

Global Trends in Quality Education Research under ESD and the 2030 Agenda: A Bibliometric Review

Mochammad Ja'far Amri Amanulloh, Achmad Supriyanto, Raden Bambang Sumarsono

Universitas Negeri Malang, Indonesia

e-mail: mochammad.jafar.2301328@students.um.ac.id, a.supriyanto.fip@um.ac.id,
raden.bambang.fip@um.ac.id


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ABSTRACT. This study explores research trends on quality education within the Education for Sustainable Development (ESD) framework and the 2030 Agenda. This study uses a bibliometric analysis approach to identify key publication developments from 2020 to 2024. The data was retrieved from Scopus-indexed journals and analyzed using R and VOSviewer software. The study's analysis encompassed 442 relevant articles, meticulously interpreted according to the established criteria. The findings of this study indicate an increase in the number of publications each year (except 2021), with almost all types of scientific papers being articles (70%) in Social Science studies as the largest field of study. The study also interprets the number of publications and the impact of scientific papers through citations containing the source of articles, authors, institutions, and countries with fluctuations in each criterion. The frequently utilized keywords can be categorized into eight color clusters, demonstrating the keyword usage level. The study's limitations are evident in its periodization, approach, and data distribution. Notwithstanding these limitations, the study offers pertinent implications for establishing new trends in future research. In particular, in the fields of research, public policy, and education, the findings of this study have significance for improving the quality of education at every level, from schools to universities.

Keywords: 2030 Agenda, Bibliometric Review, Education for Sustainable Development (ESD), Quality Education

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INTRODUCTION

The year 2030 is an important target for global education efforts to realize sustainable development (Arora & Mishra, 2019). UNESCO was established in 2015 and approved by most member countries of the United Nations. As the main hand in proclaiming peace, security, and development through education, UNESCO has a central role in ensuring inclusive, equitable, and quality education and promoting lifelong learning opportunities for all (Rifqi et al., 2024; UNESCO, 2020).

Education for Sustainable Development (ESD) is present as an integral part of the SDGs in the field of education, which is the target in point 4, namely "quality education" (Kioupi & Voulvoulis, 2019) (UNESCO, 2014). ESD is one of the main instruments to achieve the vision and mission of global sustainable development (UNESCO, 2020). By emphasizing education that leads to social, economic, and environmental sustainability (Hariram et al., 2023), UNESCO supports the application of ESD principles in formal and non-formal education to equip communities with the skills and knowledge necessary to face global challenges (Ryazanova et al., 2020).

Sustainable development and education are very close (Sterling, 2014). In education, development is oriented toward improving the quality of human resources (Shulla et al., 2020; Stofkova & Sukalova, 2020). Sustainable development positively impacts quality education by creating better conditions for access and quality of education (Camilleri & Camilleri, 2020). This concept is carried out to encourage the improvement of environmentally friendly and efficient infrastructure (Tafida et al., 2024), such as better schools and supportive learning facilities, access to education becomes more equitable, full bureaucratic support for education, especially for remote areas (Hiererra et al., 2023; Supriyanto et al., 2020).

Curricula oriented to global issues such as climate change, economic sustainability, and green technology are increasingly being applied to prepare students for future challenges (Tasdemir & Gazo, 2020). Technological developments also play an important role by enabling more flexible learning and the development of digital skills (Haleem et al., 2022). On the other hand, improving social welfare through sustainable development allows families to prioritize education more (Sumarsono, 2017); it is very important to build a good relationship between them (Sumarsono et al., 2016), see this as a basic need such as school construction (Wiyono et al., 2019), which has an impact on providing optimal facilities for student learning and more basically, life needs such as health (Heuckmann & Zeyer, 2022), and clean water (Seike et al., 2023) have been met. All of this creates an environment that supports quality education, prioritizing collaboration between governments, the private sector, and society to ensure that education teaches not only knowledge but also skills relevant to global needs (González-salamanca et al., 2020).

ESD can influence student outcomes regarding their sustainability awareness (Pauw et al., 2015). However, students do not significantly develop the competency component of self-confidence actions under their influence (Olsson et al., 2022). It shows the premise that ESD impacts consciousness but cannot fully develop competence in itself. Time is key in implementing ESD (Stössel et al., 2021), which cannot be directly felt in changes and development of human resources (Spatscheck, 2012). In this regard, the passage of time makes studies on ESD continue to develop and generate new insights (Kadji-Beltran & Zachariou, 2022). Therefore, to support implementation, it is necessary to conduct regular monitoring so that new trends related to ESD can be identified, especially in realizing quality education in achieving the 2030 agenda (Agbedahin, 2019). This implementation takes a long time, so the more developed the existing study, the wider the scope of implementing quality education in every aspect.

