramírez Suárez et al., 2023), (Gugssa, 2023)
Instilled Values and Impact of Ecopedagogy	Ecological awareness, environmental responsibility, and collaboration.	(Collado et al., 2020), (Häggström, 2022), (Vesterinen, 2023), (Chen, 2022), (Chappell & Hetherington, 2024)
The Role of Teachers and Curriculum	Teachers as ecopedagogical facilitators and policy support are already at their maximum.	(Ali, 2022), (Vesterinen, 2023), (Kuzmina et al., 2020), (Ramírez Suárez et al., 2023), (Gugssa, 2023), (Häggström, 2022)
Implementation Challenges	Addressing the challenges in providing ecopedagogy within the curriculum	(Ali, 2022), (Collado et al., 2020), (Chen, 2022), (Chappell & Hetherington, 2024), (Ramírez Suárez et al., 2023), (Kuzmina et al., 2020)

Regarding teaching approaches and learning models, the findings ranged from controlled experiments assessing intervention effects (Collado et al., 2020) to participatory and project-based approaches that foster student contribution (Häggström, 2022). Several studies highlighted the narrative or storyline approach as a framework for long-term projects (Häggström, 2022), while research on teacher guidebooks (Vesterinen, 2023) emphasized practical, adaptable instructional models. Interdisciplinary and digital STEAM-based approaches (Chappell & Hetherington, 2024) demonstrated learning designs that

integrate natural, technological, and cultural aspects to promote critical learning and action. On the other hand, descriptive studies on local practices (Ramírez Suárez et al., 2023) and (Gugssa, 2023) identified diverse models applied in real settings, highlighting the need for policy alignment and systemic support.

From the perspective of values and learning outcomes, most articles reported that ecopedagogical interventions generally succeed in improving environmental attitudes and sustainability competencies; however, evidence of tangible behavioral change was often weaker or required a longer period to manifest. (Collado et al., 2020) found a significant increase in environmental attitudes through nature-based programs, yet behavioral effects were smaller and less consistent. (Chen, 2022) demonstrated that augmented reality (AR) media can enhance engagement and self-efficacy, potentially fostering pro-environmental behavioral intentions, while (Vesterinen, 2023) emphasized the development of holistic competencies—knowledge, skills, and attitudes—through teacher guidebooks. Other studies (Häggström, 2022)(Chappell & Hetherington, 2024) showed that approaches fostering agency and creativity can lead to collective action and learning activism, although long-term behavioral impact depends on sustained facilitation and contextual factors.

Furthermore, the role of teachers and curriculum emerged as key factors in the successful implementation of ecopedagogy. Most articles underscored the importance of teachers as facilitators, learning designers, and mediators between students and ecological realities. (Ali, 2022) highlighted that teachers must be able to connect local wisdom with learning objectives, while (Vesterinen, 2023) and (Kuzmina et al., 2020) demonstrated that teacher guidebooks and administrative support enhance the sustainability of ESD/EE practices. (Häggström, 2022) and several field studies (Ramírez Suárez et al., 2023) (Gugssa, 2023) depicted teachers as co-designers who require training, time, and resources to prepare project-based or storyline activities. (Turoń et al., 2021) further noted that for technical topics such as electric mobility, age-appropriate materials and teacher training are essential to ensure effective curriculum integration.

Despite numerous positive outcomes, nearly all articles also identified significant challenges in implementing ecopedagogy at the elementary level. The most frequent barriers included limited resources (access to outdoor spaces or AR/STEAM technology), disparities among schools or regions, the need for ongoing teacher training, and structural or policy-related constraints. Collado et al. (2020), Chen (2022), and Chappell & Hetherington (2024) emphasized issues of technological access and inequality Kuzmina et al. (2020) and Ramírez Suárez et al. (2023) highlighted organizational barriers and the need for policy support for whole-school approaches; and Ali (2022) cautioned that variations in local wisdom require contextual adaptation to avoid superficial or symbolic integration. Overall, these challenges indicate that effective strategies require a combination of resources, training, institutional support, and cultural adaptation.

