

Bibliometric Analysis of Studies on Environmental Education in Early Childhood Education

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Abstract

The aim of this study is to conduct a bibliometric analysis of articles related to environmental education in early childhood (EEEC). The sub-objectives of the study were to determine the distribution of studies on EEEEC by years, the most used keywords, the most cited articles, the most active researchers, the most cited journals and the most active collaborating countries. Bibliometric analysis methods were used in the research. Bibliometric mapping analysis was preferred to provide visual representations of the relationships between the main concepts. The data were obtained from the Web of Science (WoS) database and the 191 articles accessed because of filtering were analysed using VOSviewer software. As a result of the research, it was determined that studies on EEEEC have increased over the years. Among the keywords, “early childhood education”, “environmental education” and “sustainability” came to the fore respectively. The most cited study was “Beyond Stewardship: Common World Pedagogies for the Anthropocene”. Prominent journals included “Australian Journal of Environmental Education” and “Sustainability”, while the most influential authors were identified as “Alsina, A.” and “Rodrigues-Silva, J.”. Among the countries, “Australia”, “Canada” and “Brazil” are at the forefront. Encouraging more co-operation and interdisciplinary studies in the field of EEEEC will help deepen research in this field.

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1. Introduction

In today's rapidly growing demographic structure and globalization, various environmental problems and serious crises are being experienced more than ever before due to uncontrolled urbanization, industrialization, deforestation, and the loss of valuable agricultural lands. These issues, regardless of perspective, cause significant harm to humans and other living beings (Liu, Hussein & Bin Mat Noor, 2024; Pimentel et al., 2004). In fact, nearly one-tenth of diseases and deaths worldwide are caused by environmental problems (Singh & Singh, 2017). To tackle these problems, education and participation are among the primary elements. On one hand, humans are damaging the environment, while on the other hand, efforts are being made towards environmental education and education for sustainable development to eliminate this damage and leave a better world for future generations. Consequently, these areas are becoming increasingly important (Acosta Castellanos & Queiruga-Dios, 2022; Güzelyurt & Özkan, 2019).

Environmental education is a strategic approach that promotes collaborative environments, allowing individuals to share their local knowledge, experiences, beliefs, and practices, and aims to develop environmental awareness, attitudes, behaviors, skills, and actions through education. This educational model aims to create an environmentally conscious and aware society by bringing together the contributions of various individuals (Ardoin, Bowers & Gaillard, 2020). Thus, environmental education is seen as one of the important steps in eliminating human-induced environmental problems (Özdemir, 2016). Environmental education is an effort to increase individuals' awareness levels by providing them with knowledge and experience related to the environment. In this way, individuals' beliefs, attitudes, and most importantly, behaviors towards the environment will develop in an environment-centered manner (Frantz & Mayer, 2014). At this point, environmental education serves as a bridge between the individual and nature. Environmental education is critical for developing environmentally friendly behaviors, adapting to the natural environment, and mitigating global environmental problems. Recycling waste, using energy-efficient devices, and avoiding unnecessary energy consumption play an important role in reducing the carbon footprint (Gómez-Prado et al., 2022; Schönfelder & Bogner, 2020). Conserving water resources by saving water, using natural products free of chemicals, and opting for environmentally friendly transportation methods such as public transport or bicycles minimize environmental damage. Additionally, planting trees reduces carbon emissions and increases biodiversity. Such behaviors enhance people's environmental sensitivity and encourage active

participation in solving environmental problems (Gude, 2017). Effective environmental education equips individuals or communities with various skills to collaborate on positive environmental actions, allowing them to be more dynamic in addressing environmental issues and solutions (Ardoin, Bowers, & Gaillard, 2020; Hungerford & Volk, 1990).

Considering that environmental education is a way of thinking and behaving, the greatest responsibility of societies in terms of sustainability should be to ensure that children develop a positive attitude towards the environment and to provide them with the necessary values, knowledge, and skills (Trott & Weinberg, 2020). In terms of the gains provided by environmental education, it is accepted that the best period to start environmental education is the preschool years when a person's personality begins to form. At this point, it is critically important to start environmental education at an early age to ensure that children develop a positive attitude towards the environment and are raised as responsible individuals in the later stages of their lives (Barrable, 2019; Kotaman, Karaboğa, Bilgin & Tuğrul, 2022; Yalçın, Yalçın, Bozan & Gecikli, 2016). Early childhood education covers the 0-6 age groups, and the foundation of children's cognitive, social, and emotional development is laid during this period. During this period, children absorb all information like a sponge and gain basic ideas about their surroundings and the world around them (Wilson, 1996). Environmental education given to children in this age group has a lasting positive impact on various aspects of their development. Thus, children will develop positive attitudes towards the environment and be raised as responsible individuals (Poje, Marinić, Stanisavljević & Rechner Dika, 2024).

