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The Rise of Ecopedagogy in Elementary Science: A Five-Year Bibliometric Mapping

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Abstract

The ecopedagogy learning model in science education at the elementary school level has received increasing attention in recent years, along with the need to enhance environmental awareness among students. This study examined research trends in ecopedagogy in elementary science education. This study used a bibliometric analysis of 52 Scopus-indexed publications from 2020 to 2025. The study aimed to identify publication patterns, key contributors, research themes, and emerging directions. Bibliometric methods analyzed publication output, journal sources, international collaboration, and country contributions. Data were visualized using VOSviewer. Results showed a gradual increase in publications, from 8 in 2020 to 13 in 2025. The United States and China are the leading contributors, with about 15 and 10 publications, respectively. Social Sciences dominate the subject area (56.5%), followed by Environmental Sciences (14%). Key research themes included environmental education, sustainability, interdisciplinary learning, and the use of technology in ecological instruction. The study highlighted growing global interest in ecopedagogy. It emphasizes the need to integrate ecopedagogy into elementary science curricula to foster environmental awareness. The study also suggested stronger teacher training and interdisciplinary collaboration. Future research should empirically study classroom implementation to assess ecopedagogy's impact on students' environmental understanding and behavior.

INTRODUCTION

Background of the Study

Ecopedagogy is an educational approach that integrates environmental issues into pedagogy to foster a deep understanding of ecological issues and their impacts on the natural and social environments. The importance of ecopedagogy in educational contexts, especially at the elementary school level, has increased in recent years due to the increasingly pressing environmental crises such as climate change, deforestation, and biodiversity loss (Misiaszek, 2022; Zocher & Hougham, 2020). Ecopedagogy not only teaches environmental science but also promotes a holistic understanding of ecology, encourages responsible environmental management, and fosters sustainable behaviors in students (Ghazian & Lortie, 2024; Sutrisna et al., 2025). Therefore, integrating ecopedagogical

principles into science education is crucial for cultivating environmentally conscious citizens in the future.

Recent studies show that classroom ecopedagogy models boost students' environmental literacy and ability to think critically about ecological issues (Anggawirya et al., 2023; Adzani et al., 2024). Using ecopedagogy in elementary schools builds basic ecological values early, shaping students' attitudes and actions for environmental conservation (Adzani et al., 2024). By teaching critical ecoliteracy skills and adding environmental issues to the curriculum, teachers enable students to learn about the environment and actively protect it (Fadjarajani & As'ari, 2021; Ismiyati et al., 2025). The application of ecopedagogy at the elementary school level remains relatively underexplored. Much research focuses on higher education or specialized environmental programs (Lestari et al., 2023; Sulaswari & Wasino, 2024). However, recent studies show that using ecopedagogy in elementary science instruction can significantly enhance students' environmental awareness and foster positive behavioral changes. Programs that integrate local environmental knowledge, such as sustainable agricultural practices or local ecological traditions, engage students and connect them with their environment (Jandrić et al., 2026; Maslani et al., 2023). These programs not only teach ecological concepts but also help develop a sense of community and social responsibility.

Despite growing interest in ecopedagogy, key challenges remain in its integration into formal education systems. The literature identifies a lack of teacher training and resources as major barriers to effective implementation (Manik et al., 2021; Zocher & Hougham, 2020). Additionally, although ecopedagogy is linked to environmental education, its broader philosophy—encompassing critical social analysis and ecojustice—remains underutilized (Maslani et al., 2023). Key findings point to the need for research examining how ecopedagogy can be practically applied at the elementary school level, especially in science instruction, and how these practices can be adapted for diverse settings. This study aimed to provide a bibliometric analysis of current trends in ecopedagogy research, with a unique focus on its application in elementary school science learning. By systematically reviewing key publications from 2020 to 2025, this study identified prominent themes, methodologies, and research findings, offering a clear picture of major developments in this field. The study's novelty lies in mapping these developments to practical strategies for integrating ecopedagogy into elementary curricula, thus supporting educators and policymakers in advancing environmental education. This analysis will further contribute to the ongoing conversation about preparing future generations with the knowledge, skills, and attitudes necessary to address environmental challenges effectively (Amaliati et al., 2024; Firmansyah et al., 2024).

Problem of the Study

Although the concept of ecopedagogy is increasingly recognized as an important framework for global environmental education, several systematic reviews indicate that significant conceptual and implementation gaps persist in primary education. A systematic review of global ecopedagogy studies found that most research focuses on higher education and Western contexts, while its application at the primary school level has received little in-depth study (Intsiful et al., 2025). Furthermore, a meta-analysis (Amaliati et al., 2024) found that most ecopedagogy programs fail to emphasize the critical and transformational dimensions central to this approach. This indicates a gap between the theoretical framework of ecopedagogy and its classroom application.

Furthermore, a systematic review by Yang et al., (2025) identified that much environmental education research remains descriptive and has not consistently measured changes in students' ecological attitudes, values, and behaviors. This lack of affective indicators is also highlighted by another meta-analysis that emphasizes the importance of long-term, outcome-based evaluation (Lovren & Jablanovic, 2023). A recent global review Parry & Metzger, (2023) also highlighted that resource constraints and inadequate teacher training are major barriers to implementing ecopedagogy in elementary schools. Many teachers lack sufficient pedagogical and ecopedagogical competencies to integrate ecological topics in a contextual and critical manner (Fatahidin, 2025).

In addition to practical constraints, a review Dentith et al., (2022) emphasized that most ecopedagogy research still lacks the integration of social and ecological justice principles (ecojustice) into learning practices. This dimension is central to ecopedagogy's goal of developing critical and responsible citizens committed to socio-ecological sustainability. Several cross-national reviews also demonstrate a lack of research leveraging digital technology to enhance ecopedagogy-based learning, despite the technology's significant potential for enhancing student engagement (Misiaszek, 2025). Another meta-review emphasized the need for project-based and localized learning designs that bridge global issues and students' local contexts (Adeoye, 2025; Ensweiler, 2025).

