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Environmental Literacy: A Bibliometric Analysis

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Abstract: Environmental literacy is important in modern education to encourage individuals to become more environmentally aware. This research aims to reveal research trends, research methods, education levels, and countries that conduct environmental literacy research. The technique used is bibliometric analysis. Sixty-eight documents indexed in the Scopus database were analyzed using VOSviewer and Biblioshiny, with publication years ranging from 2019 to 2024. The findings show that the survey method is dominant in environmental literacy research. Environmental literacy measurements in the adult group account for the largest number. Publications about environmental literacy increased significantly in 2020–2021 and 2023–2024. The United States is the leading country in environmental literacy research. Environmental education and environmental literacy are trending topics in this field of research. This shows that there is an increasing research focus on environmental issues in the educational context.

Keywords: Bibliometric analysis; Environmental literacy; Survey

Introduction

Environmental literacy is an important aspect that must be embedded in education (Sasa et al., 2022). Environmental education aims to create people who have good environmental literacy skills (Putra et al., 2021). Environmental literacy theory assumes that individuals with good environmental literacy have adequate knowledge and attitudes and behave in an environmentally friendly manner (Svobodová, 2023). Environmental literacy is recognized as a fundamental component in directing individual environmental conservation behavior (Alibaygi et al., 2024). This includes the ability to see environmental conditions, be aware, make decisions, and take action to build balance in the environment through sustainable behavior, protect the environment, and ensure the quality of human life (Tomás et al., 2022).

The formation and cultivation of environmental awareness can be done through a branch of science that is closely related to human life and the environment, namely natural sciences (Hekmah et al., 2019). Someone who has environmental literacy can overcome environmental conflicts with responsibility, commitment, and the sustainable development of natural systems, as demonstrated by skills, attitudes, and knowledge (Lopera, 2019). In addition, McBeth (2011) explains that age is very important; younger students tend to have lower levels of environmental knowledge and skills but higher levels of pro-environmental attitudes and behavior than older students (McBeth et al., 2011).

Cincera's (2020) research presents findings from a Czech environmental literacy survey conducted in 2020 (Cincera et al., 2023). The effects of environmental and sustainability education, as well as the effects of gender and age on environmental knowledge, attitudes, beliefs, place attachment, locus of control, and behavior are analyzed using teaching strategies. The findings support the relevance of the strategies studied in forming young

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students' environmental literacy. Older students and boys showed lower levels of pro-environmental values and behavior. Yeh (2021) integrated environmental problems as an initial problem to explore high school students' problem-solving processes and proposed the concept of environmental problem-solving to investigate the interaction between high school students' scientific performance and strategies (Yeh et al., 2022). The results show that students with higher scores in environmental scientific achievement also scored higher in the environmental problem-solving process. Students with higher scores in environmental literacy can offer better problem-solving strategies, analyze solutions proactively, and present several plans. Huang also conducted related research to explore the relationship between environmental literacy education and sustainable development in schools (Huang et al., 2023).

Tabaru's (2024) research investigated the effect of place-based teaching practices on students' environmental literacy in life sciences subjects for Grade 3 elementary school students. In this study, the experimental group was taught place-based teaching practices for 10 weeks using the Environmental Literacy Instrument for Children (ELIC) (Örnek et al., 2025) . The findings show that providing place-based teaching practices at primary school age will have important results in developing environmentally responsible behavior and attitudes. Building environmental knowledge among students is important, especially regarding global and local environmental issues. This aims to improve sustainable environmental management (Kuruppuarachchi et al., 2021). Based on several studies that have been carried out, environmental literacy measurements can be carried out from elementary school to university level. Environmental literacy is measured using the Environmental Literacy Instrument for Children (ELIC), Middle School Environmental Literacy Survey (MSELS), and Environmental Literacy Survey (ELS). Mujib's (2023) research shows that the environmental literacy questionnaire is a reliable and valid tool for assessing the environmental literacy of secondary school students in Indonesia (Mujib et al., 2023).

Purpose and Research Question

This article aims to analyze study profiles, research trends, research methods, education levels, and countries conducting environmental literacy research using bibliometric analysis. The research questions are as follows:

RQ1: What is the profile of studies on environmental literacy including annual publications, country publications, institutional publications, and publications by authors?