Previous research by Grosseck et al. (2019) and Yang & Xiu (2023) is very broad in determining the range of research data distribution from 1992 to 2018 and 1992 to 2022 on the Education for Sustainable Development theme. Some of these studies describe two main research directions for the entire period: integrating education into sustainable development and sustainable development into education. Meanwhile, García et al. (2020) conducted a similar study with findings on the relevance between quality education and sustainable development goals using a bibliometric approach. In this study, the analysis of the findings was not very specific, so the research exposure was limited to talking about numbers without seeing the effect more comprehensively. On the other hand, Prieto-Jiménez et al. (2021) in their research found five core clusters in the discussion of the Sustainable Development Goals and Education, namely SDG in general, SDG 4 on Quality Education, Education for Sustainable Development, Higher Education and Education Management, which only focused on the University level as a higher education organization and agent of change in the social sphere. The conclusion of the research emphasized the need to change the role and function of University education to address sustainable development. The research is fairly limited, as it uses a narrow data network and needs to be developed further, even though it is not a comprehensive study.

Based on some previous research, the author tries to conduct similar research to see the development gap in the research period to look for further trends in different periods but still on the same theme, namely Education for Sustainable Development (ESD), Quality Education, and

the 2030 Agenda more generally. This research aims to identify trends in the main topics that appear in the literature on quality education related to the 2030 agenda and ESD. The focus of this research lies on the massive number and impact of publications by looking at citations that exist both on the object of the author, institution, country, and keywords that are often used in research related to quality education on the 2030 agenda or ESD implementation that bring out the latest patterns and trends with their analysis. The results of this identification will be useful for future researchers by deepening topics considered lacking and gaps that must be deepened.

METHOD

In order to achieve some of the above goals, the author uses the Bibliometric approach, which allows us to see the current conditions of reality and information from various scientific subjects according to their respective findings (Dervis, 2019). Bibliometric analysis is used to summarize large amounts of bibliometric data to describe intellectual structures and emerging trends in a topic or field of research (Donthu et al., 2021). This method is particularly useful when the scope of a research review is wide, such as when discussing topics involving many disciplines or literature spread across multiple sources (Passas, 2024).

In this context, analysis can include quantitative aspects, such as evaluating the number of publications, citations, and collaboration networks, which provide more objective and measurable insights (Chain et al., 2019). In addition, bibliometric analysis can also focus on qualitative aspects, such as an in-depth understanding of key findings in the literature or the development of theories in the field under review, although these focus more on interpretation than numerical measurements (Donthu et al., 2021). This approach will produce a scientific synthesis on a specific subject and enable the opening of a continuous scientific literacy discourse on topics or research focuses that need to be developed more deeply in each scientific field to allow future research with a more objective approach.

