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# SCIENTIFIC PUBLICATION TRENDS IN GREEN EDUCATION: A BIBLIOMETRIC ANALYSIS

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## INTRODUCTION

Green education is the education on environmental conservation or sustainability given to the learners. It is a crucial part of learning that focuses on ecological awareness, responsible citizenship, and sustainable actions. Its importance is seen at the primary, secondary and higher levels of education providing a holistic awareness of environmental challenges and encouraging active engagement to make a more sustainable world. The notion of green education is the development of knowledge, skills and values based on environmental sustainability, ecological literacy and conservation activities. The beginning of the application and implementation of constructivism in society (Adnyana, Mahendra, & Raza, 2023). The main goal of green education is to increase knowledge, understanding and motivation for environmental protection, sustainability and responsible interaction with the natural world. It encourages the adoption of sustainable practices, active engagement in community efforts, advocating for policy changes, and making environmentally conscious decisions. Green education is also important to produce ecologically knowledgeable and responsible individuals who can tackle current and future environmental concerns. It helps individuals to play a proactive role in creating a sustainable and resilient world. Green education and education for sustainability share similar goals and principles. The principles of green education, when adopted by industries, communities, and individuals, will enable them to pursue cleaner production processes (Akinsemolu & Onyeaka, 2025).

## MATERIALS AND METHODS

The bibliometric analysis was conducted using the bibliometrix package (version 5.3) for the R programming language (Aria and Cuccurullo, 2017), along with the biblioshiny graphical interface that enables interactive visualisation and data analysis.

The data was retrieved from the Web of Science and Scopus databases on 26th April 2026 using the following search strategy: TITLE-ABS-KEY ("green education") AND PUBYEAR < 2026. The initial search resulted in a total of 187 records in the Scopus database and 120 in the Web of Science database. All records were exported, and data merging was performed to eliminate duplicates, after which a total of 210 records remained for analysis.

Table 1. Most cited documents

| Paper | DOI | Total Citations | TC per Year |
|---|---|---|---|
| GENG Y, 2013, J CLEAN PROD | 10.1016/j.jclepro.2012.07.013 | 122 | 8,7 |
| RAMLOWAT D, 2019, ADV INTELL SYS COMPUT | 10.1007/978-981-13-3338-5_23 | 112 | 14 |
| ALAVI S, 2023, INT J PRODUCT PERFOR | 10.1108/IJPPM-05-2020-0232 | 53 | 13,2 |
| PRIETO-SANDOVAL V, 2022, J CLEAN PROD | 10.1016/j.jclepro.2022.132509 | 52 | 10,4 |
| ZHAO W, 2015, INT J SUST HIGHER ED | 10.1108/IJSHE-02-2014-0021 | 46 | 3,8 |
| YU T, 2019, J ENVIRON MANAGE | 10.1016/j.jenvman.2019.06.101 | 41 | 5,1 |
| AHAKWA I, 2023, ENERG POLICY | 10.1016/j.enpol.2023.113514 | 40 | 10 |
| ZHANG M, 2020, IEEE ACCESS | 10.1109/ACCESS.2020.3008443 | 36 | 5,1 |
| YU T, 2020, ENVIRON SCI POLLUT R | 10.1007/s11356-019-07450-7 | 34 | 4,9 |
| AKINSEMOLU A, 2025, RENEW SUST ENERG REV | 10.1016/j.rser.2024.115239 | 32 | 16 |