RQ2: What methods are used in environmental literacy research?

RQ3: At what levels can environmental literacy be measured?

RQ4: How does co-occurrence network analysis work in environmental literacy research?

RQ5: What is the thematic map and evolution in environmental literacy research like?

RQ6: What are the trending topics in environmental literacy research?

Method

This research uses bibliometric analysis to determine trends in environmental literacy research from 2018 to 2024 by analyzing articles published in the Scopus database. Bibliometrics is a quantitative approach used to analyze and visualize collective scientific knowledge and evolutionary trends in a defined domain. This technique involves the systematic processing and interpretation of large amounts of unstructured data (Donthu et al., 2021). Using this method can provide a deeper understanding of a particular field of study by assessing the productivity, patterns, trends, and effects of scientific literature, famous authors, institutions, publishers, and countries, and identifying prospective research shortcomings (Yuan et al., 2023). The bibliometric method process is presented in Figure 1.

Figure 1. Stages of bibliometric analysis (Liu et al., 2024)

The article database was obtained from Scopus. A search using the keyword “environmental” yielded 3,145,229 documents. TITLE-ABS-KEY (environmental AND literacy) produced 5,366 documents. TITLE-ABS-KEY (environment AND literacy AND school) produced 1,162 documents. TITLE-ABS-KEY (environmental AND literacy AND school AND education) generated 816 documents. A total of 816 documents were then subjected to the filter stage. In the first stage of the filter, it was limited to the years 2019-2024, resulting in 454 documents. Second, filtering based on document type was limited to articles and reviews resulting in 342 documents. In the third stage, language filtering was carried out, resulting in 317 documents were obtained. Articles were selected from articles written in “English”. In the fourth stage, filtering of "all open access" articles resulted in 211 documents.

A dataset of 211 articles was obtained in CSV, RIS, and Bibtex formats. The dataset consists of the abstract,

keywords, bibliographic information, citation information, and reference information for each item. Data were analyzed with Vosviewer and Biblioshiny. VOSviewer was used because of its ability to display large bibliometric maps in a way that is easy to interpret (van Eck et al., 2010).

Results and Discussion

Profile of Studies

Annual Publication

A total of 211 articles were screened through the Scopus database. Figure 2 presents the distribution of research developments during the period 2019-2024. Environmental literacy research fluctuates from year to year and peaks in 2021 with 40 documents. The first publication of environmental literacy was in 2019, and the related publications experienced an increase in 2019-2021. In 2021-2022 there were two environmental literacy publications, and in 2022-2023 there were no such publications. Starting from 2023 to 2024, environmental literacy publications reappeared with five articles.

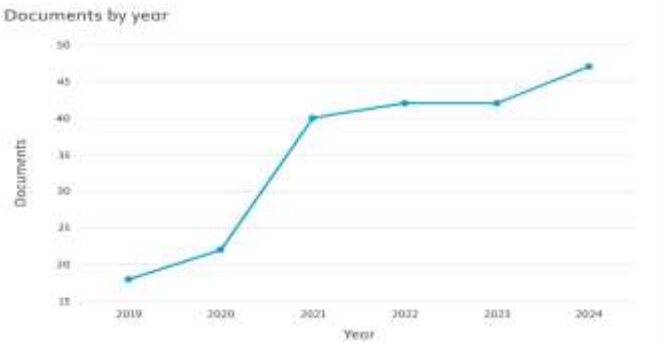

Figure 2. Distribution of publications per year on environmental literacy articles

Publication Countries

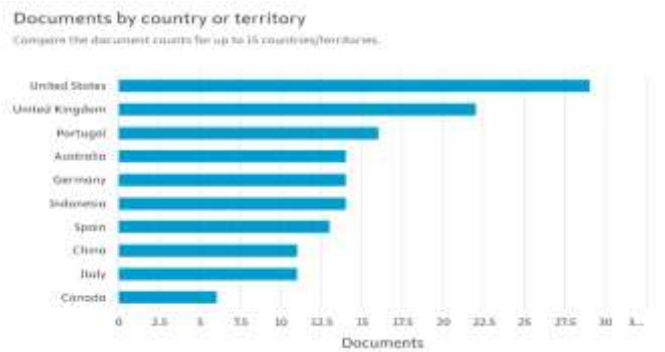

Figure 3. Documents by country

The identification results show that 10 countries contributed to environmental literacy publications from 2019-2024. Figure 3 shows the number of articles published by each country. Italy and China published 11 articles. Spain had 13 articles. Indonesia, Germany, and Australia produced 14 articles each. Portugal had 16 articles, and the United Kingdom had 18 articles. The United States is the highest-publication country in environmental literacy research. A total of 29 articles were published during the period 2019-2024. Indonesia, Germany, and Australia each produced 14 articles.

