Education for Sustainable Development (ESD) Research Trends 2020-2024: Bibliometrics Analysis

Ana Luthfiyah[1]*, Waspodo Tjipto Subroto[2], Norida Canda Sakti[3]
*[1]Universitas Negeri Surabaya, Indonesia
[2] Universitas Negeri Surabaya, Indonesia
[3] Universitas Negeri Surabaya, Indonesia

[1]ana.23009@mhs.unesa.ac.id; [2]waspodosubroto@unesa.ac.id; [3]noridacanda@unesa.ac.id

*Ana Luthfiyah

Keywords

Education For Sustainable Development (ESD); bibliometric review; Critical Thinking

Abstract

This study examines Education for Sustainable Development (ESD) research trends from 2020 to 2024 using bibliometric analysis with Scopus data and VOSviewer. It identifies key keywords, author collaborations, and influential journals or institutions in ESD. The findings reveal a significant rise in ESD publications, with European countries like Spain, Germany, and Sweden leading contributions. Cross-country and interdisciplinary collaborations enrich the ESD literature and promote integrative approaches in education. Bibliometric visualizations highlight interconnected themes such as higher education, teacher training, and sustainability policy. Stakeholder engagement and experiential learning are identified as crucial for ESD implementation. This research provides valuable insights into ESD's development and offers recommendations to enhance its effectiveness in advancing sustainability goals across educational levels.

Introduction

The development of the current modern era has not only had a positive impact but has given rise to global problems such as climate change, biodiversity loss, economic inequality, and social injustice that require solutions with a holistic and sustainable approach. Education is identified as one of the key solutions in addressing these issues because of its strategic role in shaping the mindset and behavior of the younger generation towards sustainability. In this context, *Education for Sustainable*

Development (ESD) has become an important concept that emphasizes the development of awareness, knowledge, and skills needed to address sustainability issues (UNESCO, 2019).

The ESD concept has a broader goal not only focusing on knowledge of environmental issues, but also must be able to improve critical thinking skills, creativity, and problem-solving skills that enable students to be able to face complexity in a sustainable manner and play an active role in solving these challenges. This is in line with research (Faizah & Nugraheni, 2024)(J Jumrodah et al., 2021; Silence, 2023)which shows that the development of critical thinking skills is a key aspect in continuing education, as these skills encourage students to evaluate information in depth and come up with innovative solutions.

Over the past five years, increased attention to the Sustainable Development Goals (SDGs) has prompted researchers to increasingly focus on ESD research as an instrument to achieve sustainability;(Kopnina, 2020Primasti, 2021; Olsson et al., 2022Fiel'ardh et al., 2023; (Bespalyy et al., 2024). ESD plays an important role in supporting SDGs 4 on quality education and 13 on action on climate change by integrating sustainability insights into educational curricula at various levels (Tesfamicael & Eng, 2024;Araneo, 2024). These studies highlight innovative approaches, such as project-based learning and digital technologies, that can increase learner engagement and the relevance of ESD in the curriculum (Huang et al., 2024;Zhang & Wang, 2022).

However, although the number of ESD-related publications continues to increase, a deeper understanding of emerging research patterns and trends in this field is still needed. Bibliometric analysis has proven to be an effective method for exploring research dynamics within a field, particularly in understanding keyword trends, collaborative networks between authors, and the identification of influential journals and institutions. With this approach, researchers can identify under-explored areas of research, find opportunities for international collaboration, and formulate a more focused research direction.(Mishra et al., 2024).

This study aims to identify ESD research trends in the last five years (2019–2024) using bibliometric methods. The research data will be taken from the Scopus database and analyzed using VOSviewer, which allows visual mapping of dominant keywords, collaboration between authors, and the most influential journals and institutions in ESD research. This research is expected to make a meaningful contribution in understanding the direction of ESD research development, identifying challenges that still need to be overcome, and offering recommendations to improve the application of ESD in supporting sustainability.

As such, this research will add insight into the ESD-related academic literature, but also provide a stronger foundation for educators, policymakers, and researchers in developing education that supports sustainability goals.

Method

Research design

The study adopts a bibliometric research design, utilizing Scopus data and VOSviewer software to analyze trends and contributions in Education for Sustainable Development (ESD) research.

Research sample

The sample comprises bibliographic data of publications related to ESD retrieved from the Scopus database. The data is collected using the keyword "Education for Sustainable Development" and exported in RIS format.