Presenting different environmental problems and solutions in terms of sustainability is only possible through environmental education studies conducted in this field. Therefore, it is thought that environmental education studies will affect both the current generation and future generations. Considering the importance of environmental education in early childhood, it can be concluded that research in this area is vital. Studies emphasize that individuals who receive environmental education in early childhood are more sensitive to environmental problems and grow up as solution-oriented individuals, develop problem-solving skills, and are successful in solving environmental problems they encounter in later years, increase their environmental awareness and sustainability consciousness, and play an important role in developing positive attitudes towards the environment and acquiring skills to solve environmental problems (Adams & Savahl, 2017; Bascopé, Perasso & Reiss, 2019; Corraliza & Collado, 2019; Cutter-Mackenzie & Edwards, 2013; Wilson, 1996). In this context, when

the relevant literature is examined, it is determined that there are various bibliometric analysis studies on environmental education (Arias-Chávez et al., 2022; Arya et al., 2024; Bozdoğan et al., 2023; Çelik, 2022a; Karakuş & Polat, 2021; Kurtulus & Tatar, 2021; Ok, 2022; Su et al., 2022; Wang & Lv, 2021) and bibliometric studies on bullying management strategy in early childhood education (Aisyah et al., 2023), technology use (Aktas, 2022), STEM (Bui et al., 2024; Nhi et al., 2024; Su & Yang, 2023; Xue, Keat, & Tarofder, 2024), mathematics education (Çelik, 2022b; Maharani, 2023), critical thinking skills (Ergin & Temel, 2023), parenting (Handayani, 2024), artificial intelligence (Yi, Liu & Lan, 2024), augmented reality use (Kayaduman & Sağlam, 2024), robotic coding (Kırksekiz & Kol, 2023), and teacher education (Tunç et al., 2023). Due to the inaccessibility of systematic review studies on early childhood education, the lack of a comprehensive study on which bibliometric analyses are available on environmental education in early childhood is noteworthy. This indicates a need for a review study on environmental education in early childhood.

In this context, bibliometric analyses of studies in the field of environmental education in early childhood will help identify current research gaps and assist future studies in this area. Given the critical role of environmental education in early childhood, bibliometric analyses in early childhood environmental education will shed light on solving environmental problems and environmental education. Environmental education studies in early childhood education are important for presenting relevant research trends as a whole and revealing gaps in knowledge in the field. Doing so can encourage researchers to fill research gaps and address issues that have not been fully explored or supported by evidence.

In this way, the bibliometric analysis of Early Childhood Environmental Education (EEEC) will also support the development of the curriculum in this field. Therefore, this study aims to present a bibliometric mapping analysis of studies on early childhood environmental education conducted in the Web of Science. It aims to examine the studies in this field to reveal current research trends, priorities, and research gaps. By providing a general evaluation of early childhood environmental education studies, it will help see the big picture and guide researchers, decision-makers, and policymakers. Therefore, the purpose of this study is to conduct a bibliometric analysis of articles related to EEEEC. For this purpose, the research questions are listed below:

1. What is the distribution of the number and citations of studies related to EEEEC over the years?

2. What is the distribution of the most used keywords in studies related to EEEEC?
3. What is the distribution of the top 10 most cited articles related to EEEEC?
4. Who are the most influential researchers in EEEEC (citation and co-citation)?
5. What are the most cited journals related to EEEEC (citation and co-citation)?
6. Which countries are the most influential and collaborative in EEEEC?

2. Method

Bibliometric analysis methods were applied to evaluate research on environmental education in early childhood. Bibliometric mapping analysis was preferred because it provides visual representations of the relationships between key concepts. Bibliometric analysis is a method of analysing data published in various journals over a specific period and includes the examination of keywords, citations, and authors (Rusly et al., 2019). This method reveals the relationships between disciplines, fields, specializations, and individual articles through mapping and visualization. Bibliometric methods are easily accessible sources of citation data (Passas, 2024).

2.1. Data Source and Collection

With the development of online databases such as Web of Science (WoS), Scopus, PubMed, and Google Scholar, and software for conducting bibliometric analyses, these methods have become more widespread. Among these databases, WoS stands out globally and is frequently used in bibliometric analyses (Wu, Li, Tong, Wang & Sun, 2021; Zupic & Čater, 2015). In this research, WoS and Scopus databases, which are commonly used in bibliometric analyses, were used as sources. In the process of determining the studies to be included in the screening and research, the reporting steps for systematic reviews (Table 1 and Figure 1) were used as a guide (Moher et al., 2009).

Table 1. Keywords used in database searches

Early childhood search terms	Operator	Environmental education search terms
(“pre-school” or “pre-school education” or “pre-school teaching” or “kindergarten” or “kindergarten class” or “kindergarten school” or “early childhood education” or “early childhood learning” or “early childhood”)	AND	(“environmental education” OR “environmental education”)

The screening was concluded on November 7, 2024. As a result of the screening, 569 articles were identified. After selecting “article” as the document type, 360 articles were found. When “Education Educational Research” was selected as the Web of Science category, 282 articles were identified. After selecting “Web of Science Core Collection” as the database, 195 articles were found. Finally, after removing duplicates and irrelevant studies, 191 articles were included. The data collection for the study was completed on November 7, 2024.