The synthesis results indicate that ecopedagogy in elementary education has evolved into a multidimensional approach that integrates direct experiences, cultural values, technological innovation, and social engagement. This approach not only focuses on ecological knowledge but also on character formation, critical awareness, and moral responsibility toward environmental sustainability. Therefore, strengthening teacher roles, ensuring curriculum flexibility, and providing institutional support are essential prerequisites for realizing a transformative and sustainable ecopedagogy-based education.

3.5 Overall data synthesis

Based on the synthesis of the ten analyzed studies in Table 5 reveals a consistent orientation within modern environmental education, emphasizing contextual learning, the use of diverse instructional media, and learning designs focused on strengthening elementary students' ecological attitudes, knowledge, and behaviors. In terms of research aims, most studies concentrate on how environmental education can shape pro-environmental behavior (Chen, 2022; Collado et al., 2020), how locally grounded curricula can enrich students' ecological awareness (Ali, 2022), and how new pedagogical

approaches—whether technology-based, narrative-driven, or modular can enhance students' sustainability competencies (Chappell & Hetherington, 2024; Häggström, 2022; Turoń et al., 2021). Other studies focus on evaluating ESD implementation at the elementary level, including school policies and teachers' roles in fostering a culture of sustainability (Gugssa, 2023; Kuzmina et al., 2020; Ramírez Suárez et al., 2023; Vesterinen, 2023). Collectively, these aims reflect a growing trend that environmental education is no longer viewed merely as content knowledge, but as a strategic effort to develop a generation with strong ecological literacy, social competence, and sustainability identity.

Table 5. Synthesis of findings from each study

Author	Research Purpose	Research Finding	Learning Media	Relevance to Elementary School level
Collado et al. (2020)	<ul style="list-style-type: none"> To examine the impact of nature-based education on environmental attitudes. To assess children's environmental behaviors through a controlled experiment 	Nature-based education significantly enhances children's environmental attitudes.	Outdoor settings	High
Chen (2022)	<ul style="list-style-type: none"> Explore the impact of augmented reality (AR) digital picture books on environmental education. Assess the effects on children's environmental attitudes and behaviors 	<ul style="list-style-type: none"> This study highlights the importance of integrating local culture and augmented reality into environmental education to enhance students' perception and engagement. The findings indicate that improvements in students' environmental knowledge, values, and behaviors lead to a greater likelihood of engaging in responsible environmental actions 	Augmented Reality (AR)	High
Ali (2022)	<ul style="list-style-type: none"> Integrating local environmental issues into the school curriculum. Enhancing students' ecological awareness and conservation behavior. 	<ul style="list-style-type: none"> The theme of environmental education based on local values is highly important The curriculum should address issues of pollution, conservation, and sustainable practices. 	Local learning resources / Indigenous knowledge	High

Turoń et al. (2021)	<ul style="list-style-type: none"> • Identify educational methods for teaching electric mobility. • Introduce electric mobility and support the development of new services. 	<ul style="list-style-type: none"> • The researcher developed an innovative educational concept based on three pedagogical pillars—diagnosis, forecasting, and content development—that can be applied across all levels of education through various learning methods. • The results indicate that this model has the potential to raise public awareness, expand the adoption of electric vehicles, and create new opportunities within the electric mobility industry. 	Tiered learning modules	High
Kuzmina et al. (2020)	<ul style="list-style-type: none"> • Addressing gaps in whole-school engagement strategies for Education for Sustainable Development (ESD). • Framing schools as service-oriented organizations for sustainable education. 	<ul style="list-style-type: none"> • Schools should define students' sustainable experiences as a core service concept. • Develop a culture of innovation driven by sustainability and actively engage stakeholders. 	School policy documents and whole-school programs	High
Hägström (2022)	<ul style="list-style-type: none"> • Explore the use of storytelling approaches for sustainability education. • Enhance students' agency and democratic capabilities 	The findings indicate that the Storyline approach has the potential to support the development of students' democratic competencies and can facilitate learning and action on sustainability issues.	Storyline-based materials	High
Ramírez Suárez et al. (2023)	<ul style="list-style-type: none"> • Introducing ecological balance and fostering an understanding of environmental protection. • Enhancing the quality of education through sustainable development strategies 	<ul style="list-style-type: none"> • These findings highlight that environmental education (EE) is more widely recognized than education for sustainable development (ESD). 	Field-based activities	High