Furthermore, a recent SLR by O'Brien & Howard (2024) found that ecopedagogy research rarely assesses the link between science learning and elementary-aged students' ecosocial awareness. Methodological limitations also emerged. Most studies did not use mixed-method or longitudinal approaches to monitor ongoing changes in students' ecological behavior (Low-Choy et al., 2021). Thus, this study asks: how have trends and directions in ecopedagogy research on science learning in elementary schools developed over the past five years, as revealed in a systematic synthesis of global scientific publications? The study also identifies conceptual, methodological, and practical gaps that hinder full integration of ecopedagogy in elementary education, and offers evidence-based recommendations for strengthening this approach (Abdullah & Madhakomala, 2025).

Research's State of the Art

Recent literature indicates that the application of ecopedagogy in elementary education, particularly in science learning, has attracted the attention of international researchers and educators. Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education discusses how intervention-based curricular ecopedagogy can change the practice of science education through experiential and critical real-world experiences to structure a culture-dominant environment (Zocher & Hougham, 2020). This approach emphasizes that ecopedagogy is not just about adding content to the environment, but about actively deconstructing cultural biases and cultivating reflective awareness in education science. In the context of the study, the school's basic education. Early on, the literature on Environmental Education in Primary Schools showed that, from an early age, students can be guided to be responsible for their own behavior and to respond to the environment through education in a formal setting that integrates cognitive and affective aspects (Ding et al., 2022).

Although the article does not yet specifically mention ecopedagogy, it confirms the importance of the educational environment as a basis for shaping students' actions toward nature. Another relevant study focuses on the role of science education in shaping sustainability awareness. For example, "Science Education as a Pathway to Sustainable Awareness" shows that elementary school science teachers view science teaching not only as a means of imparting knowledge, but also as an opportunity to instill environmental values and change behavior (Al-Barakat et al., 2025).

This research showed that integrating environmental theory and values can pave the way for transforming students' attitudes towards the environment. In addition , the research action professional, " How Participation in a Teachers' Eco-Pedagogy Workshop Affects the Promotion of Teachers' Environmental Education and Organizational Concepts shows that training ecopedagogy for school teachers can increase their understanding of drafting an education environment and capabilities to implement it in the classroom (Asli et al., 2024). This shows that teacher readiness and professional capacity are important factors in the effective implementation of ecopedagogy. In the context of national and global education, China's Education for Sustainable Development chapter in the latest edition discusses how ecopedagogy can enrich the curriculum through participatory learning, such as the Campus Eco-Friendly Vertical Planting initiative, to build active ecological awareness (Iftekhar et al., 2025).

Although no large-scale empirical study in school-based science exists, this chapter is relevant as an example of integrating ecopedagogy into policy education. Although there is already literature addressing aspects of theory, intervention, teacher readiness, and curriculum, an important gap remains. One of the main gaps is the lack of empirical studies on direct ecopedagogy in science learning that include measures of students' long-term behavioral outcomes. Many studies are either conditional or descriptive and do not yet use longitudinal methods or mixture models to assess

whether change is sustainable. Second, some major international studies on ecopedagogy and context-centered education in medium or university settings, whereas context-based school-specific science learning receives little attention. This makes it difficult to understand how draft justice ecological (ecojustice) and values are critical to the study. Third, aspects of teacher readiness, local content adaptation, and practical barriers (such as resources, time, and institutional support) remain underexplored empirically in the existing literature. For example, although there is a study of teacher workshops (Asli et al., 2024), follow-up research on the impact of classroom implementation on students is still limited. Thus, this study filled this gap by systematically analyzing ecopedagogy research trends in the context of elementary school science, based on publications from 2020 to 2025, mapping the pedagogical strategies, themes, methods, and outcomes that have been used, and identifying research areas that still need further development.

Gap Study and Objective

Ecopedagogy, as an educational approach that combines ecology and pedagogy, has been limited in its application in elementary school learning. Although several studies have examined this concept at the tertiary or secondary education level, its application at the elementary school level, particularly in science subjects, has not been explored in depth (Blades, 2024). One challenge is teachers' limited literacy in ecopedagogy, which can hinder its effective implementation in teaching. Limited teacher education regarding the concept of ecopedagogy is a barrier to realizing environmentally sustainable learning in elementary schools (Payne 2018; Zocher & Hougham, 2020). The persistent gaps in environmental integration within science curricula pose a challenge. While several studies have suggested the importance of environment-based learning for building students' ecological awareness, implementing this concept is often hampered by limited resources and a lack of a comprehensive approach within elementary school science curricula. Much existing learning focuses on teaching the scientific aspects of ecology without emphasizing sustainable behavioral change (Stanišić & Maksić, 2014; Kleese, 2024).

The lack of a critical approach in ecopedagogy, which leads to the social analysis of environmental issues, remains rare in elementary school education. A more holistic, social justice-based approach to teaching sustainability and ecological issues can have a more profound impact on students' social and environmental awareness. This is crucial for developing a generation that not only understands ecology but also actively participates in solving environmental problems in their communities (Fadjarajani & As'ari, 2021; Misiaszek, 2020). It also aims to provide a clearer picture of the challenges teachers face in implementing ecopedagogy and to identify strategies that can enhance students' understanding of broader environmental issues, both locally and globally (Kartamiharja, 2025; Sulaswari & Wasino, 2024). To address these gaps, this study aims to conduct a bibliometric analysis of ecopedagogy research in elementary science education based on Scopus-indexed publications from 2020 to 2025. Specifically, this study seeks to: (1) analyze publication trends and growth patterns, (2) identify leading journals, authors, and countries, (3) map collaboration networks, and (4) examine the thematic structure and evolution of research topics. Through this approach, the study provides a more systematic and data-driven understanding of the current state and future directions of ecopedagogy research at the elementary level.

