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## **Research in Environmental Education. A bibliometric analysis of the last two years**

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**Abstract**--The objective of the study is to characterize the world scientific production on Environmental Education (EA) in the Scopus and Web of Science , between the months of January 2020 to March 2022. We worked with a universe made up of 638 documents from the Web of Science and 774 from Scopus, extracted from 254 and 327 sources respectively. The bibliometric analysis indicates a very similar citation average between both databases (1.45 for Web of Science and 1.40 for Scopus). The average number of citations per document is also similar, being 1,276 and 1,589 in WoS and Scopus . The rate of collaboration between authors is slightly lower in Web of Science . The most cited article in both databases is titled “ How renewable energy consumption contribute to environment quality ? The role of education in OECD countries ”, the most productive author on the subject is Bruce Johnson, the journals that host the greatest production on EE are *Sustainability* ( Switzerland ) and *Remea -revista eletronica do mestrado em educacao* . The USA and Brazil are the countries with the largest amount of research in both databases and the type of scientific production that stands out the most are original articles.

**Keywords**---*bibliometric indicators; scientific production, Environmental Education.*

## **Introduction**

Environmental degradation is a growing global concern. Increasing demographic pressures, escalating consumption patterns and rapid industrial development are key factors contributing to this degradation. The crisis that stems from these problems puts vulnerable sectors at risk (children, pregnant women, the elderly, etc.) to whom governments do not pay due attention. <sup>1,2</sup>

It is increasingly recognized that sustainable development policies, plans and actions are more likely to be implemented when supported by an educated and informed public. In this sense, the objective of Environmental Education (EE) is to develop a world population that is aware of and concerned about the environment and its associated problems. This is achieved by generating knowledge, skills, attitudes, motivations and commitment to work individually and collectively to solve current problems and prevent new ones. EE occurs in diverse contexts since it seeks to educate the population in a holistic way, especially when coexistence takes place in sociocultural and ecological contexts threatened by the current crisis of civilization. <sup>3,4</sup>

EA involves the sharing of knowledge to build values, attitudes and skills that prepare individuals and communities to collaboratively undertake positive environmental actions <sup>5</sup>. However, to be effective, education cannot be a one-way transfer of information; rather it should be a collective construction that includes the social reality and the traditional knowledge of local communities <sup>6</sup>. EE, therefore, must be practical, interdisciplinary, empowering and relevant to students' daily lives.

The importance of EE lies in its role as a means to establish and strengthen the relationship between individuals and the environment <sup>1,7</sup>. This training is comprehensive and occurs throughout life, preparing the individual to understand the main problems of the contemporary world, and providing the skills and attributes necessary to play a productive role towards the improvement of life and The environmental protection. <sup>8,9</sup>

In recent years, scientific production on AD has increased considerably <sup>10,11,12</sup>. The importance of his study lies in the need to assume EE not only as an informative process, but as a mechanism that helps transform the world educational reality. For this, it is necessary to develop critical thinking, participation and collaboration between individuals and, what is more important, to strengthen in students the affective bond with their family, friends and environment. For this reason, EE has become a relevant and interesting academic and research field, which has led to the publication of different documents, including reflections, literature reviews and empirical research.

Bibliometric studies analyze the dynamics and trends in the generation and production of knowledge. This type of study allows us to know the current state of a certain field of knowledge, and its research patterns, that is, the most cited

authors and those with the greatest production on a certain field of knowledge, the most cited articles, the most productive countries. , collaboration networks, among others. For Lopera-López et al. <sup>13, p.429</sup> “Bibliometric studies in EE allow reconstructing the history of research in the field in local and global contexts, knowing the prevailing pedagogical trends, epistemological, methodological obstacles, etc.”. Therefore, different studies have addressed the problem of AD from a bibliometric approach <sup>14,13,9,15,16,17,18</sup> confirming the importance of this type of research.

Due to the above, this research aims to characterize the world scientific production on AD in times of pandemic, using the Scopus and Web of Science (hereinafter WoS ), between the months of January 2020 to March 2022.

## Method

The present study is of a bibliometric type, with a descriptive and retrospective scope. The worldwide scientific production generated on AD in the period of the COVID-19 pandemic (2020-2022) was considered as the unit of study.