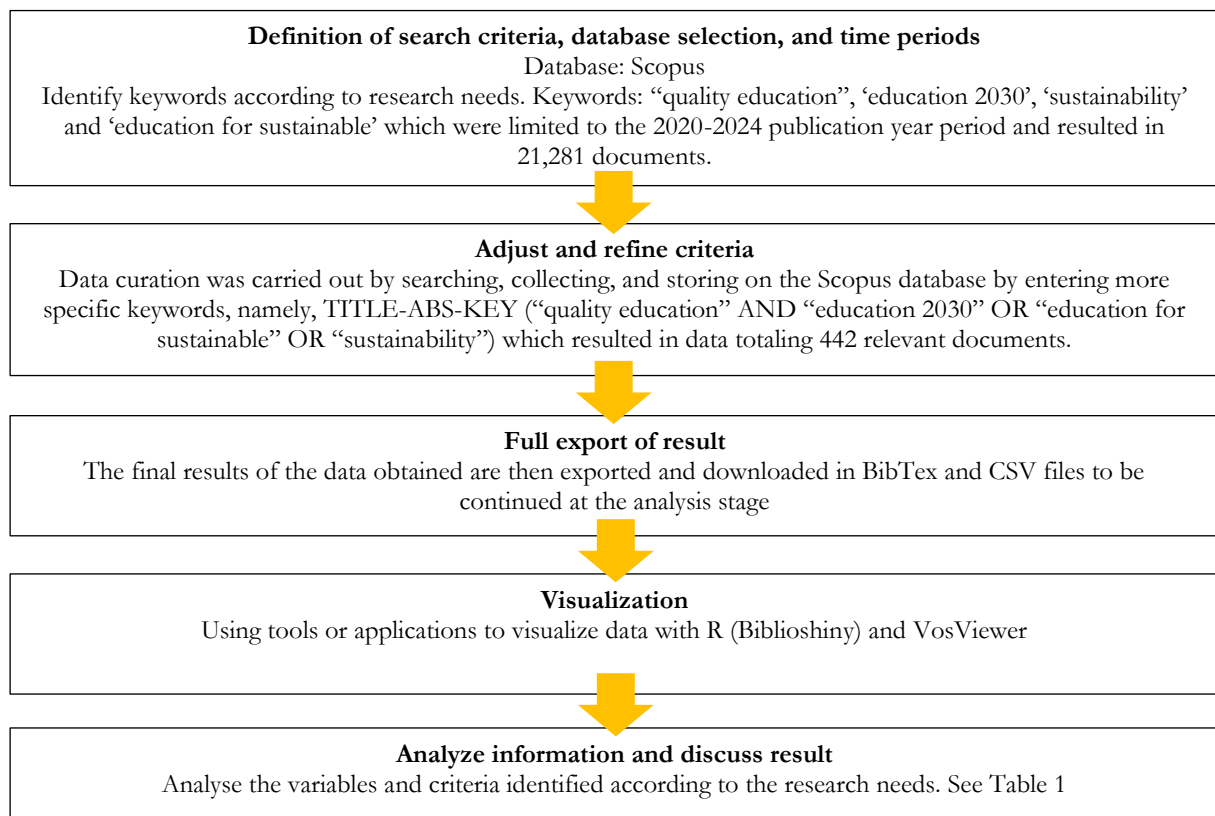


Figure 1. Bibliometric Research Methods

The Scopus database was searched using the keywords "quality education," "education 2030," "education for sustainability," and "sustainability" to obtain the results. The Scopus database was selected due to the author's constrained access and the comprehensive nature of the data in other databases. Additionally, Scopus' credibility was considered to be superior. This selection was made to minimize discrepancies in data formats, which could influence the research outcomes when subjected to analysis with the available tools. These keywords were chosen to reflect the context of the study that focuses on quality education within the framework of the 2030 Agenda and sustainability education. Data were obtained with a search period between 2020 and 2024 to determine the results of some previous research findings. The initial search results resulted in a total of 21.281 documents (accessed on 25 Nov 2024), with the distribution of the number of publications by keywords: *Quality Education* (n=9386), *Education 2030* (n=2518), *Sustainability* (n=4883), and *Education for Sustainable* (n=4494). However, many documents are not directly relevant to this topic of study. As the number of publications increases, there is a heightened probability of encountering data bias. This is due to the persistent growth in the number of research publications that address the themes and topics selected by the authors. This phenomenon is likely to give rise to discrepancies in data utilization and the outcomes of the analysis.

The next process is curation, which is carried out to filter the search results to be more relevant to the research topic by using the logic of the keyword combination that has been set. The curated results finally resulted in 442 relevant articles for further analysis by entering the keywords 'TITLE-ABS-KEY ("quality education" AND "education 2030" OR "education for sustainable" OR "sustainability")'. All the articles selected in this number come from Scopus-indexed journals, so the quality and relevance of data sources are guaranteed. The selected articles include a variety of variables that are important for bibliometric studies, such as the year of publication, the main author, the journal that was published, the main keywords, the country of origin of the research, and the institutions involved. The final results of the data obtained are then exported and downloaded in BibTex and CSV files to be continued at the analysis stage. In this paper, the author limits several variables with criteria to determine trends that emerge from research on quality education, ESD, and the 2030 agenda. The author specifies these variables and criteria in Table 1.

Table 1. Variable and criteria of inclusion/exclusion

Variable	Criteria
1) Year	Publications in 2020-2024
2) Source Type	All scientific writing documents such as articles, books and book chapters, and conferences
3) Subject area	Fields that have 20 or more with indexed publications
4) Periodic Publications	Top 10 publications with indexed articles
5) Author	Have more than 2 publications and are ranked by top ranking alphabetically by name
6) Institutions and Country	Top 10 institutions and 10 indexed countries
7) Publication with the Most Impact	Has more than 100 citations
8) Keyword	Have at least 13 frequencies and be sorted alphabetically in the top 10 keywords

Data analysis was carried out with the help of R (version 4.4.1) and VOSviewer (version 1.6.20) software, which were used to analyze statistics, numerical calculations, and data visualization (Dervis, 2019). Both of these software help identify key trends in research, collaborations between authors or institutions, and connections between key concepts being analyzed. At this stage, an indicator or criterion is needed that can be used as a reference in analyzing the data obtained. The main thing highlighted in the research trend is the number, which will intersect with the number of works in each author, institution, and region, the use of keywords, and the impact of publications calculated in the form of numbers and averages.

RESULT AND DISCUSSION

Result

This study's result is the identification of the writing objectives established in the initial section. The subsequent findings are consistent with the criteria delineated in Table 1.

Publication Trends (2020-2024)

As illustrated in Figure 1, there has been a discernible upward trend in the number of publications from 2020 to 2024, despite annual fluctuations. In 2021, there was a slight decrease of approximately 1.56% (64 to 63) compared to the previous year. This decline may be indicative of the challenges faced by researchers during that period, although the magnitude of the decline is negligible. However, in 2022, there was a notable rebound, with a 14.29% (63 to 72) increase in publications compared to 2021, indicating a gradual recovery and enhanced operational efficiency within the academic community.

A more pronounced increase occurred in 2023, with a surge of approximately 66.67% (72 to 120) compared to 2022. This surge signifies a substantial augmentation in research endeavors, potentially influenced by augmented funding, enhanced collaboration, and advancements in digital publishing platforms. Projections for 2024 anticipate a moderation in the growth rate to approximately 2.5% (120 to 123), though the number of publications continues to rise. This deceleration in growth may signify that while the fundamental factors supporting research remain intact, limitations are beginning to impede the rate of publication expansion.