Publication Institutions

Based on the Scopus database, the institutions that contributed the most were the Universita degli Studi di Camerina and the University of Coimbra. This was followed by the Hellenic Center for Marine Research, Universidade do Porto, University of Zadar, University of Plymouth, Democritus University of Thrace, and Universidade de Lisboa. Ubica and Faculdade de Ciencias da University are in the smallest order (see Figure 4).

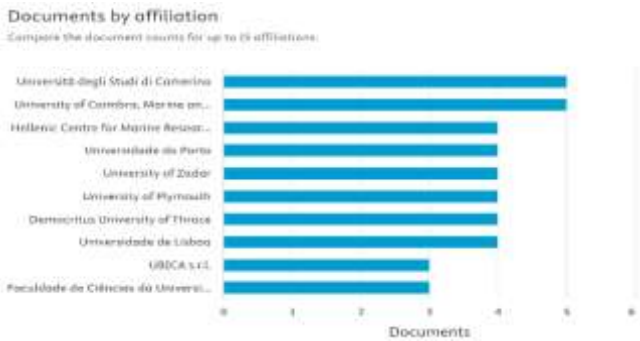

Figure 4. Number of publications based on affiliation

Publication by Author

Writers with the most publications are quite productive and influential in a particular topic or research field. Mokos and Realdon are the most productive authors related to environmental literacy, with a total of four documents. They were followed by Boaventura, Koulori, Mogias, and Previati, with three documents. Apart from the six names of researchers above, Beasley, Boubonari, Curdt Christiansen, and Freitas published two documents (see Figure 5).

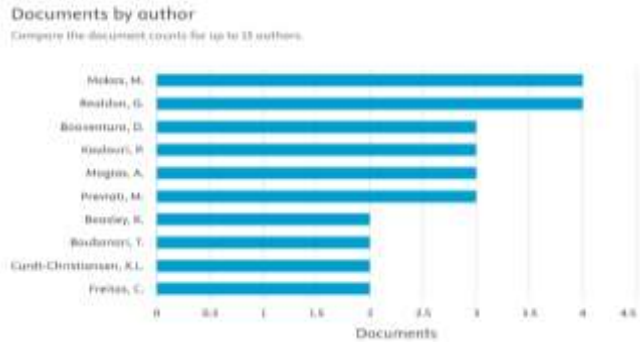

Figure 5. Number of publications by author

Research Method

The methods used in environmental literacy research are presented in Figure 6.

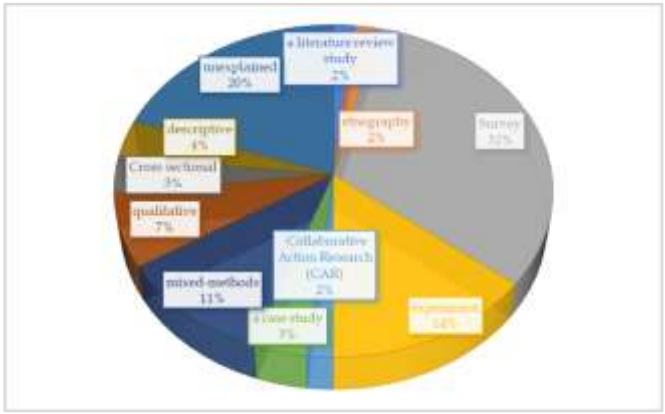

Figure 6. The distribution of environmental literacy research methods based on studies