METHOD

Type and Design

Bibliometric analysis is the primary method for evaluating scientific publications on ecopedagogy in Science Education learning at the elementary school level. This approach allows researchers to assess publication patterns, collaboration networks, citations, and the development of research topics based on specific periods and regions (Mutiarasari et al., 2025). The basic concept of bibliometric analysis is to measure scientific output using indicators such as the number of publications, citation rates, and relationships between authors and institutions. In this context, the research was conducted utilizing bibliographic data from various Scopus-indexed databases to ensure

the breadth and credibility of the study results. This method was also used to identify research patterns and the distribution of ecopedagogy themes in basic science learning through keyword co-occurrence analysis, co-authorship analysis, and co-citation analysis (Dağtaş, 2025; Hung, 2025; Murti et al., 2025; Wang et al., 2024).

This study combined a Systematic Literature Review (SLR) approach with bibliometric analysis using VOSviewer (version 1.6.20) and Biblioshiny for R (version 4.0.2) software. This dual approach is designed to provide a comprehensive mapping of research trends and conceptual directions of ecopedagogy in science learning. Each stage of the research was conducted based on the principle of open data (open science), ensuring that all materials, code, and research protocols can be replicated by other researchers in accordance with the Preferred Reporting Items for Systematic Reviews and Meta- Analyses (PRISMA 2020) standard (Page et al., 2021). The analysis criteria comprised the number of publications per year, journal and publisher sources, citation counts, institutional affiliations, authors' countries of origin, and thematic distribution of keywords. This methodology enables visualization of relationships among elements in scientific publications, thereby illustrating the structure and dynamics of knowledge concerning ecopedagogy in primary education. Additionally, a network analysis of author collaborations was performed to identify centers of scientific productivity and contributions across countries. The methodological and pedagogical dimensions of each article were also examined to assess the extent to which ecopedagogy is incorporated into science learning in elementary schools, in both formal and non-formal contexts.

Data and Data Sources

The data for this study were collected exclusively from the Scopus database, which is widely recognized as one of the most comprehensive sources for bibliometric analysis. Scopus was selected due to its extensive coverage of high-quality, peer-reviewed international publications and its suitability for analyzing research trends, citations, and collaboration networks. Data collection was conducted in 2025, with the publication period limited to articles published between 2020 and 2025. The search strategy employed a combination of keywords using the following query: (“ecopedagogy”) AND (“science education” OR “science teaching” OR “elementary education”). The initial search yielded 97 documents. These documents were then screened based on predefined inclusion and exclusion criteria. The inclusion criteria were: (1) articles published in peer-reviewed journals indexed in Scopus, and (2) studies focusing on ecopedagogy or environmental education in the context of science learning. Documents that were duplicates, non-peer-reviewed, or lacked complete bibliographic metadata were excluded. After the screening process, 52 articles were selected for further bibliometric and thematic analysis.

Data Collection Technique

All bibliographic data was saved in RIS, CSV, and BibTeX formats for cross-device soft analysis compatibility. The data was then processed using VOSviewer for network mapping and Biblioshiny for analysis of publication trends and dynamic themes. The study selection process followed the PRISMA framework, as illustrated in Figure 1. The initial search identified 97 records in the Scopus database. No duplicate records were found, resulting in 97 articles proceeding to the screening stage. During the title and abstract screening, 22 records were excluded for being irrelevant to the research topic. Subsequently, 75 full-text articles were assessed for eligibility. Of these, 23 articles were excluded, including 15 that were not classified as journal articles and 8 that were not written in English. Finally, 52 articles were included in the review.

Data Analysis

Data analysis in this study was conducted through two main approaches: a quantitative bibliometric analysis and a qualitative systematic review of scientific publications on ecopedagogy in Science Education learning at the elementary school level. The main objective of this analysis was to identify publication patterns, scientific collaborations, research trends, and emerging conceptual themes during the 2020–2025 period, as outlined by Xu et al. (2020) and Aria & Cuccurullo (2017). Stage First is data cleaning and transformation. The downloaded dataset from the Scopus database, in

CSV and RIS formats, was systematically checked for duplication; metadata were validated; and the consistency of publication data was assessed (Kurtuluş & Tatar, 2021; van Eck & Waltman, 2021). Publications irrelevant to the focus of ecopedagogy in primary education or outside the study's time frame were excluded from the analysis. This process aims to ensure that only articles with verified academic quality are further analyzed (Zupic & Čater, 2015; Yılmaz et al., 2022). The second stage involved a quantitative bibliometric analysis using VOSviewer (version 1.6.20) and Bibliometrix software in RStudio (van Eck & Waltman, 2019; Aria et al., 2020). This analysis consists of four main indicators:

1. Publication productivity analysis, to identify the development of the number of articles per year and the distribution by journal, country, and institution (Xu et al., 2020).
2. Co-authorship analysis, to map the collaboration network between authors and institutions (Dağtaş, 2025)
3. Co-citation analysis, to trace intellectual relationships between frequently cited articles (Aung & Hallinger, 2022).
4. Keyword co-occurrence analysis, to find dominant research topics, terminology dynamics, and shifts in scientific focus in the fields of ecopedagogy and science education (Xu et al., 2020; Misiaszek, 2025).