For this study, the Scopus and WoS databases were considered , calculating their bibliometric indicators through the R *Bibliometrix software* and the managers of said databases. Regarding the search strategies, the formula (TITLE ( environmental ) AND TITLE ( education ) ) AND PUBYEAR > 2019 was used, adapting it to the characteristics of the searches in each software and database. The results were reviewed individually, making up a final sample of 638 documents from the WoS database (extracted from 254 sources) and 774 from Scopus (extracted from 327 sources). The data obtained was exported in RIS and CSV formats to be later processed and analyzed with the help of the *Bibliometrix R* and Vos Viewer software . The bibliometric indicators considered for the research were based on general information about the data, authors and collaboration of authors. The results are presented in tables and figures.

## Results

Table 1 shows the information regarding the main bibliometric indicators extracted from the *Bibliometrix software* on EE. A total of 254 ( WoS ) and 327 ( Scopus ) sources (journals) were obtained, respectively, of which 638 ( WoS ) and 774 ( Scopus ) documents were analyzed. A very similar citation average was generated: 1.45 for WoS and 1.40 for Scopus. The average number of citations per document is also similar, being 1,276 and 1,589 in WoS and Scopus , respectively.

Regarding the number of authors, Scopus presents 2190 and WoS 1732 (173 unique authors in articles for the case of Scopus and 120 for the case of WoS ), of which a high number of articles present multiple authorship (on average 3 authors per article). The rate of collaboration between authors is slightly lower in WoS (3.12) compared to Scopus (3.39 ). Finally , WoS presents 738 keywords and Scopus 1891.

Table 1  
Bibliometric information on AE in Scopus and WoS (2020-2022)

<b>Description</b>	<b>WoS</b>	<b>Scopus</b>
<b>Main information about the data</b>		
Sources	254	327
documents	638	774
Average years since publication	1.45	1.40
Average number of citations per document	1,276	1,589
Average number of citations per year per document	0.5086	0.5984
References	1	1
<b>Authors</b>		
Authors	1732	2190
Author appearances	1943	2495
Single Author Document Authors	117	151
Authors of multi-author documents	1615	2039
<b>Author Collaboration</b>		
Single Author Documents	120	173
Documents by Author	0.368	0.353
Authors per document	2.71	2.83
Co-authors per document	3.05	3.22
Collaboration Index	3.12	3.39
<b>document content</b>		
Keywords (IDs)	738	1891
Author keywords (DE)	1757	1876

*Note. Bibliometrix R*

When analyzing world scientific production by years, Figure 1 shows that Scopus has a higher production. The year 2021 was slightly the year with the highest production with respect to all publications. Scopus stood out this year, but not WoS .

At the beginning of March 2022, the production was 73 scientific documents, of which 23 documents were published in journals indexed in WoS and 50 in Scopus, forecasting a decrease in production for this year 2022.

