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Ecological Education in Primary School Settings: A Bibliometric Analysis

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KEYWORDS
Ecological education, primary school; Environmental education; bibliometric analysis

ABSTRACT
This research uses quantitative bibliometric analysis and qualitative content analysis of 30 studies indexed by Scopus. This research provides a complete picture of trends and progress in environmental education for children studying in primary school. The bibliometric study, conducted from 2019 to 2024, mapped trends, leading authors, and dominant research topics using VOS Viewer software. This research aims to increase stakeholders' attention to outdoor experiences and learning. Hands-on ecological education in nature, cooking experiences, and incorporating ecological topics into language teaching are common pedagogical techniques found in content analysis. Meanwhile, problems such as lack of resources, teacher preparation, and mismatch between outdoor and classroom activities hinder effective implementation. This study also shows that environmental education benefits students' environmental awareness and pro-environmental behavior by emphasizing the importance of greater resources, increasing teacher support, and incorporating sustainability goals into the curriculum.

Introduction

Ecological education is an important part of basic education because it can help students contribute to the environment by teaching them to practice sustainably and increase their environmental awareness (Cicchino et al., 2023). Teaching students in elementary schools about environmental concepts is useful for forming future generations who are environmentally responsible, considering the increasing concerns about environmental damage, climate change, and loss of biodiversity worldwide. Effective ecological education can help elementary school students gradually become more environmentally friendly as they start learning (Gebretsadik et al., 2023). More and more research has focused on implementing environmental education in elementary schools in recent years (Eichinger et al., 2022; Jobborova, 2023; Rushton et al., 2025). This study examines various pedagogical approaches, such as outdoor education, experiential learning, and integrating environmental concepts into various disciplines. Ecological education is gaining popularity, but thorough research into trends, key ideas, and how these programs influence students' environmental knowledge and behavior is still essential. This research aims to fill this gap through a comprehensive bibliometric analysis (Agarwal et al., 2022; Donthu et al., 2021) and content

evaluation (Neuendorf, 2017) of the Scopus-indexed literature on ecology education in primary schools. Using VOS Viewer software, this study will show trends, notable authors, and major research topics in ecology education over time. In addition, a thorough analysis of the content of thirty selected publications will present pedagogical approaches, related themes, and problems encountered in implementing ecological education. Combining these two approaches aims to understand the current state of environmental education better and attract further research interest on this topic. This will help create more effective and impactful environmental education programs for elementary school students.

Materials and Methods

This study employed a mixed methods approach, integrating quantitative bibliometric analysis (Agarwal et al., 2022; Donthu et al., 2021) with qualitative content analysis (Neuendorf, 2017) to comprehensively examine the state of ecological education in primary schools.

For the bibliometric analysis, data were sourced from the Scopus database, which is recognized for its wide range of peer-reviewed journals and academic articles. The keywords "primary schools" and "ecology education" were used in the search to identify relevant studies published between 2019 and 2024. The time frame was chosen to reflect the most recent developments in the field. A total of 584 articles were initially retrieved, and after applying specific inclusion criteria, such as relevance to the topic and academic rigor, 30 studies were selected for detailed analysis. This dataset provides a broad view of the trends, authorship patterns, citation networks, and key research topics in ecological education. VOS Viewer software enabled mapping relationships between publications, highlighting connections between key themes, influential authors, and frequently cited works. This software visualizes the co-occurrence of keywords and allows for a better understanding of how ecological education research has evolved and which areas have received the most scholarly attention.

In addition to the bibliometric analysis, a qualitative content analysis was conducted on the selected 30 studies. This process involved systematically examining the texts to identify recurring pedagogical strategies, themes, and challenges in implementing ecological education in primary schools. By coding the content, the analysis aimed to uncover how different teaching methods, such as outdoor education, experiential learning, and cross-curricular integration of environmental topics, are being applied. The qualitative approach also examined common barriers to effective implementation, such as lack of resources, teacher preparedness, and the alignment between outdoor activities and classroom teaching. This dual approach—combining the quantitative strengths of bibliometrics with the in-depth insights from content analysis—provided a holistic understanding of the current landscape of ecological education, its challenges, and its potential for future development.