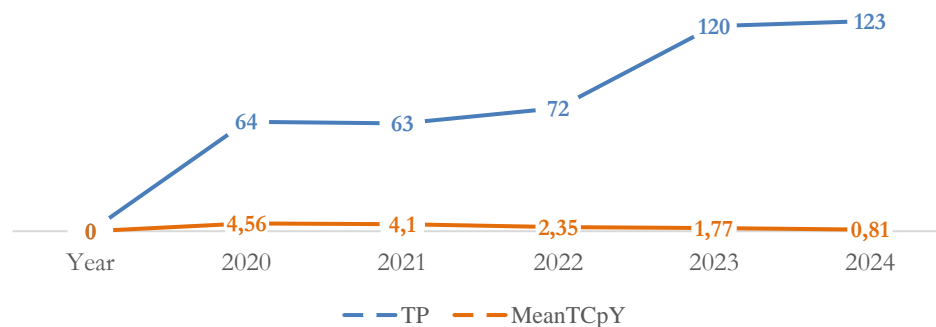


Figure 2. Total publications and mean citation by year

In contrast, the average number of citations per year (MeanTCperYear) decreases from 2020 to 2024. In 2020, the average number of citations per year was 4.56, which is quite high, but this number dropped to 4.1 in 2021. In 2022, there was an even larger decrease, with an average citation of only 2.35, which could reflect a change in research focus or a decrease in attention to publications in that year. In 2023 and 2024, the average citations decreased to 1.77 and 0.81, respectively, even though the number of publications continues to increase. It could be due to more publications receiving less attention or impact from the academic community and the difference in years affecting the average yearly results.

Distribution of Scientific Papers Based on Publication Type

In Figure 2, we can see that 70% of the total publications are articles, indicating that most of the research is focused on publications in scientific journals. It is common in the academic world, as journal articles are often considered the main channel for disseminating the latest research results. 13% of publications are in the form of conference papers, showing that while conferences play an important role in disseminating research results directly and more quickly, the proportion is much smaller than journal articles. Meanwhile, 15% of publications are book chapters, and only

2% are full books, reflecting that while books and book chapters remain important in science, they tend to play a more limited role than journal articles or conference papers.

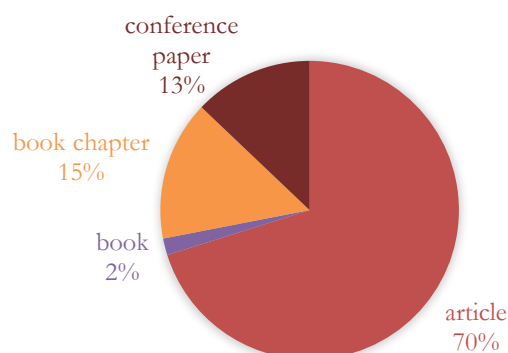


Figure 3. Type of document

These data show the dominance of scholarly articles in academic publications. Conference papers and books/book chapters are less common but still relevant in certain contexts.

Distribution of Publications by Field of Science

Table 2. Subject area

Subject Area	Total Publications
1) Social Sciences	306
2) Environmental Science	194
3) Energy	143
4) Computer Science	142
5) Engineering	64
6) Business, Management and Accounting	53
7) Economics, Econometrics and Finance	43
8) Earth and Planetary Sciences	23
9) Decision Sciences	23
10) Medicine	20

Based on the percentage of publications by field of science (see Table 2), Social Sciences dominates with 27.7% (306 publications), indicating that research in the field of social sciences is very prominent. Environmental Science accounted for 17.6% (194 publications), focusing on environmental issues. Energy and Computer Science accounted for 12.9% (143 publications) and 12.8% (142 publications), respectively, signaling the importance of research in energy and information technology. Engineering contributes 5.8%, while Business, Management, and Accounting reach 4.8%, showing less attention to this field than other fields. Economics, Econometrics, and Finance contributed 3.9%, while Earth and Planetary Sciences and Decision Sciences each contributed 2.1%. Medicine contributes 1.8%, which is relatively smaller than other science fields.

Highest Number of Publications and Citations

From the data of Table 3, Sustainability (Switzerland) stands out with 101 publications and 1,085 citations, showing a great influence in the field of sustainability, both in the volume of publications and the impact of citations. In contrast, journals such as the Sustainable Development Goals Series and the World Sustainability Series, despite having 12 publications each, recorded only 25 citations, which showed a more limited influence. Conference journals such as the E3S Web of Conference and IOP Conference Series have a low impact with 6-8 publications and only six citations, which is common in early-stage research. Education Science has 58 citations from 6

publications, indicating a greater influence in the field of education compared to Environmental Education Research. Although the Journal of Cleaner Production has only five publications, it recorded 539 citations, indicating that publications in this journal are highly valued. Despite the high volume of publications, the impact of citations is more influenced by the quality and relevance of the topics discussed.