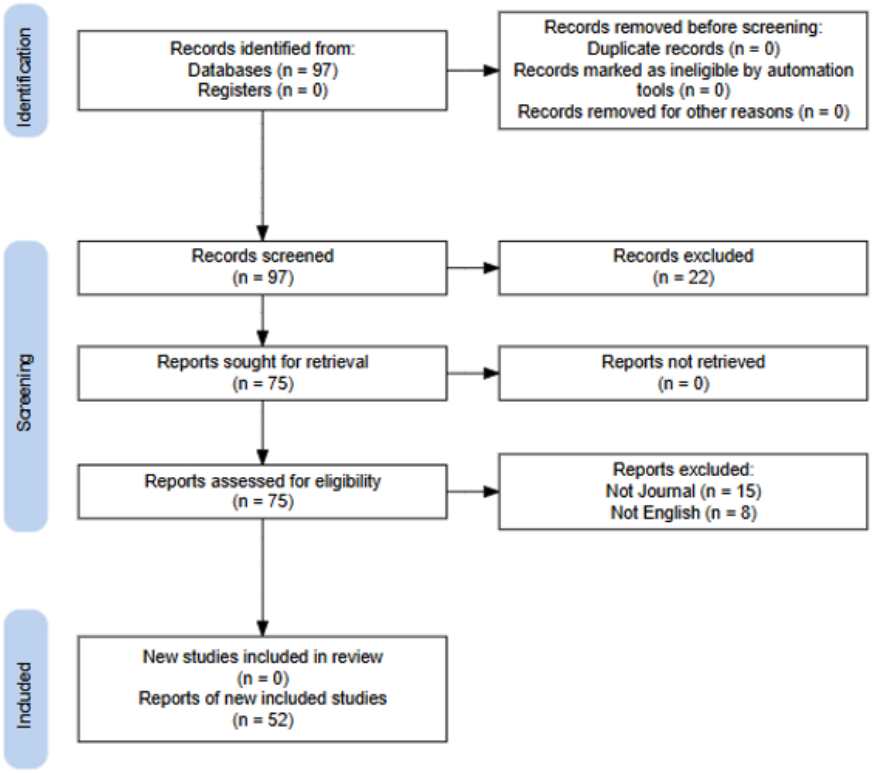

Figure 1. PRISMA flow diagram of data collection and selection process in the bibliometric analysis of ecopedagogy in science learning.

The third stage included a qualitative systematic review based on the 2020 PRISMA guidelines (Lombardi et al., 2023; Page et al., 2021). Each article meeting the inclusion criteria was analyzed based on conceptual, methodological, and empirical dimensions. The primary focus of this analysis was to identify theoretical contributions to ecopedagogy, the effectiveness of approaches in raising environmental awareness, and existing research gaps at the primary education level (Xiong et al., 2025; Moral-Muñoz et al., 2020). Visualization results were done using VOSviewer for display map network visualization, map density visualization, and temporal map (overlay visualization). These results are complemented by the Biblioshiny dashboard, which illustrates collaboration patterns, author

productivity, and theme distribution (Fahimnia et al., 2015; Kurtuluş & Tatar, 2021). These visualizations provide a comprehensive overview of conceptual relationships and intellectual structures within the field of ecopedagogy research (Moral-Muñoz et al., 2020).

In addition, a thematic analysis was conducted to group keywords based on a thematic evolution map, which allows for tracking of shifts in research focus from concepts such as environmental awareness and sustainability education to more specific topics such as critical ecopedagogy, ecojustice, and science-based learning (Misiaszek, 2025; Misiaszek, 2023; Misiaszek, 2022) This combined approach provides a deeper understanding of the direction of research development, both epistemologically and pedagogically. Overall, the results of this analysis are expected to provide empirical contributions to mapping research trends and directions for the development of ecopedagogy in elementary schools, as well as serve as an academic foundation for effectively integrating sustainability principles into science learning (Humpherys & Babb, 2020; Low-Choy et al., 2021; Abdullah & Madhakomala, 2025).

RESULTS

The results of a bibliometric analysis of publications related to environmental literacy research in the context of sustainable development show the following findings:

Publication Trends

The analysis showed a consistent increase in publications on ecopedagogy learning models in science education over the past decade, reflecting growing interest and recognition of their importance. This is shown in Figure 2.

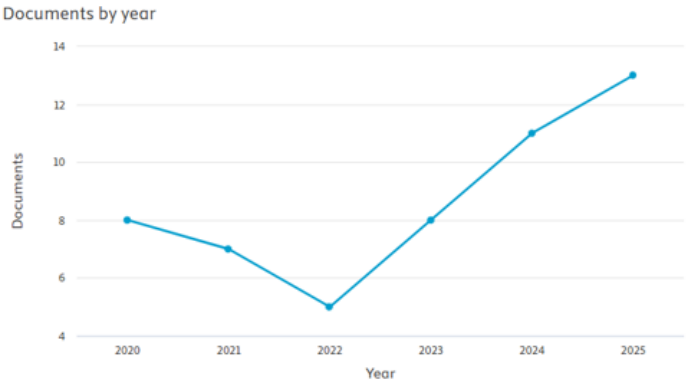

Figure 2. Publication Documents by Year in Scopus 2025 Data

The graph shows the trend in publications on ecopedagogy in science learning at the elementary school level from 2020 to 2025. In 2020, there were 8 publications. In 2021, the number of publications decreased slightly to 7, and in 2022, it reached its lowest point at 5. However, starting in 2023, the number of publications increased again to 8, followed by a more significant increase in 2024 to 11. By 2025, the number of publications is expected to reach 13, indicating a consistent growth trend in research on ecopedagogy at the elementary school level. Data analysis is presented in Figure 3.