Figure 6 shows that the methods used in environmental literacy research vary. There is a literature review study method of 2% by Rubas (2024) and, an ethnography of 2% by Persson (2024). Collaborative action research (CAR) (2%) is used by López (2021) for collaboration-based research. Case studies (3%) are used by Ratriyana (2023) and Kongson (2020) for in-depth analysis of certain cases. The descriptive method of 4% was used by Alibaygi (2024) in environmental literacy research which is recognized as a fundamental component in directing individual environmental conservation behavior (Alibaygi et al., 2024; Kongson, 2020). Apart from that, Putra's research (2021) aimed to describe data on environmental literacy abilities. The cross-sectional method of 3% was used by Pansakun et al.(2024) and Incesu et al. (2024). Qualitative 6.2% was used by four researchers such as Masykuroh et al. (2024) to understand the phenomenon in depth. Mixed methods of 11% are used by six researchers such as Goldman (2024) to combine quantitative and qualitative approaches (Goldman et al., 2015). Eight researchers including Shakirova (2024) used experimental methods of 14%. A total of 18 studies did not explicitly explain the methods used, with the number being 20%. The survey method at 32% is the method most widely used by 19 researchers such as Ubbes (2024) and others, to collect data from large populations. Surveys have become the most dominant method in environmental literacy research.

Educational Level

Measurement of environmental literacy at various levels is presented in Figure 7. Figure 7 presents environmental literacy measurements that can be carried out at various levels of education. It shows that the number of journal articles on the environmental literacy measurement for the adult group is the highest, namely 14. This may reflect that adult involvement is relevant in the context of environmental issues, decision-making, or other social activities. The group from the elementary school level also has quite a large number, namely 13. This shows that environmental education or the theme being researched is introduced from an early age, showing the importance of early learning in building environmental awareness. In their research, Tabaru (2024) investigated the effect of place-based teaching practices on students' environmental literacy in life sciences subjects for Grade 3 elementary school students (Örnek et al., 2025). In the high school group, the number is almost the same as in the elementary school group, indicating continued involvement at this level of education. In high school, students are encouraged to study environmental or social topics more deeply, considering that they are better able to understand more complex issues. The number of university student groups and that of junior high school student groups is the same, namely 8. University student involvement can indicate that they are involved in research or more structured environmental awareness programs. Meanwhile, for junior high school, this shows that students have begun to be introduced to global issues and are given basic insight into deeper topics. The number of teacher groups involved is quite small compared to the number of other groups. This happens because the teacher's role is as a facilitator rather than the main participant. However, teacher involvement is very important because teachers act as a transmitters of knowledge and awareness to students.

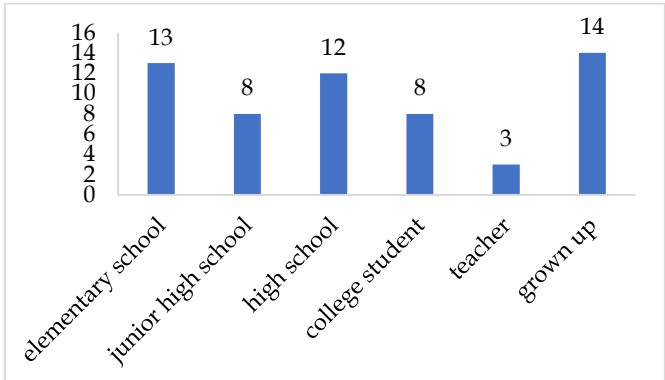

Figure 7. Distribution of education levels based on studies

Co-occurrence Network Analysis

Figure 8 presents the results of co-occurrence visualization created using VOSviewer, showing the relationship between keywords or terms that often appear together in a particular data set, related to the topic "environmental literacy".

Figure 8. Co-occurrence keyword by author

In the red cluster (education for sustainable development), there are terms such as "knowledge", "student", "teacher", and "sustainable development". This shows a focus on education for sustainable development. The research by Alibaygy (2024) emphasizes the need to improve environmental education to increase the role of students in environmental conservation and sustainable development. The green cluster (environmental literacy) includes terms such as "environmental knowledge", "early childhood", and "teaching". This cluster illustrates the relationship between environmental literacy and the concepts of environmental knowledge, teaching, and childhood. Masykuroh et al. (2024) explain that teaching environmental literacy in early childhood education consists of teacher competency and the implementation of ecological literacy learning. The red cluster (education for sustainable development) contains the terms "student", "teacher", "knowledge" and "sustainable development". This cluster focuses on sustainable education. Huang (2023) conducted research to explore the relationship between environmental literacy education and sustainable development in schools (Huang et al., 2023).