Table 3. Total publications and citations

Journals	TP	TC
1) Sustainability (Switzerland)	101	1085
2) Sustainable Development Goals Series	12	25
3) World Sustainability Series	12	25
4) E3S Web of Conference	8	6
5) Environmental Education Research	7	9
6) IOP Conference Series: Earth and Environmental Science	7	6
7) Education Science	6	58
8) Frontiers in Education	6	17
9) Journal of Cleaner Production	5	539
10) Discover Sustainability	4	184

Author with the Most Scientific Contributions and Impact

Table 4 shows that Baena-Morales, S., contributed the most to the field of sustainability by writing four articles on the topic. Furthermore, Nedungadi, P., and Raman, R. have a smaller number of articles on the field of sustainability, with three articles. Al-Mhdawi, M.K.S., and Al-Rahmi, W.M. contributed less than previous researchers by writing only two articles related to the field of sustainability.

Table 4. Top five authors with total article

Author	Article
Baena-Morales, S.	4
Nedungadi, P.	3
Raman, R.	3
Al-Mhdawi, M.K.S.	2
Al-Rahmi, W.M.	2

Table 5 is different from table 4. Table 5 shows author profiles based on bibliometric metrics such as h, g, m indexes, number of citations (TC), and publications (NP). Most authors have an index of h 2, meaning they cite several publications. Baena-Morales Salvador has a higher h-index (3), indicating more influential publications. The g-index is mostly the same as the h-index, except for Baena-Morales Salvador, with a value of 4, indicating that his publications are more cited. The m-index ranges from 0.5 to 1, with some authors, such as Al-Rahmi Waleed Mugahed, having slightly higher scores (0.67). For the number of citations, Domínguez-Fernández Guillermo has the highest (58), followed by Baena-Morales Salvador (44) and Frankenberger Fernanda (39). Most authors have two publications, although some have more, such as Baena-Morales Salvador, which has four publications. Although the number of publications is small, their scientific impact is mixed, with some authors showing greater influence through more citations.

Table 4. Authors' Local Impact by H Index

Author	h-index	g-index	m-index	TC	NP	PY_start
Baena-Morales Salvador	3	4	0,6	44	4	2020
Al-Mhdawi Mks	2	2	1	15	2	2023
Al-Rahmi Waleed Mugahed	2	2	0,66666667	33	2	2022
Alias Anuar	2	2	0,66666667	10	2	2022
Capua Ilaria	2	2	1	6	2	2023

Institutions and Country with the Most Contributions

Data on the most relevant institutional affiliations (see Table 6) show that Chiang Mai University is ranked at the top with 11 publications, making it the most actively contributing institution to related research. King Saud University ranks second with eight publications, demonstrating strong participation from the Middle East region. The University of Indonesia, the University of Alicante, and the University of Granada each produced six publications, reflecting the significant contributions of the Southeast Asian region, Southern Europe, and Spain in this study.

Furthermore, Bucharest University of Economic Studies, Sultan Qaboos University, UCSI University, Universidad Autónoma de Madrid, and the University of Florida, each with five publications, show similar activity in different regions, including Eastern Europe, the Middle East, Asia, and North America. The presence of institutions from various countries reflects that related research has a global scope with contributions spread evenly across various regions.

Table 5. Top ten institutions most relevant affiliations

Institutions	Total Publications
Chiang Mai University	11
King Saud University	8
Universitas Indonesia	6
University of Alicante	6
University of Granada	6
Bucharest University of Economic Studies	5
Sultan Qaboos University	5
UCSI University	5
Universidad Autónoma de Madrid	5
University of Florida	5