The graph shows the number of publications per year from five journal sources between 2020 and 2025. The Journal of Environmental Education shows a stable trend in the number of publications: 2 documents in 2020, increasing to 3 in 2021 and 2022, then decreasing to 1 in 2024, and increasing again in 2025. Educational Philosophy and Theory experiences fluctuations, with the number of publications decreasing in 2021 to 1 document, increasing in 2022 to 2 documents, but decreasing again in 2023 and 2024 to 1 document. Meanwhile, Global Studies of Childhood shows a more consistent trend, starting with 1 document in 2020, increasing to 2 in 2021 and 2022, and then increasing sharply in 2023 to 3 documents. International Studies in Sociology of Education remained stable with 1 document published annually from 2020 to 2023, and increased slightly in 2024 to 2 documents, which is expected to remain at that number in 2025. Journal of Applied Learning and

Teaching saw a more significant increase: 1 document in 2020 and 2021, rising to 2 in 2022, then to 3 in 2023 and 2024, with the same trend expected for 2025. Overall, this graph reflects an increase in the number of publications related to ecopedagogy and environmental education, although some journals show fluctuations in the number of publications from year to year.

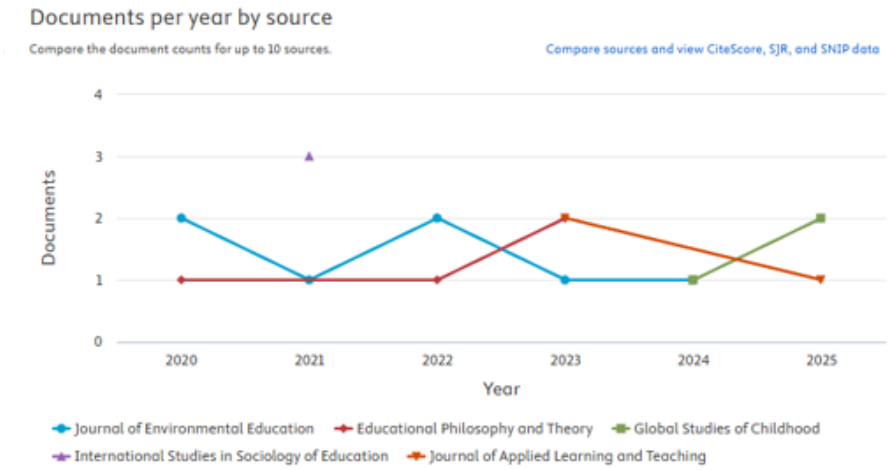

Figure 3. Number of Document Publications per Year by Source

Trends in ecopedagogy research in science education at the elementary school level are also analyzed through a comparison of documents from various countries. The 10 countries with the largest contributions are presented in Figure 4.

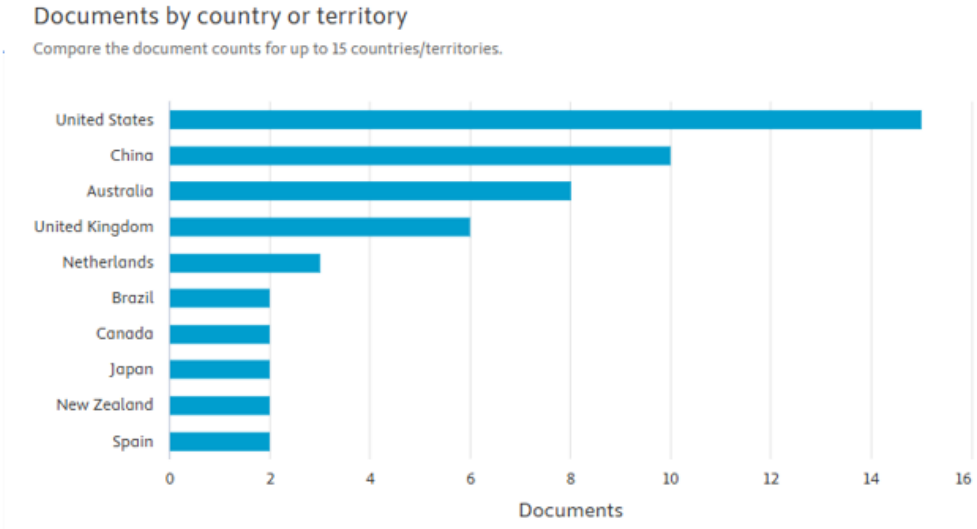

Figure 4. Publication of Documents by Country or Region

Based on the graph, an analysis of publications on ecopedagogy in science education at the elementary school level by country or region shows that the United States has the highest number, with around 15 publications, followed by China with 10. Australia and the United Kingdom each have 6 documents. The Netherlands is in fifth place with 4 documents, while Brazil, Canada, and Japan each have 2 documents. New Zealand and Spain only have 1 document. This data indicates that publications are more concentrated in large countries such as the United States and China, while other countries have made more limited contributions to this topic.

The number of publications on environmental literacy in sustainable development increased significantly from 2020 to 2025, as shown in Figure 5 using VOSviewer.

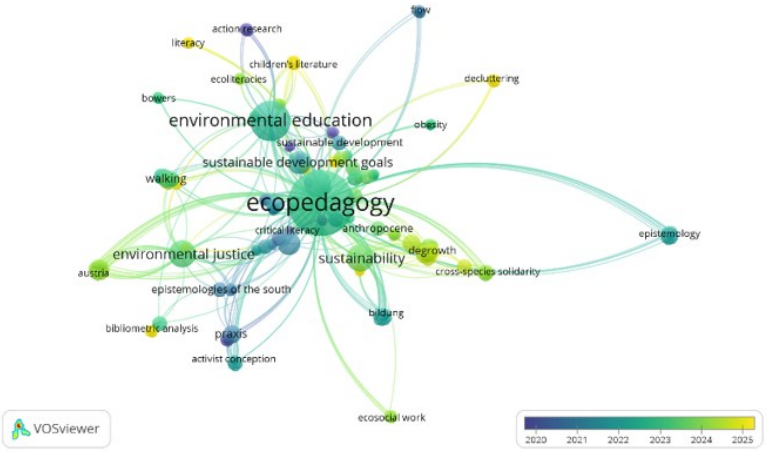

Figure 5. Collaborative Network of Ecopedagogy Research Trends in Science Education at Elementary School Level

Based on data from the VOS Viewer visualization, the collaborative network related to ecopedagogy in environmental education and sustainable development shows strong connections among key concepts, including ecopedagogy, environmental education, sustainability, environmental justice, and the Sustainable Development Goals. Paulo Freire, a key figure in critical education, is also a related figure, indicating the influence of his thinking in this field. The visualization depicts research development trends, with darker colors indicating publications from 2022 and lighter colors indicating an increase in publications in 2023, suggesting significant growth in interest in these topics during that period.