In the blue cluster (education), there are terms such as "elementary school", "primary school", and "children" which indicate a focus on educational factors and primary schools. It contains research on the effects of place-based teaching practices on the environmental literacy of 3rd-grade elementary school students (Örnek et al., 2025) . The yellow cluster (school) contains the terms "adolescent" and "environment". This cluster focuses on schools and youth. Environmental literacy research was also conducted by Svobodova (2022) to identify the cognitive, affective, and behavioral dimensions of environmental literacy as well as the impact of demographic variables on adolescents in the Czech Republic and Slovakia (Svobodová, 2023). The purple cluster (environmental awareness) contains the term university student. This cluster focuses on university-level environmental literacy research.

The lines connecting terms show the relationship or association between them based on the frequency of co-occurrence. The thicker the line, the more often the two terms appear together. For example, the term "environmental literacy" is closely related to "education for sustainable development" and "education", indicating that these three terms often appear in the same context in the documents analyzed. The size of each node (circle) indicates the frequency with which the term occurs. The larger the node, the more often the term appears in the data. From this visualization, it can be seen that the terms "environmental literacy" and "education" are large, indicating that they often appear and are the center of attention in this research. The results of the Vos Viewer visualization analysis can help us understand the main topics and the relationship between concepts in environmental literacy. The green and red clusters show a relationship between environmental knowledge and sustainable education, while the blue, yellow, and purple clusters link education, schools, and environmental awareness.

Thematic Mapping and Evolution

The results of the thematic mapping analysis illustrate the density and centrality of the main themes. Figure 9 shows the distribution of research themes based on two axes, namely the level of relevance (centrality) and the level of development (density). This diagram is divided into four quadrants with the following explanation.

Motor Themes (Driver Themes)

These themes are in the upper right quadrant and have high development, indicating that these themes are very important and are developing rapidly. In this quadrant, there are themes such as environmental literacy, environmental education, knowledge,

education, and sustainability. This shows that environment and education are the main themes and act as the main drivers in this field.

Basic Themes

Themes in the lower right quadrant have a high level of relevance but a lower level of development. Themes such as education for sustainable development, marine litter, primary education, and health literacy are in this quadrant. This shows that the basic themes highly relevent but less developed.

Niche Themes (Special Themes)

Themes in the upper left quadrant have a high level of development but low relevance. These themes are well-developed in certain areas but are less widely relevant. In this quadrant, there are themes such as teacher education.