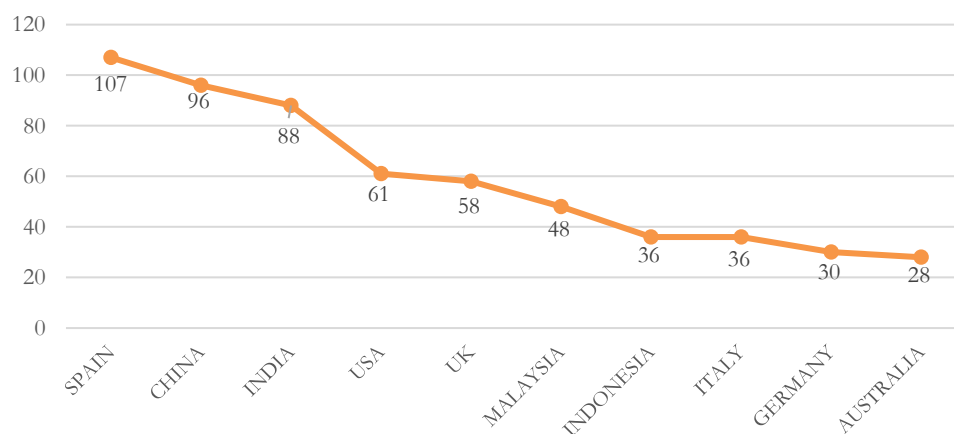


Figure 3. Top 10 country scientific production

Figure 3 shows data showing the 10 countries with the best knowledge production. Spain leads the way with 107 publications, followed by China (96) and India (88), reflecting these countries' great role in research. The USA (61) and the UK (58) made significant contributions, albeit smaller than Asian countries. Malaysia and Indonesia contributed 48 and 36 publications, respectively, highlighting research development in Southeast Asia. Italy, Germany, and Australia, with 36, 30, and 28 publications, showed stable participation from Europe and Oceania. This scientific production reflects the dominance of Europe and Asia, with contributions spread across various major countries.

Table 6. Most Cited Countries

Country	TC	Average Article Citation
China	550	17,2
Spain	478	9,8
Germany	279	25,4
USA	278	17,4
Italy	267	29,7
Indonesia	152	10,1
Saudi Arabia	121	13,4
Jamaica	110	110
South Africa	101	7,2
Australia	79	11,3

In contrast to Figure 3, Table 7 provides insight into scientific productivity and research impact by showing the number of publications and the average citations per publication for each country. China topped the list with 550 publications and an average of 17.2 citations per publication, meaning that the figure has a high production volume and a fairly wide impact. Despite having fewer publications (478), Spain recorded a smaller average of citations (9.8), indicating a focus on quantity rather than impact.

Germany, with 279 publications and an average of 25.4 citations, and Italy (267 publications, 29.7 citations) show a balance between productivity and quality, with a high citation impact. The USA, although almost comparable to Germany in the number of publications (278), has an average citation of 17.4, which is slightly lower but still quite strong. With 152 publications and an average of 10.1 citations, Indonesia shows stable development in the Southeast Asian region, although the impact is still relatively low compared to other major countries. Saudi Arabia recorded 121 publications with an average of 13.4 citations, which shows a competitive contribution in the Middle East region.

Jamaica attracted attention with only 110 publications, but the average section reached 110, indicating a huge impact per publication, likely due to the focus on high-quality research or publication in high-impact journals. In contrast, South Africa, with 101 publications and an average of 7.2 citations, and Australia, with 79 publications and 11.3 citations, have smaller contributions in both number and impact than other countries on the list.

Table 7 describes the increase in variation in scientific productivity and research impact across countries. Some countries, such as Jamaica, Italy, and Germany, stand out for their high quality as measured through average citations, while others, such as China and Spain, excel in publication volume.

Publication with the Most Impact

Table 8 shows the leading research that has greatly impacted the academic world, selected based on the main criterion: more than 100 citations. With an impressive number of citations, these works demonstrate great relevance and influence in sustainability and education. The work of Zafar et al. (2020) leads with 286 citations, published in the *Journal of Cleaner Production*, followed by Secundo et al. (2020) with 203 citations in *Technological Forecasting and Social Change*. Although more recent, Shulla et al.'s (2021) research on *Discover Sustainability* recorded 162 citations, marking its rapid relevance. Gunawan et al. (2020) and Burbules et al. (2020), published in the *Journal of Cleaner Production and Geography and Sustainability*, respectively, obtained 134 and 128 citations. Closing the list, Ferguson & Rooft (2020), with 110 citations in the *International Journal of Sustainability in Higher Education*. These studies, published in prestigious journals, prove their contributions to sustainability and education issues and have been widely recognized and become a key reference in global academic discussions.

Table 7. Most cited publication

Author	Year	Title	Source	TC
Zafar et al.	2020	How renewable energy consumption contribute to environmental quality? The role of education in OECD countries	Journal of Cleaner Production, 268, 122149	286
Secundo et al.	2020	Sustainable development, intellectual capital and technology policies: A structured literature review and future research agenda	Technological Forecasting and Social Change, 153, 119917	203
Shulla et al.	2021	Effects of COVID-19 on the Sustainable Development Goals (SDGs)	Discover Sustainability, 2(1), 15	162
Gunawan et al.	2020	Sustainable development goal disclosures: Do they support responsible consumption and production?	Journal of Cleaner Production, 246, 118989	134
Burbules et al.	2020	Five trends of education and technology in a sustainable future	Geography and Sustainability, 1(2), pp. 93–97	128
Ferguson & Roofoe	2020	SDG 4 in higher education: challenges and opportunities	International Journal of Sustainability in Higher Education, 21(5), pp. 959–975	110

'These studies' findings show that achieving the SDGs requires a cross-sectoral approach involving education, renewable energy, and sustainability-oriented public policies. Amid global challenges such as the pandemic, it is important to integrate education, technology, and innovation as solutions to achieve more sustainable development goals.