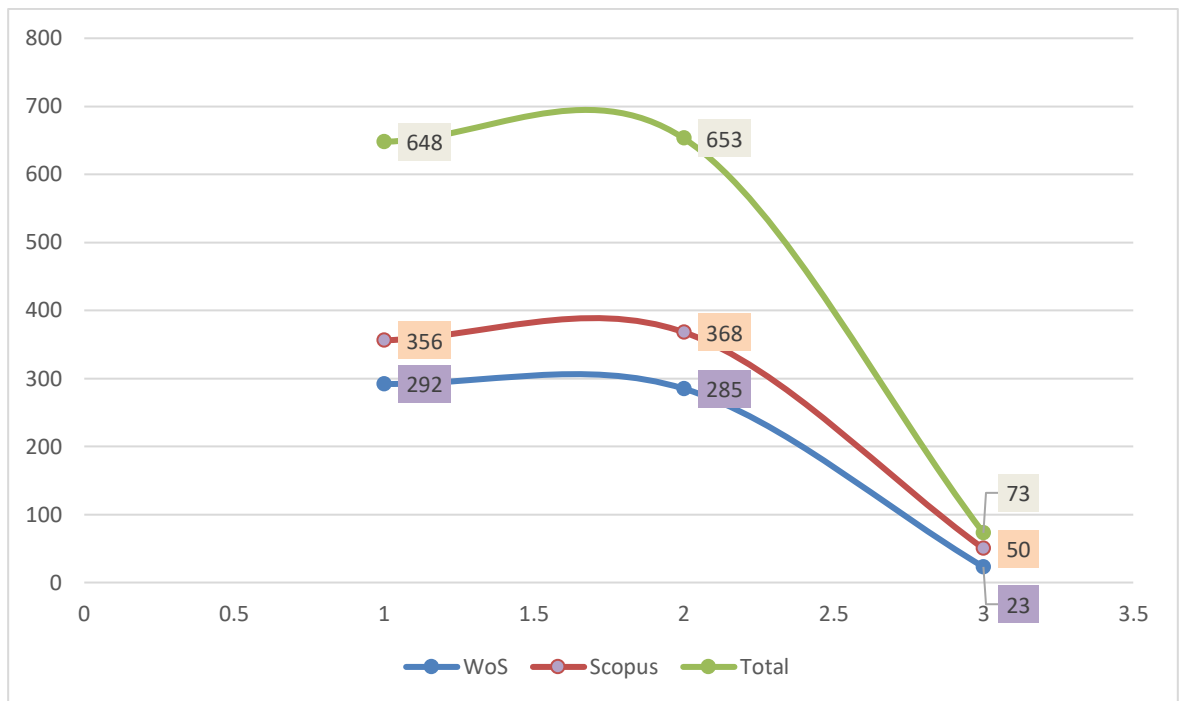


Figure 1 . Annual production in WoS and Scopus .

Table 2 shows the authors with the highest number of publications on AD. In the case of WoS and Scopus , the American Bruce Johnson stands out with 13 publications in Scopus and 7 in WoS , followed by Jan Cincera with 12 and 6 publications, respectively.

Table 2  
Authors with the largest number of publications in WoS and Scopus

Scopus		WoS	
Johnson, b.	13	Johnson B.	7
Činčera , J.	12	Cincera J	6
Stewart, A.	12	Stickney J	6
Kroufek , R.	10	Chang CH	5
Stickney , J.	6	Kidman G	5

Regarding the journals in which the articles on EE are published (see table 3), *Sustainability* ( Switzerland ) presents 61 publications in Scopus, while in WoS the journal *Remea stands out -revista electronica do mestrado em educacao Ambiental* which presents 73 publications.

Table 3  
Journals with the largest number of publications in WoS and Scopus

Scopus		WoS	
Sustainability ( Switzerland )	61	Remea -Electronic magazine of the teacher in environmental education	73
Environment education research	58	Sustainability	58
Iop conference series: earth and environmental science	32	Environment education research	51
E3s website of conferences	26	Australian journal of environmental education	19
International explorations in outdoor and environmental education	25	Journal of environmental protection and ecology	fifteen

Regarding the types of research (see table 4), original scientific articles predominate in the two databases analyzed (514 in WoS and 510 in Scopus), followed by *conferences . paper* .

Table 4  
Types of publications in WoS and Scopus

WoS		Scopus	
Original article	514	Original article	510
Early Access	32	Conference paper	132
Editorial	31	bookchapter _	61
Review	24	Review	26
book review	13	Editorial	twenty

Regarding the countries of origin of the investigations, the United States stands out with 127 articles in Scopus and Brazil with 145 in WoS . It is followed by Australia and Indonesia in Scopus and the United States and Australia in WoS (see table 5 and figure 2).

Table 5  
Countries of origin of publications in WoS and Scopus

Scopus		WoS	
USA	127	Brazil	145
Australia	65	USA	88
Indonesia	61	Australia	52
China	59	Spain	52
Spain	52	China	47



The Scopus thematic map shows how motor and *environmental themes knowledge*, *students* and *pre-environmental behaviour*. Regarding the basic topics, *education*, *education research*, *gender*, *environmental education* and *environment education research*. Regarding emerging or disappearing themes, *children*, *higher education* and *environment activism*. Finally, regarding highly specialized or niche topics, *coemissions*, *augmented reality*, *outdoor learning*, *distance learning* and *art* (see figure 4).