Results and Discussions

Bibliometric analysis, a quantitative technique, evaluates and maps the academic field of a particular research field by examining the published literature. This method uses statistical analysis

to focus on indicators such as authorship patterns, keyword frequency, number of citations, and journal impact factor. Examining these features enables bibliometric analysis to discover important trends, prominent authors, collaboration networks, and new research avenues. Bibliometric analysis provides a significant new understanding of the subject's evolution, key research topics, and which authors or studies have been most influential in ecology education. It helps academics see the evolution of ecological education research, pointing out important areas of study and lacking knowledge. This research is very useful because it shows important discoveries and leaders in the field, which helps subsequent research projects and policy formulation. To conduct bibliometric analysis on articles indexed in Scopus between 2019 and 2024, this study used keywords such as "Ecological Education" and "Primary School." The analysis facilitates a better understanding of the current state of research and future research prospects in ecological education for elementary schools by utilizing tools such as VOS Viewer to map relationships between publications, such as citation networks and co-occurrences of phrases.

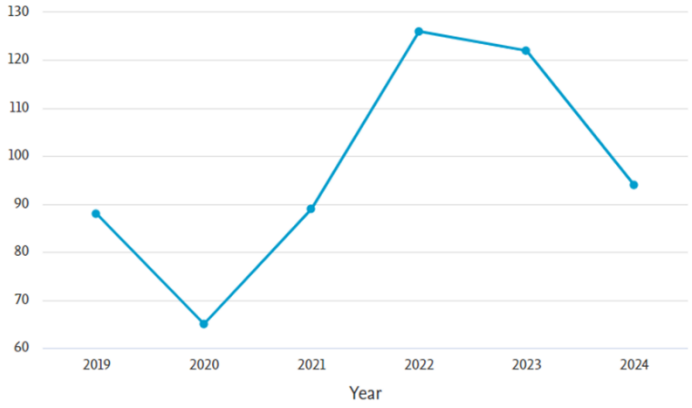

Figure 1. Researches by Year

Figure 1 shows the trend in the number of publications discussing environmental education in primary schools from 2019 to 2024. In 2019, around ninety publications showed great interest in this subject. However, there was a clear decline in 2020, with the number of publications falling to around 70. This may be due to the disruption caused by the COVID-19 pandemic, which has impacted research output in various fields. Research production increased to around 90 articles in 2021, indicating a return to academic engagement. (2022) will be the most productive year, with the number of studies reaching 130, showing increasing interest and engagement in ecology education. The publication rate drops slightly in (2023) but still produces good output, around 120 publications. However, there is a clear decline of around ninety studies by (2024). This may be due to changing academic focus or a lack of data. Despite some external obstacles, such as the pandemic, publishing trends have changed. There has been a significant increase in recent years, indicating changing attention to environmental education in primary schools.

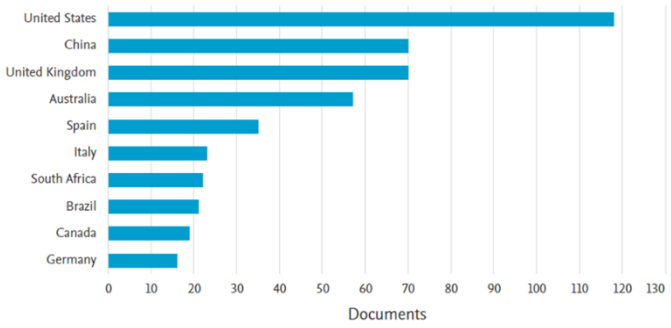

Figure 2. Researches by Country

The bar chart (Figure 2) shows the distribution of previous research on environmental education in primary schools by country, demonstrating the contribution of global research on this topic. The United States has a leading role in supporting ecological education research, with more than 120 studies in the predominance. China follows with around eighty studies, indicating significant engagement in the topic. The UK also shows significant productivity with around 70 studies. Australia follows with around 60 publications. Other countries, such as Spain and Italy, show consistent interest in ecological education research, contributing approximately forty and thirty studies, respectively. South Africa, Brazil, Canada, and Germany each contributed around 20 to 30 documents, indicating increased engagement but on a smaller scale compared with the leading countries. This graph shows that, with the United States, China, and the United Kingdom leading the way, research on ecological education is quite common in many countries. Although other countries are starting to get involved in this area, these countries have done the most to improve the knowledge and practice of environmental education for elementary schools.