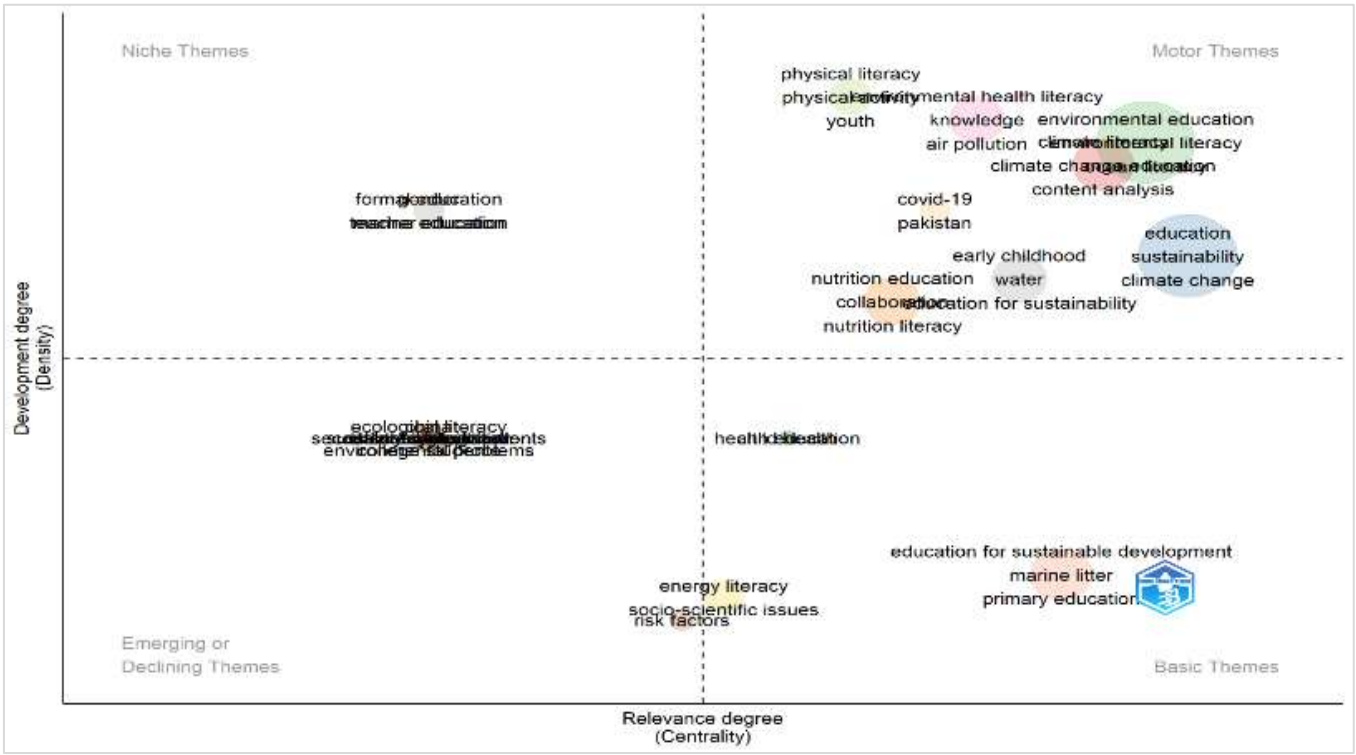

Figure 9. Environmental literacy thematic mapping

Emerging or Declining Themes

Themes in the lower left quadrant have low relevance and development. Themes such as ecological literacy and environmental problems are included in this quadrant. This suggests that these themes are less developed and receive less research focus.

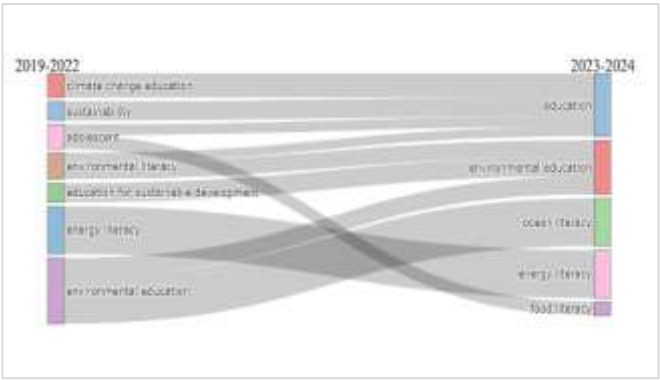

Figure 10. Thematic evolution of environmental literacy

The Sankey diagram is used to describe data flow or relationships between categories. In this figure, the thematic evolution of environmental literacy is presented. The left side shows the themes that are of main concern during the 2019-2022 period. The right-side shows developing themes from the previous period (2023–2024). Connecting lines between themes indicate contributions or transitions from one theme to another. The thickness of the line reflects the intensity of the relationship.

In the period from 2019 to 2022, seven main themes were the focus, namely climate change education, emphasizing the importance of educating the public about the impacts of climate change, as well as mitigation and adaptation steps. Sustainability focuses on the sustainable management of resources to ensure balance in ecosystems and human life. The adolescent (teenager) topic highlights the role of teenagers in environmental or sustainability education. Environmental literacy provides knowledge, skills, and

motivation to understand and deal with environmental problems. Education for sustainable development (ESD) is an educational strategy to support social, economic, and environmental sustainability. Energy literacy educates individuals about energy efficiency and its impact on the environment. Environmental education is an educational approach that aims to increase awareness of the environment.

In the 2023-2024 period, the focus of education developed into five main themes of education, including pedagogical approaches or educational policies integrated with sustainability, environmental education, ocean literacy, energy literacy, and food literacy. Environmental education remains a major concern. Ocean literacy, a new emerging theme, highlights the importance of people's understanding of marine ecosystems and their impact on climate change. Energy literacy is still maintained, with the potential for a deeper focus on new energy technologies. Food literacy, a new theme relevant to sustainability, includes education about production and the impact of food systems on the environment.