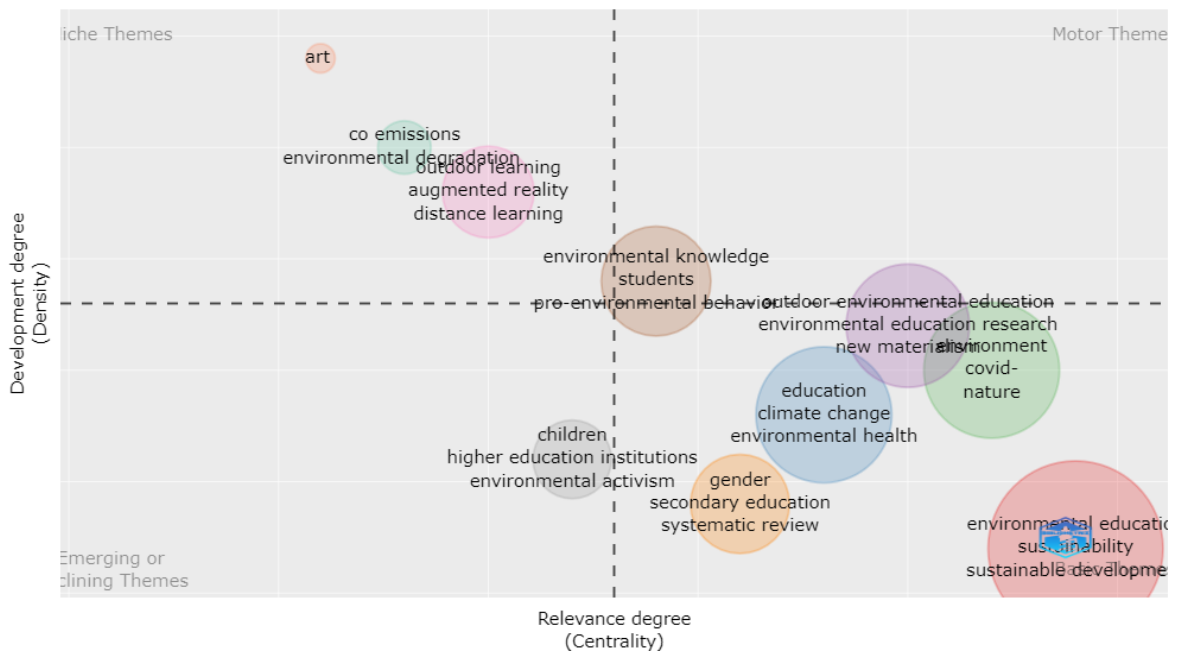


Figure 4. *Scopus thematic map.*

Regarding the co-occurrence network analysis of the keywords in the WoS database, the creation of 8 clusters, 110 items, 1141 links and a total link strength of 2070 is observed.

Cluster 1 (red) born from *sustainable development* with 49 occurrences; cluster 2 (green) with *sustainability* with 52 occurrences; cluster 3 (blue) with *environmental education* and 249 occurrences; cluster 4 (yellow) with *behavior* and 36 occurrences; cluster 5 (purple) with *education* and 34 occurrences; cluster 6 (light blue) with *knowledge* and 48 occurrences; cluster 7 (orange) with *values* and 15 occurrences; and cluster 8 (brown) with *risk* and 5 occurrences (see figure 5).

The thematic map shows *conservation*, *green* and *universities* as motor themes. Regarding the basic topics, *intervention*, *knowledge* and *sustainable stand out. development*. Regarding emerging or disappearing themes, *sustainability*, *health* and *schools* stand out. Finally, regarding highly specialized or niche topics, *performance*, *climate-change*, *coemissions*, *economic - growth* stand out. *Y engagement classroom* (see figure 6).