Most Used Keywords

In Figure 5, we can see the emergence of keywords as a mutually sustainable network. Each keyword has a different colour variation that indicates a cluster of words. The findings in this study revealed that there were eight colour clusters, of which Cluster 1 (red) with 22 keywords, cluster 2 (green) with 17 keywords, cluster 3 (blue) with 16 keywords, cluster 4 (yellow) with 13 keywords, cluster 5 (purple) with 12 keywords, cluster 6 (light blue) with seven keywords, cluster 7 (orange) with six keywords, and cluster 8 (chocolate) with one keyword.

If you look closely, the main goal of this research, quality of education, is closely related to the keywords sustainable and the 2030 agenda. It shows the relevance of research even though the quality of education is in Cluster 2, while the sustainability and 2030 agenda are included in Cluster 1. This shows both in terms of trends, research sub-fields, and the influence of more and more massive keywords in research studies.

In contrast to Figure 5, figure 6 shows a bibliometric visualization map that depicts the relationship between keywords in the academic literature with the additional dimension of time represented by the colour of the nodes. Larger nodes indicate frequently used keywords, while node colours, from blue (2021) to yellow (2023), reflect the evolution of research trends. The relationship between keywords is depicted by a connecting line, where a thicker line indicates a stronger relationship. Established themes such as sustainability, education, and sustainable development goals are blue or green, indicating their consistency since 2021. Meanwhile, quality education and the 2030 agenda are green, indicating related themes appearing in mid-2022. In contrast, new topics such as machine learning, decision-making, and long-life learning are yellow, showing increased relevance in recent years. This visualization illustrates the transition of research focus from basic themes to technology and innovation, which provides an overview of the latest developments in the academic literature.