Main Research Themes

This analysis reveals several key themes in ecopedagogy research in elementary school science education. These themes include environmental education programs and strategies, evaluation of environmental knowledge and attitudes, the role of technology in improving environmental literacy, community participation, and policy development to incorporate ecopedagogy into the education curriculum to achieve sustainable development. This can be seen in Figure 6.

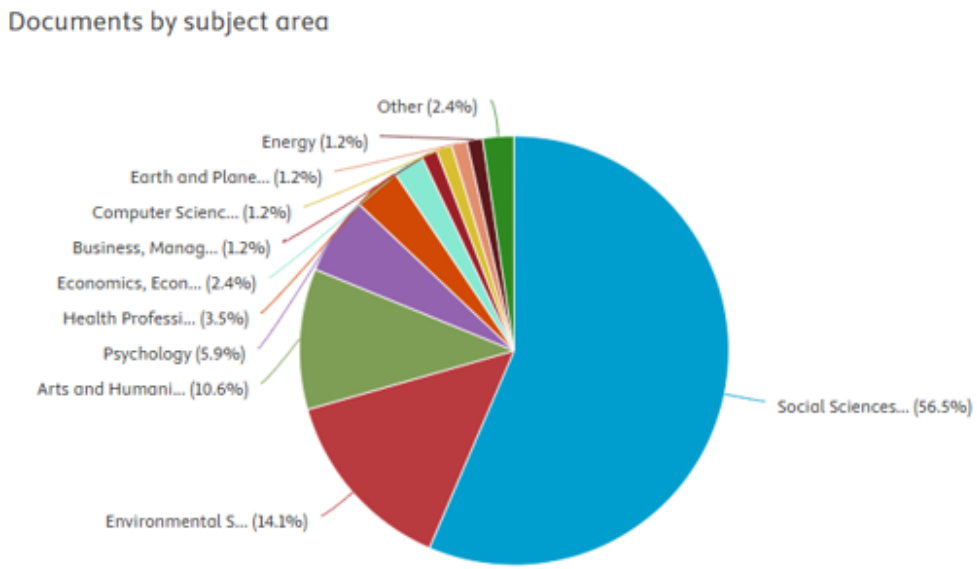

Figure 6. Documents by Subject Area Based on Scopus Data

Based on the graph, document publications by subject area show that Social Sciences dominate, accounting for 56.5% of the total publications. Environmental Sciences contributed 14%, making it the second-largest subject, followed by Arts and Humanities with 10.6%. Psychology and Health Professions each contributed 5.9% and 3.5%, respectively. Other subjects, such as Economics and

Business (Economics, Econometrics, and Finance) and Knowledge Computing, each accounted for 1.2%. Sources other than Energy and Earth and Planetary Sciences have smaller contributions, 2.4% and 1.2%, respectively. This data shows that a large part of publications focused on the field of social knowledge, with significant contributions also from the knowledge environment and art.

Citation Analysis

This analysis examines citation patterns, identifies the most cited articles, and identifies influential sources. The results reveal key works and publications that significantly impact the ecopedagogy learning model in science learning. Figure 7 illustrates the development of document citations from 2020 to 2025 in the context of the ecopedagogy learning model in science learning.

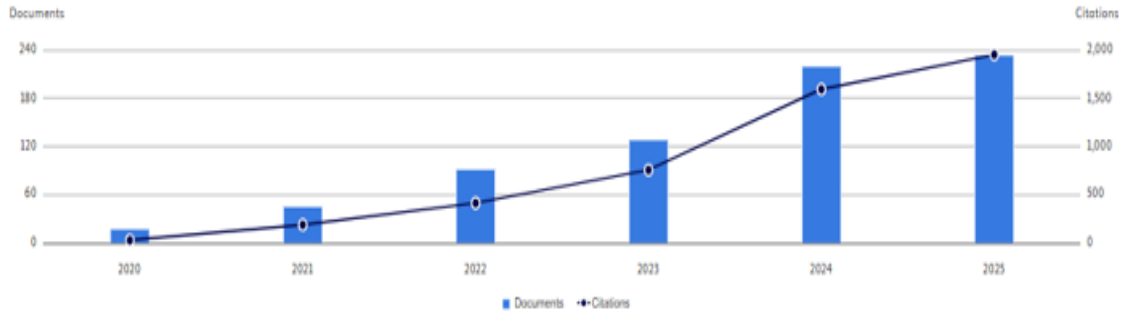

Figure 7. Citation Summary for Document

The figure illustrates the trend in the number of documents and citations related to the topic from 2020 to 2025. Overall, both indicators show a clear upward trend, indicating growing research interest in this field. The number of published documents increases steadily each year, with a significant rise starting in 2022 and continuing through 2025. This suggests that the topic has gained increasing attention among researchers, particularly in recent years. Similarly, the number of citations shows a consistent and even steeper increase over time. The sharp growth in citations from 2023 onwards indicates that the published studies are not only increasing in quantity but also gaining greater academic impact and recognition within the scholarly community. The parallel growth of documents and citations implies that the field is developing rapidly, with expanding contributions and increasing influence. The peak observed in 2024 and 2025 reflects the current relevance and emerging importance of the research area.