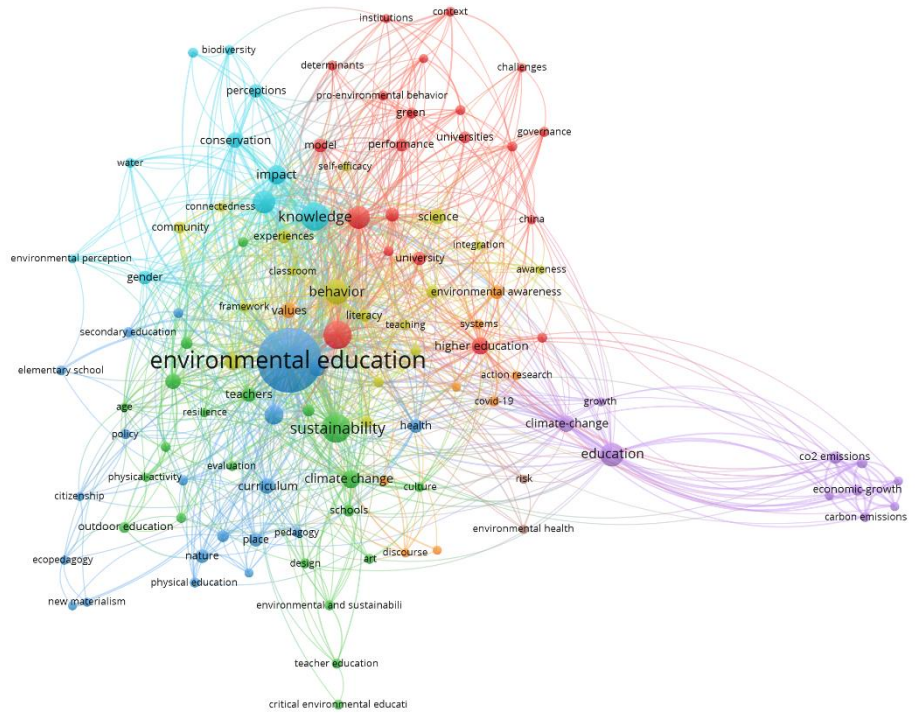


Figure 5 . Analysis of network visualization in Web of Science .

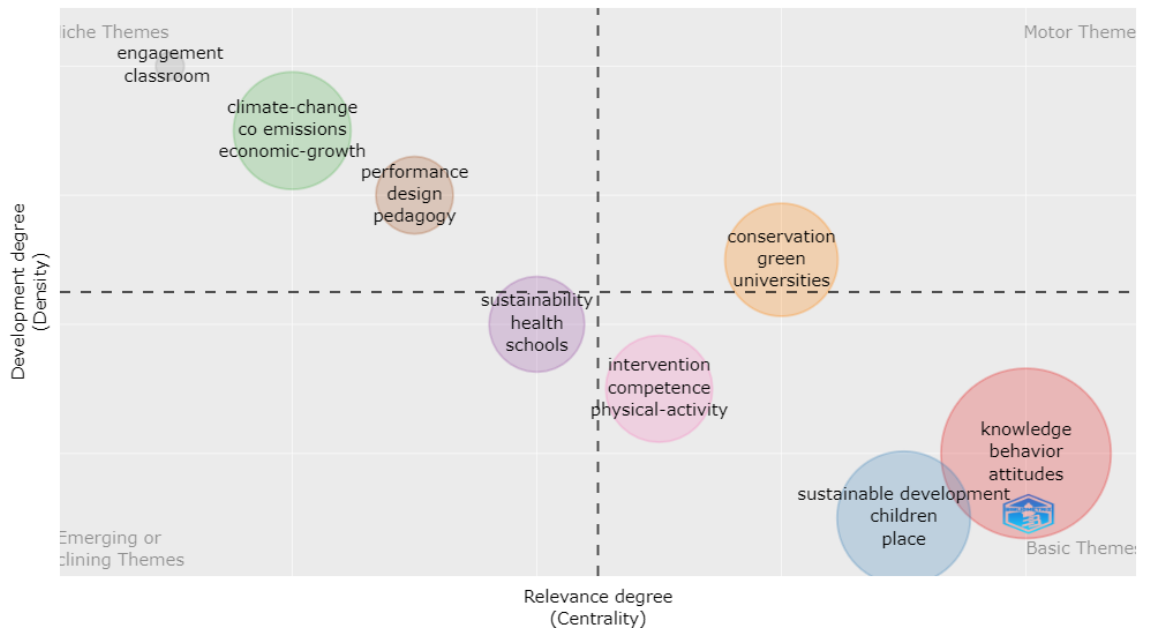


Figure 6. Web of Science thematic map.

This is corroborated in the graph of the tree map (see figure 7), highlighting in Scopus the words *environmental education*, *education* Y *sustainable development*. While in WoS *knowledge*, *behavior* and *attitudes* stand out.



Figure 7. Scopus word map (first image) and WoS (second image).

## Discussion

The study determined that the Scopus database presents a greater production on AE, thus, it can be concluded that the year 2021 was slightly the most productive with respect to all publications. This is corroborated by Lopez Perez et al.<sup>13</sup>, whose results show an accelerated increase in the production of knowledge in EE. WoS database and 774 from Scopus, extracted from 254 and 327 sources respectively, generating a very similar citation average of 1.45 for WoS and 1.40

for Scopus. The average number of citations per document is also similar, being 1,276 and 1,589 in WoS and Scopus . Along these lines, Prosser - Bravo & Caro-Zúñiga <sup>9</sup> evaluated the WoS , Scopus Elsevier, SciELO, Dialnet, Redalyc and JSTOR databases, creating a final corpus of 151 studies. Hudha et al. <sup>15</sup> , for their part, evaluated 55 articles, obtaining 317 citations and 63.4 citations/year. Finally, Usman & Ho <sup>16</sup> , carried out a bibliometric evaluation of 495 relevant documents to identify several essential indicators of research on environmental issues , including the type of publication, the most outstanding journals, thematic categories, authors, institutions, and the countries, which contributed significantly to this topic.