Research procedure

The research begins with data collection by searching publications in the Scopus database using the keyword "Education for Sustainable Development." The bibliographic data retrieved is then exported in RIS format to ensure compatibility with analysis tools. This data is subsequently imported into the VOSviewer application, which facilitates the identification of key themes, trends, and relationships within the ESD literature. The analysis produces visualizations in the form of network or cluster maps that illustrate connections between topics, authors, and institutions, providing a comprehensive overview of the research landscape in this field.(Ilham & Fadil, 2023).

Data analysis

The data is analyzed using VOSviewer to identify main themes, trends, collaborations, and under-explored areas in ESD research. Visualizations in the form of bibliometric maps help interpret the results and guide conclusions about emerging research directions and recommendations.

Results and Discussion

Results

This study was conducted on November 1, 2024 on the Scopus database on education for sustainability development (ESD) published in 2020-2024. The initial search results obtained 10613 relevant data, then an initial screening was carried out based on the subject area, type of document, keywords "Education For Sustainable Development" and "Critical Thinking", 394 valid data were obtained for this study.

Circulating by Publication Year

Publications from 2020 to 2024 continue to increase but there is a decrease in 2023. In 2020 the number of publications was 70 documents, increased in 2021 and 2022 amounting to 79 documents, then decreased in 2023 by 69, and increased in 2024 with a

total of 92. The trend of ESD research that has been published for the last five years can be seen in figure 1.
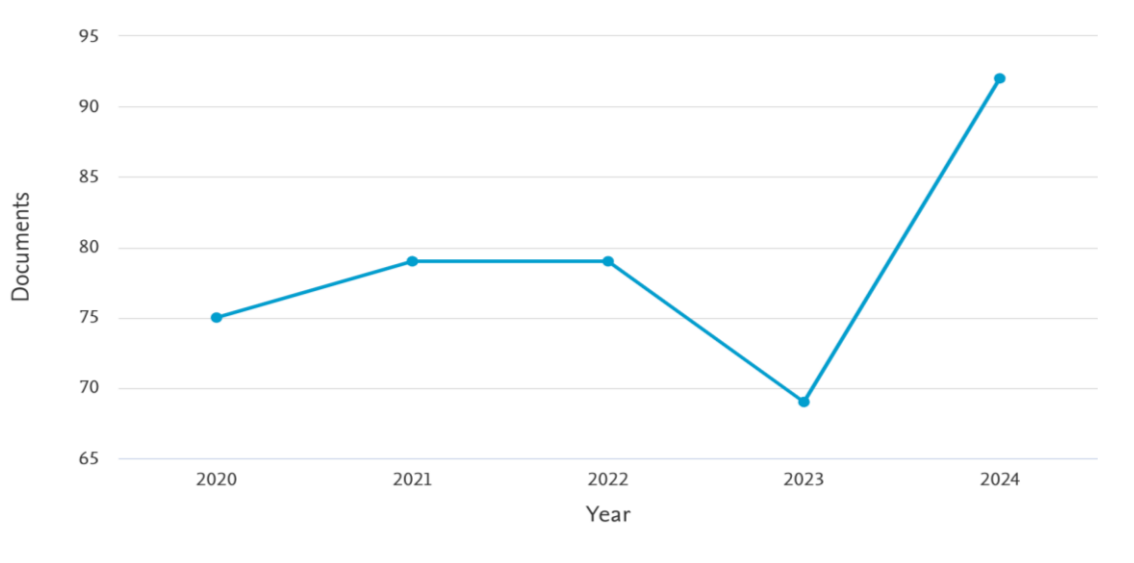
Figure 1. Publication trends in 2020-2024
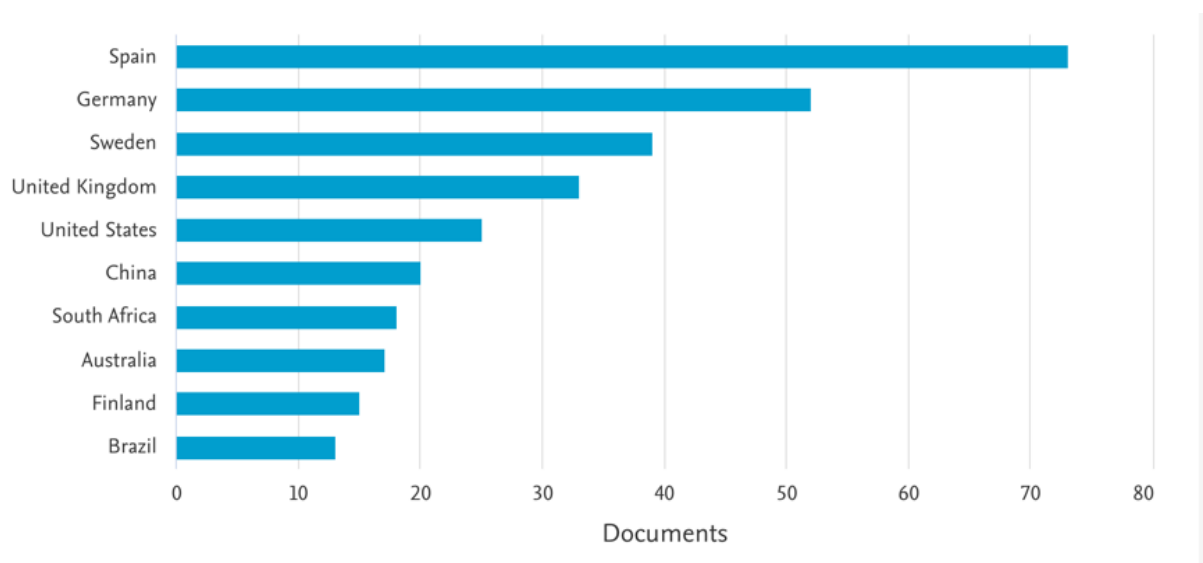
Publications by Author