Vesterinen (2023)	<ul style="list-style-type: none"> • To gain knowledge about sustainability competencies in education. • To evaluate guidebooks for their effectiveness in supporting elementary school teachers. 	<ul style="list-style-type: none"> • The topic of ESD is less prominent in K-12 schools in Boyacá. <p>This study found that Finnish elementary-level teacher guides in environmental education support the implementation of education for sustainable development.</p>	Guidebooks and teacher manuals	High
Chappell & Hetherington (2024)	The purpose of this paper is to explore and theorize creative pedagogy that intertwines teaching with creative practices to foster creativity within the context of digital STEAM, with a particular focus on marine education and environmental activism. It aims to highlight how this pedagogy can facilitate meaningful learning experiences in both elementary and secondary school settings.	<ul style="list-style-type: none"> • This study highlights the importance of creative pedagogy in enhancing digital STEAM practices within elementary and secondary school settings. • The findings emphasize the significance of the relationship between living beings and virtual environments in fostering ocean literacy among students 	Digital STEAM tools	High
Gugssa (2023)	<ul style="list-style-type: none"> • To analyze teachers' perspectives on the delivery of environmental education. • To identify the obstacles to effective environmental teaching practices. 	<ul style="list-style-type: none"> • Teachers prefer place-based environmental education. • Barriers include large class sizes and safety concerns. 	Outdoor classroom activities	High

From the perspective of research findings, all studies report consistent results showing that environmental education designed with adaptive approaches effectively enhances multiple dimensions of elementary students' learning. Studies employing nature-based approaches demonstrate substantial improvements in students' environmental attitudes and exploratory behaviors due to their direct engagement with natural phenomena (Collado et al., 2020). Similar findings are reported in studies that emphasize culturally grounded learning, where students show increased emotional connection to environmental issues when instructional materials are linked to rituals, stories, or local wisdom (Ali, 2022). Additionally, several studies highlight that integrating technologies such as augmented

reality (Chen, 2022) and digital STEAM tools (Chappell & Hetherington, 2024) not only boosts engagement but also deepens students' understanding of complex ecological concepts. Other studies underline that narrative- and story-based pedagogies strengthen students' agency and sense of ownership toward sustainability issues (Häggström, 2022). Overall, these findings demonstrate that diverse instructional approaches—traditional or modern—are highly effective as long as they foster direct, emotional, cognitive, and social connectedness between students and environmental issues.

In terms of learning media, the studies exhibit a wide range of media usage, including nature-based materials, digital technology, cultural artifacts, narratives, and school policy instruments. Nature-based media such as environmental exploration, outdoor activities, field trips, and hands-on fieldwork are widely used to provide concrete and contextual learning experiences (Collado et al., 2020; Gugssa, 2023). Digital media such as augmented reality and STEAM devices support simulations, interactive visualizations, and digital creativity, enriching students' understanding of ecosystem dynamics or environmental issues that cannot be directly observed (Chappell & Hetherington, 2024; Chen, 2022). Meanwhile, culturally grounded media—including folktales, traditional practices, and local values—are integrated to strengthen students' ecological identity and connect learning content to their daily lived experiences (Ali, 2022). Pedagogical media such as Storyline approaches, tiered learning modules, and teacher guides also play a crucial role in providing consistent methodological frameworks that are easy for educators to implement (Häggström, 2022; Turoń et al., 2021; Vesterinen, 2023). This diversity of media illustrates that environmental education can be flexibly adapted according to the resources, needs, and contexts of each school.