Table 1. Top 10 Citations in Scopus Data

Title	Year	Citation
The postdigital turn: Philosophy, education, research	2022	76
An ecopedagogical , ecolinguistic reading of the Sustainable Development Goals (SDGs): What we have learned from Paulo Freire	2022	19
Ecopedagogy : Freirean teaching to disrupt socio-environmental injustices, anthropocentric dominance, and unsustainability of the Anthropocene	2023	18
Learning for life: ESD, ecopedagogy and the new spirit of capitalism	2022	16
Ecopedagogical literacy of a pandemic: Teaching to critically read the politics of COVID-19 with environmental issues	2021	151
Making meanings of walking with/in nature: embodied encounters in environmental outdoor education	2021	13
'Don't Say It's Going to Be Okay': How International Educators Embrace Transformative Education to Support Their Students Navigating Our Global Climate Emergency	2021	13

Title	Year	Citation
From Pseudo to Genuine Sustainability Education: Ecopedagogy and Degrowth in Business Studies Courses	2024	12
A Freirean ecopedagogy or an imposition of values? The pluriverse and the politics of environmental education	2024	11
Swimming in flow motion: an ecopedagogy for health and physical education	2021	10

Table 1 highlights the most cited publications; however, citation performance should be interpreted cautiously, given publication age. Older articles naturally accumulate more citations, which may not necessarily indicate higher scholarly impact. A comparative view reveals that some recent publications demonstrate strong citation performance despite limited exposure time. This suggests that these works are highly relevant and are rapidly shaping current research trends. Conversely, highly cited older publications reflect foundational contributions that continue to shape the field.

Based on the top citation data displayed, the most cited article is "The postdigital turn: Philosophy, education, research" (2022) with 76 citations, followed by "Ecopedagogical literacy of a pandemic" (2021), which reached 151 citations, indicating a significant influence in ecopedagogy research related to environmental education during the COVID-19 pandemic. Others who contributed significantly to literature. These include "An ecopedagogical, ecolinguistic reading of the SDGs" (2022), with 19 citations, and "Ecopedagogy : Freirean teaching to disrupt socio-environmental injustices" (2023), which was cited 18 times. Major themes that emerged include the implementation of ecopedagogy in education for sustainability and challenges in integrating the education environment with social and political issues, as discussed in the publication "A Freirean ecopedagogy or an imposition of values?" (2024). Overall, this data shows a trend of increasing interest in ecopedagogy across various fields of education, especially after 2020.

Based on Figure 8, the author has published the most, with Misiozek and GW each publishing 6 documents. Followed by Kopnino, H. and Blades, G., who each have 4 documents. Ito, H. and Okur-Berberoglu, E. are recorded with 3 documents. Meanwhile, Payne, P.G., Russell, M., Andonyani, A., Baronowski, M., and Bedford, T. each have 2 documents. This data reflects the contribution of the main authors in research on ecopedagogy in science education at the elementary school level.

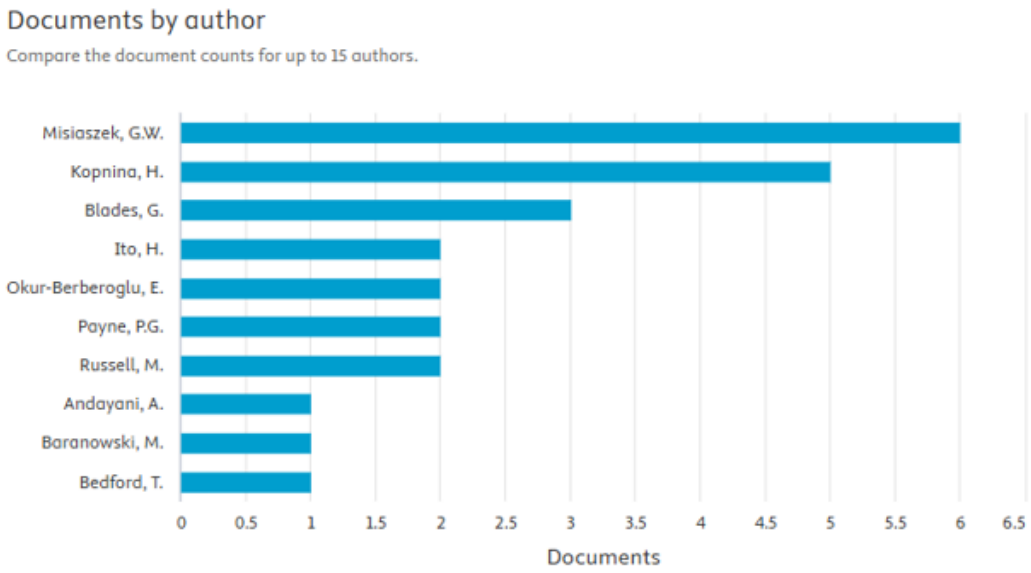

Figure 8. Comparison Amount Publication up to 10 Authors Based on Scopus Data in the Study of Ecopedagogy in Science Education at the Elementary School Level

DISCUSSIONS

Bibliometric analysis shows a significant upward trend in publications related to ecopedagogy in science education, especially from 2020 to 2025. This research reflects that a growing number of educators recognize the importance of ecopedagogy-based approaches to raising environmental awareness among elementary school students. As explained by Kleese, (2024) in "The Power and the Glory: Ecopedagogy, multicultural democracy, and Pete Seeger's Tomorrow's Children," ecopedagogy teaches students the values necessary to thrive together in a world affected by climate change while deepening the values of a more inclusive democracy. Similarly, Karabulut, (2023) in "An Analysis of Ecopedagogical Features in Turkish High School English Language Coursebooks," highlights the importance of integrating ecopedagogy into international curricula. In addition, Blades, (2024) in "WalkingScapes as Ecopedagogy " shows how education-based nature increases students' understanding of environmental issues.