Graphics in Figure 2 shows how documents on environmental education in primary schools are distributed across various topic areas, and research is categorized among various academic disciplines. With 286 studies (28.1%), the Social Sciences category shows that ecological education is mostly studied from a social science perspective, including pedagogy, educational policy, and social implications. With 190 documents (18.7%), medicine ranked second among all disciplines in terms of documentation; this may be due to the application of ecological theory or health-related environmental education in the medical field, although no Psychology was followed by 122 studies (12.0%) that focused on psychological aspects of environmental education, such as behavior modification, motivation, and cognitive development in children. child. Ecology and environmental themes are frequently discussed in teaching materials, and 87 documents (8.6%) are from environmental science. The smallest number of contributions came from the fields of health professions (39 documents, 3.8%) and the fields of agriculture and biology (41 documents, 4.0%), which may indicate an interdisciplinary approach to ecological education. The smallest number of contributions came from the arts and humanities field (34 documents, 3.3%), which may indicate an innovative and technological approach to environmental education. In other fields, such as engineering (2.3%) and earth and planetary sciences (2.3%), minimal contributions were made. This graph highlights the multidisciplinary nature of ecological education research as most research

is based in the social sciences, with significant contributions from medicine, psychology, and environmental science. However, records in other fields show that ecological education is studied from various points of view, such as health, technology, and the arts.

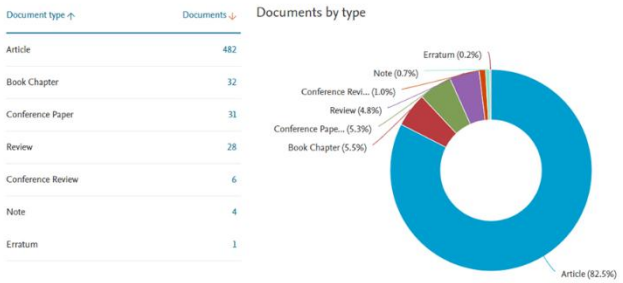

Figure 3. Researches by Types

Graphics in Fig. 3 show research categorized among several academic disciplines and the distribution of documents on ecological education in elementary schools in various topic areas. With 286 studies (28.1%), the Social Sciences category was the largest, indicating that ecological education is largely investigated from a social science perspective, including pedagogy, educational policy, and social implications. With 190 documents (18.7%), medicine ranked second among all disciplines in terms of documentation; this may reflect the application of ecological theory or health-related environmental education in the medical field, although it is not directly relevant to primary school education. Followed by 122 studies (12.0%), psychology focused on the psychological elements of environmental education, including behavior modification, motivation, and cognitive development in children. Environmental science actively addresses ecological and environmental themes in teaching materials, accounting for 87 documents (8.6%). Smaller contributions came from Health Professions, with 39 documents (3.8%), and Agricultural and Biological Sciences, with 41 documents (4.0%), which may indicate an interdisciplinary approach to ecological education. Computer Science and Arts and Humanities accounted for 34 documents (3.3%), possibly exploring creative and technological ways in environmental education. Minimal contributions were made in other disciplines, such as Engineering (2.3%) and Earth and Planetary Sciences (2.3%). With much of the research based on the social sciences and strong contributions from medicine, psychology, and environmental science, this graph highlights the multidisciplinary nature of ecological education research. However, the existence of records in other disciplines suggests an exploration of ecological education from a variety of viewpoints, including health, technology, and arts disciplines.