When assessed for relevance to the Indonesian elementary school context, nearly all studies show high relevance, as the approaches, media, and learning objectives discussed align well with the characteristics of Indonesian learners. Nature-based learning is highly relevant because Indonesia's rich natural environments offer abundant opportunities for direct experiential learning. The integration of local wisdom fits seamlessly with Indonesia's diverse cultural heritage, which contains strong ecological values. The use of digital media is increasingly relevant given the Merdeka Curriculum's emphasis on technology integration and context-based project learning. Even school-policy-based and teacher-guidance approaches (Kuzmina et al., 2020; Vesterinen, 2023) are strongly aligned with the needs of Indonesian schools to cultivate a sustainability culture, especially in the context of the Healthy School Movement, Adiwiyata programs, and the implementation of the Pancasila Student Profile.

Among these studies, the one conducted by Turoń et al. (2021), strategies involving the introduction of electric mobility were considered too complex to be taught effectively at the elementary school level—particularly in public schools located outside urban areas, where access to relevant resources is limited, like most elementary school cases in Indonesia. In addition, schools facing such conditions often experience several human resource related challenges, including low student reading literacy levels and a shortage of trained and certified teachers. However, with Turoń's simplified instructional framework for teaching electric mobility, the relevance and feasibility of integrating electric mobility concepts into Indonesian elementary education have significantly increased (high relevance level).

This discussion concludes that environmental education in elementary schools can serve as a crucial foundation for developing sustainability competencies among Indonesia's younger generation when designed through the integration of direct experiences, digital technologies, local wisdom, narrative approaches, and strong school policy support. All studies demonstrate that environmental education must go beyond merely teaching ecological facts; it must foster learning experiences that engage students emotionally, ethically, critically, and behaviorally. This combination positions environmental education not simply as knowledge transmission but as a transformative process that is highly relevant to Indonesia's sustainable future.

4. Conclusions

The ecopedagogy approach is a method that fosters students' environmental awareness, critical thinking, collaboration, and problem-solving skills. Particularly at the elementary school level, this approach is best introduced at an early age, as children's potential to develop empathy and environmentally friendly behavior can be optimized through learning methods that promote active participation and are adapted to the social and cultural contexts in which they grow. The ecopedagogy approach is well-received by elementary school students, especially when implemented using appropriate instructional strategies.

Based on the data summarized from the *Systematic Literature Review* (SLR) findings, such strategies can be carried out by integrating local cultural values and technology, involving school organizations and stakeholders, applying storytelling-based approaches, and enhancing digital STEAM practices. This study is limited by the availability of reputable international journal literature on ecopedagogy in the context of Indonesian elementary education. For future research, it is recommended to further explore the ecopedagogy approach at the elementary school level by grounding the study within the ecopedagogical framework rather than relying solely on its practical implementation. Additionally, future studies are encouraged to popularize research on this topic through the use of mixed-method or Research and Development (R&D) methods, as the analysis of the top 10 cited articles indicates that this methodological approach has not yet demonstrated its presence.

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Author Contribution

The author contributed to all aspects of this study, including conceptualization, methodology, data curation, formal analysis, writing – original draft preparation, writing – review & editing, visualization, The author has read and approved the submitted version of the paper.

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Data Availability Statement

The author confirms that no new datasets were generated or analyzed in this study. The research is based on a systematic literature review (SLR) of existing publications, and all data analyzed are available in the cited references within the manuscript. Due to the nature of the study, no additional datasets were created, and access to the reviewed articles is subject to the publishers' availability.

Conflicts of Interest

The author declares no conflict of interest.

Declaration of Generative AI Use

During the preparation of this work, the author utilized ChatGPT to assist in organizing ideas, QuillBot to refine sentence structure and enhance manuscript clarity, SciSpace for mapping the literature review, Watase UAKE for accessing Scopus database sources and analyzing literature collections using the PRISMA protocol, and Harzing's Publish or Perish to search for additional sources integrated with the Scopus database. After using these tools, the author reviewed and edited the content as necessary and takes full responsibility for the final publication.

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