Based on the data obtained, the highest publication related to ESD researchers was carried out by Gericke with a total of 9 publications by collaborating with various authors in various years. The research carried out is (Berglund & Gericke, 2022;). Eilks S and Shancez conducted ESD research as many as 7. Some other authors can be seen in figure Sund & Gericke, 2020(Zidny & Eilks, 2022)(Valderrama-Hern above Ndez et al., 2020)2.there is 2022 The top ten authors can be seen in figure 2. The number of publications by researchers shows the existence of a solid collaborative network between these researchers. Several authors are often referred together, forming cross-country and cross-field research groups. This collaboration strengthens ESD literature and expands its impact in teaching, demonstrating the importance of an interdisciplinary approach to sustainable education as well as the need for critical thinking skills for future generations.
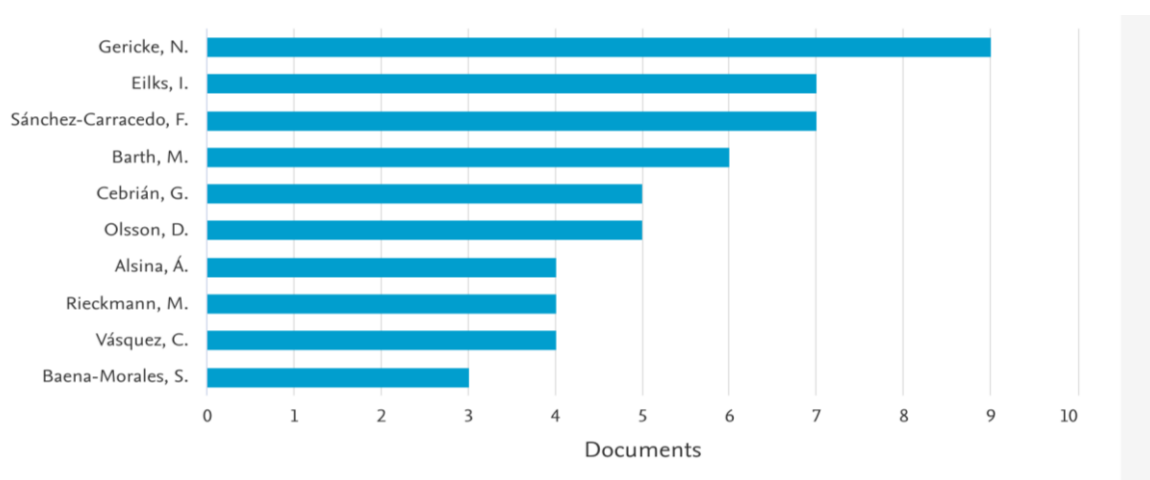
Figure 2. Publications By Author

Publications by Country

The country with the most publications is Spain with a total of 73 documents. This shows that Spain has a very high level of attention to the research topics analyzed in this data. Then Germany with 52 documents, followed by Sweden with 39 documents and the United Kingdom with 33 documents. The distribution of the next publication can be seen in figure 3. Based on the data, it can be seen that European countries dominate in publications on this topic, with five of the top ten countries coming from Europe (Spain, Germany, Sweden, the United Kingdom, and Finland). This shows that Europe has a high level of concern and interest in the topic being researched.