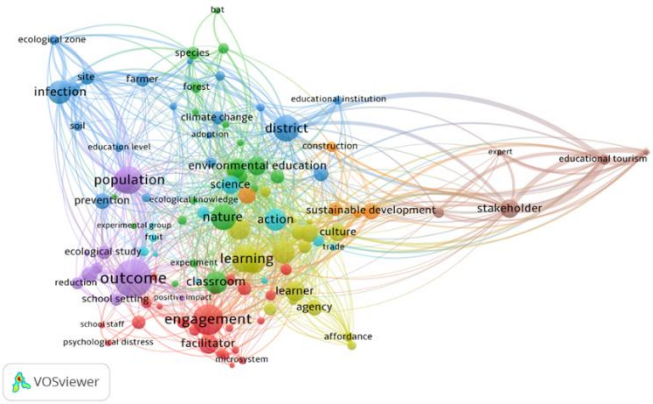

Figure 4. Bibliometrics Using VOSViewer

Figure 4 shows the types of publication documents from research on environmental education in elementary schools. With 482 documents, 82.5% of the total publications relate to accounting. This suggests that most research in this area comes from the primary method of academic information exchange: peer-reviewed journal articles. With 32 studies, book chapters account for 5.5% of all articles and represent a contribution to an edited volume or dedicated book on this topic; with 31 publications, conference research accounts for 5.3% of all articles and represents some of the research presented and discussed at academic conferences; and with 28 studies, methodical or critical reviews of current literature on ecology education typically account for 4.8 percent. Other documents are notes (0.07 percent) and erratums (0.2 percent), which are rare, with only four documents and one document for an erratum.

To deepen this bibliometric analysis, VosViewer uses keywords and important ideas that often appear in studies on ecological education in elementary schools, displayed using the VOS Viewer visualization (Figure 4). The larger keywords in this visualization indicate the terms that appear most frequently: The lines connecting these keywords show the relationship or co-occurrence of these terms in the same research note. This map reveals several theme clusters. With keywords such as "environmental education," "nature," "science," and "climate change" being common, environmental science and education are two of the main themes. This theme indicates a heavy emphasis on integrating environmental science into educational programs and increasing awareness and actions related to sustainability.

Learning and engagement—where words like “learning,” “classroom,” “engagement,” and “facilitator” came up a lot—was another major theme. This cluster emphasizes student involvement and the role that teachers can play in promoting environmental learning, while highlighting pedagogical methods applied in ecological education. Additionally, reflecting themes related to the broader impacts of ecological education, especially social and psychological impacts, including community and health-related effects, are terms such as “population,” “outcome,” “psychological distress,” and “prevention.”

Reflecting the relevance of society and stakeholder involvement in ecological education, especially related to sustainability goals, clusters that focus on sustainable development and stakeholder involvement use keywords such as "sustainable development," "stakeholder,"

"culture," and "educational tourism." Finally, clusters that include words such as “district,” “educational institution,” and “construction” indicate a focus on organizational and infrastructural support for ecological education, thereby examining how districts and schools are adopting ecological ideas into their operations.

This study shows several gap. It seems that beneficial ecological education, such as out-of-class practice or project-based learning, receives less attention. Additionally, there seems to be no language related to diversity and equality. This may indicate that there is a lack of research on the ways in which disadvantaged groups can participate in or benefit from environmental education. Finally, less attention has been paid to long-term impact studies, which could assess how environmental education at an early age influences children's behavior, careers, and community involvement over the long term. This decline opens up opportunities for additional research on the practical application, inclusion, and long-term outcomes of ecology education.

Conclusion

This study aims to summarize trends and advances in ecological education research for elementary school students through quantitative bibliometric analysis and qualitative content of 30 carefully selected studies. The results indicate that hands-on, outdoor learning is the primary method for increasing ecological awareness and engagement in elementary schools. Research on Ecological Education for Children (2024) found that school gardens and nature-based activities successfully increased students' understanding of the environment and their relationship with nature. Other strategies suggest ecological education can improve environmental and health outcomes if integrated into daily activities. These include learner-centered food and nutrition education (2024), cooking as experiential learning KiiDSAY Project, (2024), stories in language teaching (2024), and digital educational materials, such as interactive games (2023). It emphasizes the growing trend towards creative and multidisciplinary approaches to engaging students in innovative ways in environmental education.

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