In this context, the approach of ecopedagogy is more accepted in various countries, including in curriculum education social. Sulaswari & Wasino, (2024) in "Exploring Ecopedagogy Through Local Wisdom-Based Social Studies Learning", which connects education with local and environmental values. This research indicates that locally based approaches are becoming increasingly popular in developing ecological understanding. Zocher & Hougham, (2020) In "Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education," the author suggests that education-based experience will enrich sustainability-focused science learning. The analysis also revealed that publication-related ecopedagogy in science education is concentrated in large countries such as the United States and China. As explained by Misiaszek (2020) and Surata et al. (2026) in "Countering Post-truths Through Ecopedagogical Literacies", the approach of ecopedagogy is used to criticize false narratives about environmental issues and sustainability. In Australia, Blades, (2024) in "WalkingScapes as Ecopedagogy," developed education outside the room as part of an ecopedagogy approach, which leads to an understanding of ecology through direct experience with nature. Research in Turkey by Karabulut, (2023) also underscores the importance of curriculum-based ecopedagogy in teaching students about sustainability through eye-catching lessons in English at the school level. Research in Indonesia by Adzani et al. (2024) in "Implementation of Ecopedagogy in Learning School" provides the basis for effective ecopedagogy implementation to increase environmental awareness in schools. Overall, collaboration among these countries enriches global education practices grounded in ecopedagogy.

Integrate ecopedagogy into the curriculum, making it the main focus in developing learning-based sustainability. The article by Misiaszek, (2022) "Ecopedagogy: Freirean teaching to disrupt socio-environmental injustices" shows that the Freirean approach in ecopedagogy is highly effective for critiquing social and environmental injustices that occur . As explained by Sulaswari et al. (2024) in "Exploring Ecopedagogy Through Local Wisdom-Based Social Studies Learning", the use of local wisdom in teaching ecopedagogy enriches the experience of students in understanding the connection between social and environmental issues. Blades, (2024) in "WalkingScapes as Ecopedagogy " proposes that an approach based on naturalism must be more integrated into the curriculum to create a literacy environment for students. In addition, Kartamiharja, (2025) "Development of Ecopedagogy in Green Campus Educational Book" highlighted the importance of educational media grounded in ecopedagogy to introduce students to global environmental issues more effectively.

Approach-based learning is also increasingly used to enrich ecopedagogy in schools. Sulaswari & Wasino, (2024) in "Exploring Ecopedagogy Through Local Wisdom-Based Social Studies Learning," the author highlights how local wisdom, such as cultural rituals, is used to introduce students to concepts of ecopedagogy in the context of social studies. Hossain, (2024) In "An Overview of the Existing Scholarship on the Critical Aspects of Ecopedagogy," an approach based on integrated, local ecology can increase students' awareness and strengthen their connection to the natural environment around them. In the study by Zocher & Hougham, (2020) in "Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education", they emphasize the importance of an experiential approach based on value environment while delving into issues of sustainability . In

addition, Ichsan et al., (2025) In "Development of Ecopedagogy in Green Campus Educational Book" revealed that media based on ecopedagogy that introduces sustainability through experience can also directly facilitate the teaching of values, enriching local curriculum education.

Analysis shows that international collaboration is more important for strengthening the study of ecopedagogy. Payne, (2018) In "Editorial: De-distancing 'us' from the rest of Earth: ecopedagogical analysis and approaches," the author emphasizes that education grounded in de-distancing can help students overcome challenges in the global environment and build a more ecological and holistic outlook. Sulaswari & Wasino, (2024) in "Exploring Ecopedagogy Through Local Wisdom-Based Social Studies Learning," it was revealed that collaboration between global and local education in ecopedagogy increases understanding of holistic sustainability. Research by Zocher & Hougham, (2020) in "Implementing Ecopedagogy as an Experiential Approach to Decolonizing Science Education" proposes that implementing ecopedagogy in science education curricula must include experience-based international cooperation, which enables global transformation in thinking about education sustainability.

CONCLUSION

This study makes a significant contribution to developing an understanding of the application of ecopedagogical learning models in science education at the school level. Based on the bibliometric analysis, although ecopedagogy has received greater attention in recent years, especially after 2020, the implementation approach in elementary science learning remains limited. Findings: This gives a new outlook on the importance of integrating ecopedagogy into the curriculum. This is to increase students' awareness of the environment and support the achievement of development objectives in sustainable research. This also highlights the importance of an interdisciplinary approach that combines ecology, social, and justice perspectives in education, which has not yet Been Widely implemented in science education. Study this on a number of necessary limitations. First, research is limited to analyzing existing documents and publications, without primary data collection on the implementation of ecopedagogy in the field, so that the findings obtained reflect only research trends, not implementation directly at the school. Second, the limited time for data collection makes the analysis incomplete with respect to various aspects of ecopedagogy implementation in schools. For the next study, it is recommended to conduct in-depth studies with informants from various schools that implement ecopedagogy, as well as a field study on its classroom implementation. In addition, more detailed studies can provide a clearer picture of the comprehensive impact of the long-term application of learning models and ecopedagogy on students. This study offers important suggestions for the future development of education-based ecopedagogy. First, educators at the elementary school level can more fully integrate ecopedagogical principles into the curriculum, especially in eye science lessons, to foster students' environmental awareness from an early age. Second, collaboration between teachers, parents, and the community is very important for supporting the implementation of education-based ecopedagogy, because the educational environment needs support from all parties. Finally, the government, together with researchers and practitioners in education, needs to design a policy to provide additional educational support, implement ecopedagogy across all levels of education, and develop teacher-training programs to strengthen teachers' understanding of ecopedagogy in teaching.

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