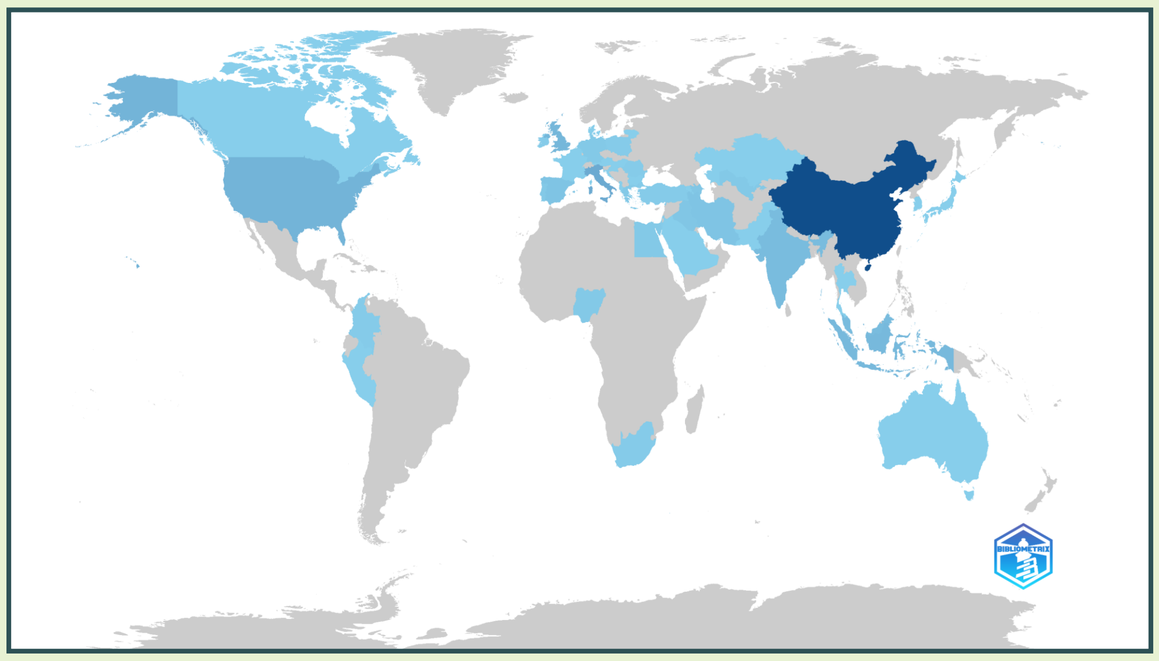

Image 1. Countries' Scientific Production

## RESULTS

The analysed dataset includes 210 documents published in 169 different sources (journals, books, etc.), indicating the dispersion of research output across various publication channels. Such a pattern may reflect the interdisciplinary nature of the field in which relevant works are published in various journals, or a relatively decentralised publishing structure. The time span of the analysed documents extends from 1992 until 2025 the year, where the presence of works from 2025. The year likely reflects the inclusion of articles in early access, preprints, or publications assigned in advance to future issues of the journal. Therefore, caution is necessary when interpreting the most recent trends, as the data for that period may still be incomplete. Regarding the types of documents, original scientific articles (n = 98) dominate the set, which is characteristic of the academic research field. A significant share of conference papers and proceedings (n = 27 and n = 25, respectively) suggests that the rapid dissemination of research results is an important characteristic of this field, with conference publications often preceding or complementing journal publications. The presence of book chapters (n = 19) and monographs (n = 9) further indicates a certain level of maturity and consolidation of knowledge within the field.

An annual growth rate of 12.59% indicates a strong and continuous increase in research activity and interest in the analysed topic over the observed period. Growth rates above 10% are commonly associated with emerging areas or dynamically developing research fields of high activity. In the creation of the analysed 210 documents, a total of 598 authors participated, with the average number of co-authors per document being 3.25, which clearly indicates a highly collaborative research environment. The high ratio of authors to the number of documents further confirms this pattern. Only 39 documents (about 18.6% of the total corpus) were written without co-authors, which further emphasises the collaborative nature of the field and suggests that independent research efforts are relatively rare compared to team-based approaches to research.

The average number of citations per document is 5.752, which represents a measure of incoming impact, i.e. the frequency with which the documents from the analysed set are cited in other scientific papers. Considering that the average age of the documents is just over six years (6.07), the cited level can be roughly assessed as moderate. Although it is not exceptionally high, it is not negligible either, which suggests that the works within the analysed corpus are recognised and used as a foundation for further research. For a more complete interpretation of this indicator, it would be useful to compare it with relevant reference values for similar research fields or disciplines, given that average citation rates vary significantly depending on the area of research and the typical time frame for accumulating citations.

## CONCLUSION

Bibliometric analysis of a corpus of 210 documents published in 169 sources over the period from 1992 until 2025. The year indicates a dynamic and growing interdisciplinary research field, as evidenced by a strong annual growth rate of 12.59% and a high average level of co-authorship of 3.25 authors per document. A moderate average citation rate of 5.752 citations per document, along with an average document age of 6.07 years, suggests that the analysed field exhibits a stable scientific impact and recognition within the broader research community.

## REFERENCES

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