Regarding authorship, Scopus presents 2190 and WoS 1732 (173 unique authors in articles in the case of Scopus and 120 in the case of WoS ). The collaboration index between authors is slightly lower in WoS (3.12) compared to 3.39 in Scopus. Finally, WoS presents 738 keywords and Scopus 1891. As for the most prolific signing authors, it stands out the study of Muhammad Wasif Zafar, Muhammad Shahbaz , Avik Sinha , Tuhin Sengupta and Quande Qin, titled “ *How renewable energy consumption contribute to environment quality ? The role of education in OECD countries* ”, the same one that received 71 citations in WoS and 79 in Scopus since its appearance in September 2020 in the *Journal of Cleaner Production* .

The most prolific author on EA is the American Bruce Johnson with 13 publications in Scopus and 7 in WoS . For Gomes et al. <sup>14</sup> , Krasny ME was the author who published the most on the subject, followed by Kopnina H and Bogner FX. Regarding the scientific journal that concentrates the largest number of articles on EE, *Sustainability* ( Switzerland ) stands out, presenting 61 publications in Scopus. In the WoS database , the journal *Electronic Journal of the Teacher in Environmental Education* stands out - *electronic journal of the teacher in environmental education* with 73 publications. It should be noted that in the research by Kurtulus & Tatar <sup>17</sup> , the highest numbers of articles accessed were published in *Environmental Education Research* (f = 241), *International Research in Geographical and Environmental Education* (f = 145) and *Sustainability* ( Switzerland ) (f = 122).

Regarding the countries of origin of the research indexed in both databases, the United States stands out with 127 articles in Scopus and 145 in WoS . Australia and China appear in second and third place in the case of Scopus and Spain and China, second and third in the case of WoS . This is corroborated by Onoprienko et al. <sup>18</sup> , who affirm that more attention is paid to American authors or affiliations. Prosser - Bravo & Caro-Zúñiga <sup>9</sup> , for their part, studied the scientific production of Spain, Latin America and the Caribbean (2000-2020), with Cuba, Mexico and Colombia being the countries with the most publications. Kurtulus & Tatar <sup>17</sup> corroborate what was found by this research, pointing out that most of the articles published on the subject are by researchers from the United States, the United Kingdom, and Brazil.

In the two databases analyzed, original scientific articles predominate (514 in WoS and 510 in Scopus). This is corroborated by Lopera- Perez et al. <sup>13</sup> who concluded that, considering all the documents included in the analysis, original

articles are the most common form of publication, representing 92.02% of all the documents analyzed.

Regarding the co-occurrence network analysis of the keywords in the Scopus database, the creation of 8 clusters, 156 items, 2577 links and a total link strength of 5662 was observed. In the WoS database, the creation of 8 clusters, 110 items, 1141 links and a total link strength of 2070. In the Scopus thematic tree the environmental terms stand out *education*, *education and sustainable development*. While in Web of Science knowledge, *behavior* and *attitudes* stand out. For Lopera- Perez et al.<sup>13</sup>, the descriptors whose frequency exceeds a thousand are *education*, which appeared in 71.4% of all the documents, and *knowledge* in 54.6%, both appearing in more than half of the publications. The first *environmental* or *EE* descriptor is *environmental education*, which appeared in 19.65% of the documents, followed by *sustainability* (12.4%).

The data showed a slight increase in scientific production on AD. One of the reasons is the current environmental degradation and climate change as latent threats to all countries and human societies, which is why environmental problems have been attracting the attention of politicians, the public, the press and researchers. Such problems have been widely featured in scientific publications and warnings.<sup>19</sup>

This study has some limitations. The first is that it is based on a limited set of keywords and only two databases. The second, although this study uses bibliometric and bibliographic software as tools (*VOSviewer*, *Zotero*, *Bibliometrix*, *Publish or perish*), the subjective evaluations of the authors occur and can lead to errors. It is recommended that future studies use a larger sample by expanding the keywords used and more accessible databases. It is also recommended to corroborate these results with other software for bibliometric analysis. It is also recommended that additional related studies provide more elaborate explanations of the phenomenon based on existing studies that discuss AD.

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