The education for sustainable development (ESD) theme branches into several themes in 2023–2024, namely environmental education and ocean literacy. This shows that the concept of sustainability is applied more specifically to environmental education and marine ecosystems. The environmental literacy theme is relevant and contributes directly to environmental education and ocean literacy. Environmental literacy becomes the basis for understanding more specific issues. The energy literacy theme is consistent from 2019–2022 to 2023–2024, indicating that energy literacy remains important in education because the issue of renewable energy is increasingly pressing. Food literacy emerged as a new theme that had no direct connection to the previous period. This indicates the importance of food issues in sustainability. The adolescent theme no longer appeared in the 2023–2024 period, indicating a change in focus from age-oriented education (adolescence) to more specific and cross-age themes.

Trend Topics

The results of biblioshiny analysis show that there is a trend in research topics in environmental literacy. Figure 12 shows trends in environmental literacy research topics. There is a vertical axis (term) which is a list of terms or main topics that are the focus of the research. The horizontal axis (year) is the period from 2020 to 2024. The size of the circle shows the frequency of appearance of the term in literature or research data. The larger the circle, the higher the frequency. The blue gradient shows which terms are used most frequently.

Education is a topic that consistently appears throughout the 2020-2024 period, with a large circle indicating that this term is dominant in research. Environmental education and environmental literacy increase significantly after 2022, indicating an increased focus on environmental issues in the educational context. Climate change has emerged since 2022, which is related to increasing global awareness of the issue of climate change. Sustainability has a similar pattern, becoming an increasingly relevant topic, especially regarding sustainable development goals. Although ocean literacy and environmental awareness are relevant, they have a narrower or more specific research scope.

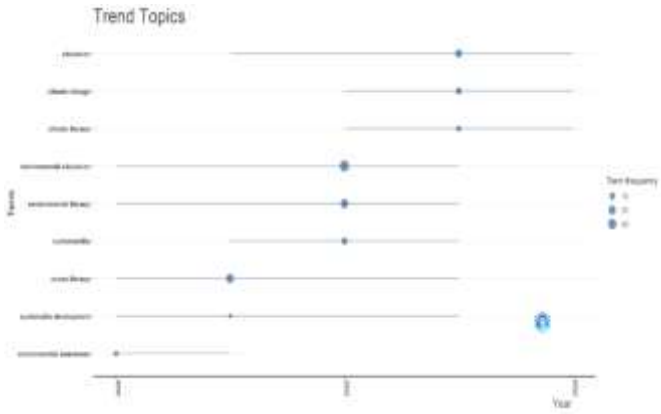

Figure 11. The trend of environmental literacy topics

Issues such as environmental literacy, sustainability, and climate change show significant growth, reflecting the global focus on climate change mitigation and related education. The topic of education (education and environmental education) continues to be a top priority in various studies, thus emphasizing that environmental literacy through education is important. Several terms in this trend are interrelated, for example, environmental literacy supports sustainable development through environmental awareness. These topic trends can provide important insights into how research is moving toward a focus on education and environmental sustainability. Terms such as climate literacy and sustainable development will likely continue to grow as the global need to educate people about sustainability.

Conclusion

The results of the bibliometric analysis show that the methods used in environmental literacy research vary. The methods include literature review, ethnography, collaborative action research (CAR), case study, descriptive, cross-sectional, qualitative mixed-methods, experiments, and surveys. Surveys have become the most dominant method in environmental literacy research. Environmental literacy measurements

can be carried out at various levels of education, namely elementary school, middle school, high school, higher education, teachers, and adults. The adult group dominates in measuring environmental literacy. Environmental literacy research publications fluctuate from year to year and peak in 2021 with 40 documents. The United States is the country with the highest number of environmental literacy research publications. The authors with the most publications and who are quite productive and influential in the topic or field of environmental literacy research are Mokos and Realdon. The co-occurrence results show that the terms "environmental literacy" and "education" have large sizes, indicating that they often appear and are the center of attention in research. There is a connection between environmental knowledge and sustainable education, as well as education, schools, and environmental awareness. Trends in educational topics (education and environmental education) continue to be a top priority in various studies, thus emphasizing that environmental literacy through education is important.

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