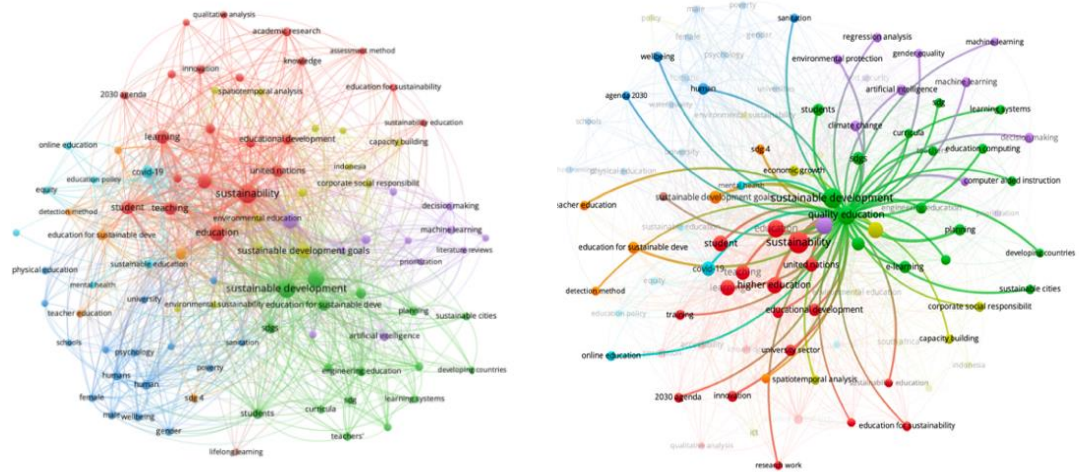


Figure 2. Network Visualization

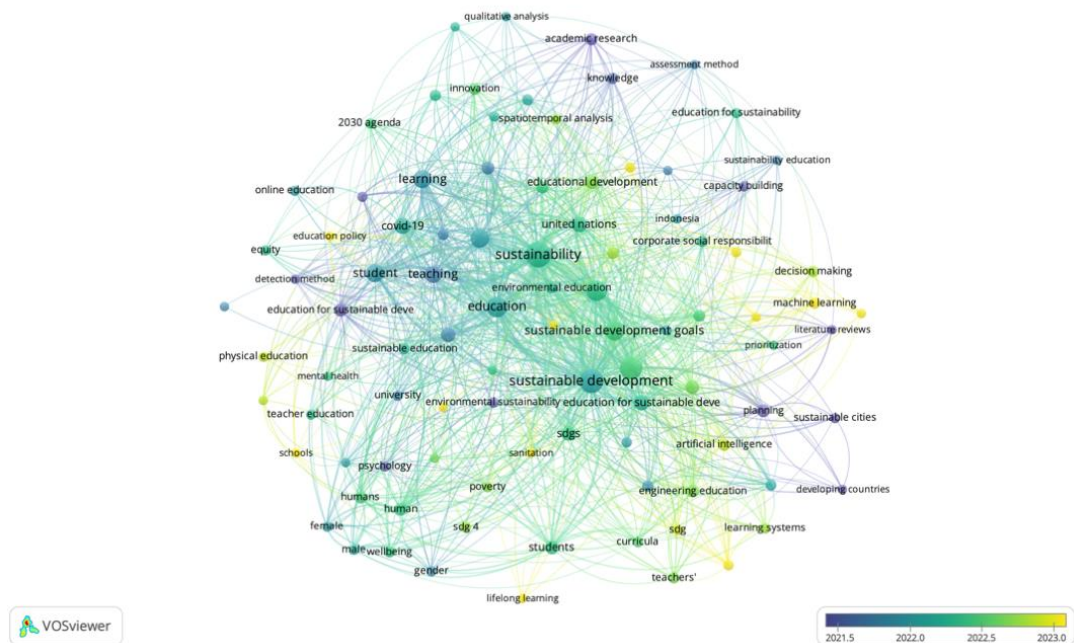


Figure 3. Overlay Visualization

Discussion

Bibliometric analysis has been a prevalent method for evaluating and understanding the status of ESD research across various disciplines, offering insights into prominent authors, countries, themes, and trends (Prieto-Jiménez et al., 2021). Education for Sustainable Development (ESD) has garnered considerable research interest in recent years, as evidenced by the bibliometric analysis of several previous studies that highlighted its development in the preceding years. In the study by (Gorski et al., 2023), the development of the number of publications in the early phase began in 1989 to 1995 and experienced a stable number in 2005. Concurrently, (García et al., 2020) and Prieto-Jiménez et al. (2021) have noted the highest number of publications in 2019. In this study, the number of publications with related themes exhibited a relatively stable increase, with a continuous annual growth trend.

In education, ESD has evolved from a primary focus on environmental, economic, and social issues (Araújo-Vila et al., 2023) to a more comprehensive integration with other fields of study. The concept of Quality Education in point 4 (in this case, ESD) is the foundation for achieving other SDGs (Baharun et al., 2024). When viewed holistically, the findings of this study demonstrate that the scope of scientific fields encompasses broader results by incorporating other scientific fields as a distinct classification that links ESD with 16 additional SDGs (Sato et al., 2020). This phenomenon can be attributed to interconnected multi-classifications within scientific domains. In this case, publications indexed by Scopus do not explicitly reveal multiclassification in scientific fields. However, Scopus search findings categorize them into different subject areas (e.g., computer science, social science, and medicine). It underscores the necessity of examining the data sources utilized in a study, particularly in literature-based research. A particular form of writing can be classified across multiple subject areas if the subject under discussion encompasses various disciplines (Tontodimamma et al., 2021). This phenomenon can be regarded as a form of multiclassification based on the research topic (Song et al., 2021).

This study only has similarities with other studies in the Social Science subfield, which remains in the first place. The significance of social science in fostering trust in scientific research and transcending disciplinary boundaries is well-documented (Fouché, 2024; Reinhardt & Ross, 2019). The database utilized in this study, Scopus, is specifically designated for social science studies (García et al., 2020). In Indonesia, the future of social sciences hinges on collaboration between the State's universities and academic networks to address challenges and enhance their impact on teaching and policymaking (Achwan et al., 2020). A meticulous examination of the findings reveals a striking contrast between the results of this study and those of previous research. This discrepancy is particularly evident in the sub-findings, except in the scientific field, where there is a notable congruence in bibliometric-based publication trends concerning the same topic and approach.

ESD is a major keyword in achieving the Sustainable Development Goals (SDGs), especially regarding this study's renewable energy and sustainability policies. The research of (Zafar et al., 2020) showed that renewable energy consumption contributes positively to environmental quality, with education playing a role in reducing carbon emissions, which has implications for policies, especially education—emphasized the importance of intellectual capital in supporting SDGs, especially in the public and private sectors—revealed that the COVID-19 pandemic hinders the achievement of SDGs but also encourages innovation in education and technology—highlighted the role of CSR in supporting education through short-term mentoring and long-term investment. In addition, (Ferguson & Roofe, 2020) and (Burbules et al., 2020) emphasized the role of higher education in promoting SDG 4 through teaching, research and community service. Thus, achieving the SDGs requires a cross-sectoral approach that integrates education, renewable energy and technological innovation in policymaking for global sustainability.

CONCLUSION

This study concludes that the number of publications on quality education within the Education for Sustainable Development (ESD) framework has significantly increased between 2020 and 2024, reflecting growing academic attention to the relationship between education, sustainability, and the 2030 Agenda. However, despite this rise in research output, the average citation impact per publication has declined, suggesting a more dispersed influence within the academic community. The study also highlights the dominance of social and environmental sciences in this discourse, emphasizing sustainability as a central theme in global education research. Geographically, Spain, China, and India lead scientific production, with institutions such as Chiang Mai University and Universitas Indonesia making notable regional contributions. However, research distribution remains uneven, signalling the need for greater cross-institutional and international collaboration. There is a noticeable shift towards technology and innovation in education, emphasizing lifelong and machine learning. It underscores the necessity of integrating sustainability,

technology, and education to achieve the 2030 Agenda's goals. The study suggests enhancing multidisciplinary collaboration between scholars, politicians, and the commercial sector to increase ESD's impact. Despite its periodization, approach, and data distribution limitations, this study provides valuable insights into emerging research trends, particularly in public policy and education, with implications for improving learning quality across educational institutions worldwide.

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