Figure 3. Publications by country

Vos Viewer Visualization

The visualization results can be seen in Figure 4 which shows that Education for sustainable development (ESD) is the largest node and is located at the center of the network, showing that this term is a core concept that connects various other terms. This shows that ESD is the central focus in this study. Then higher education, seen as one of the large sub-clusters, shows that many studies focus on the role of higher education in supporting sustainable development. Teacher training and transformative learning in a fairly large cluster adjacent to ESD, shows the importance of teacher training and transformative learning in the implementation of ESD. Furthermore, Critical Thinking and Sustainability Consciousness indicate the linkage of ESD with the formation of critical thinking and sustainability awareness, which is very relevant for education that focuses on sustainability goals. This visualization shows a dense relationship between various terms, reflecting an interdisciplinary approach that connects aspects such as education policy, learning methodologies, stakeholder engagement, and global goals such as the SDGs (Sustainable Development Goals). Supporting themes such as experiential learning, education policy, the 2030 agenda, and stakeholder

involvement also emerged as important elements. This shows that ESD is not only seen from the perspective of classroom learning but also as a systematic effort involving policy and community participation(Martínez-Hernández & Robles-Moral, 2023).

Figure 4. Vosviewer Visualization

Discussion

From the results of this bibliometric analysis, several important findings can be highlighted. First, the trend of publications related to *Education for Sustainable Development* (ESD) shows an increase over the past five years, with the peak of publications in 2024. The temporary decline in 2023 may reflect external factors or changes in research focus during the year. Overall, however, the increase in publications indicates a growing interest in ESD, which is considered one of the keys to developing a generation that cares about sustainability. Second, publication data shows that leading researchers such as Gericke, Eilks, and Shancez have published numerous articles on ESD. This collaboration between cross-country and cross-disciplinary researchers strengthens the ESD literature and demonstrates the importance of an interdisciplinary approach in this study. This collaboration not only enriches the literature, but also expands the impact of ESD research in teaching practice, especially in the

development of critical thinking skills. Third, the distribution of publications by country shows the dominance of European countries, especially Spain, Germany, and Sweden. This dominance is most likely due to the strong policies of European governments in support of continuing education, especially with the integration of ESD into higher education curricula. This indicates that ESD is an important concern in the region, driven by regional policies and global development goals such as (García-Feijoo et al., 2020)(Misiaszék, 2020)*the Sustainable Development Goals* (SDGs). (Adams et al., 2023) The visualizations generated by VOSviewer show that ESD is a key concept that connects a wide range of topics, including higher education, teacher training, and transformative learning. This inter-concept relationship demonstrates an interdisciplinary approach, combining aspects of policy, learning, and stakeholder participation. Stakeholder engagement and education policy also emerged as important elements, suggesting that ESD implementation requires support from a wide range of parties outside the educational environment(Saleem & Challenge, 2023).

Conclusion

This research reveals that ESD is becoming a very relevant topic in the global educational literature, with a trend that continues to increase. Europe's dominance in publications shows a high level of concern for ESD, which is reflected in education policies and government programs in the region. Collaboration between researchers from different countries also plays an important role in strengthening the ESD literature and supporting the interdisciplinary approach needed to achieve the sustainability goals. Bibliometric visualization shows that ESD not only involves concepts in education, but is also related to policies, learning methodologies, and community engagement. It is recommended for the next researcher to explore the role of digital platforms and technology in improving ESD, especially in supporting transformative learning and experiential learning.

Authorship Contribution Statement

Ana Luthfiyah: Conceptualizing the research, developing the research design, collecting and managing bibliometric data, interpreting findings, drafting the manuscript, and overseeing the entire research process. The research was supported by the Indonesian Education Scholarship (Beasiswa Pendidikan Indonesia). Waspodo Tjipto Subroto: Supervising the research process, providing critical feedback on the research design and analysis, and contributing to the discussion and conclusion sections. Norida Canda Sakti: Assisting in data analysis, creating bibliometric visualizations, organizing the results presentation, and reviewing the final manuscript for consistency and accuracy.

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