2.1. Data Analysis

VOSviewer, a widely used bibliometric software, will be used to facilitate bibliometric analysis. This programme helps to identify salient themes and influences by visualising co-citation networks and identifying bibliometric clusters. The data analysed in accordance with the objectives of the study are presented with visuals. In addition, descriptive statistics such as frequency were used in the study (Lasino, Rukmana, Mokodensho, & Aziz, 2023; Van-Eck & Waltman, 2010).

3 Findings

3.1. Trends of annual publications and cites

The research data was conducted between the years 1980-2024 and 191 articles were found as a result of filtering. A total of 1821 citations related to EEE The average number of citations per study is 12.23 The H-Index of the studies is 27

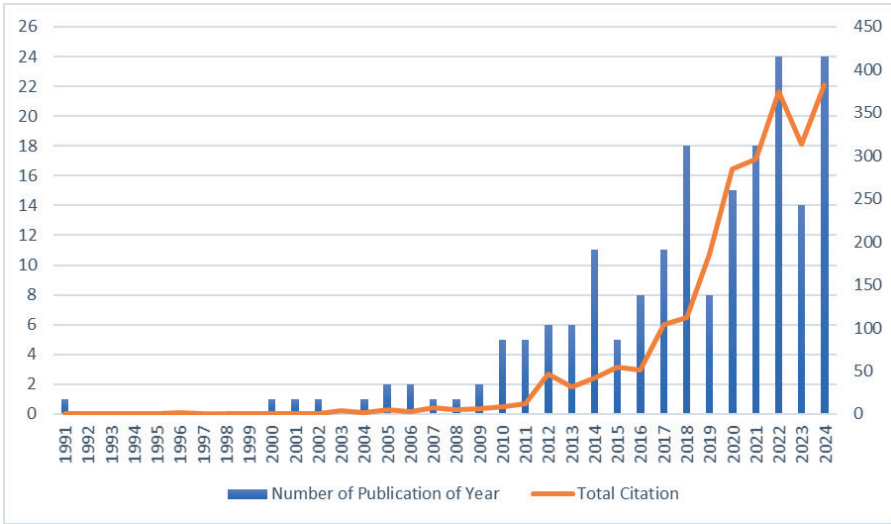


Figure 1. Number of publications and citations according to scientific studies published on EEEEC

Figure 1 shows the annual number of publications and citations related to environmental education in early childhood between 1991 and 2024. These indicators can be divided into two periods: 1991-2009 and 2010-2024. Between 1991-2009, a total of 13 publications and 36 citations were made. Between 2010-2024, 178 publications and 2300 citations were made. It was determined that the number of articles in the first period increased approximately 14 times in the second period. Similarly, the number of citations increased many times more than the first period. These values show that the subject of EEEEC has attracted the attention of researchers since 2010 and studies continue to be added.

3.2. Analysis of keywords

Keywords represent the main topics and related subtopics of published scientific studies (Wu et al., 2022). The co-occurrence and network analysis of keywords related to EEEEC can help researchers to comprehensively understand the relationship between keywords and analyse the relationship between various conversations in this field.

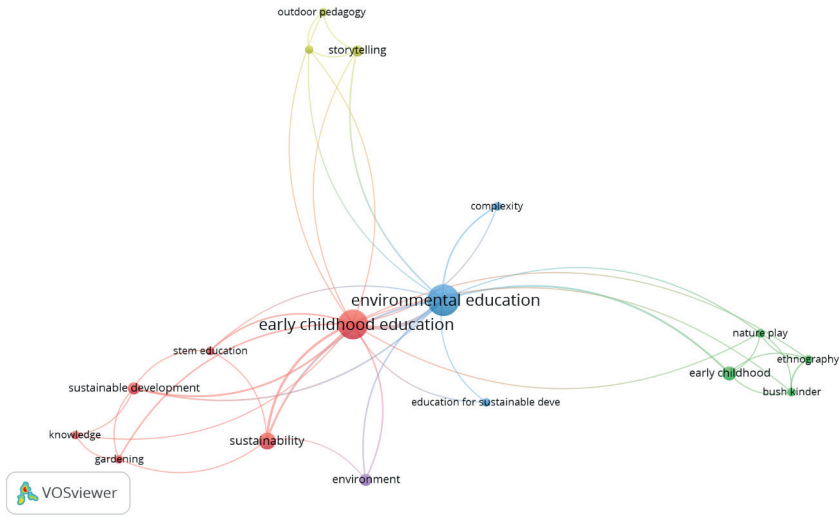


Figure 2. Keyword network analysis of scientific studies on EEE

The prominent keywords related to scientific studies on EEE are “early childhood education (occurrence 22, total link strength 366)”, “environmental education (occurrence 24, total link strength 32)”, “sustainability (occurrence 7, total link strength 12)”, “sustainable development (occurrence 4, total link strength 8)” and “early childhood (occurrence 5, total link strength 6)”. In addition, the words “bush kinder”, “environment”, “ethnography” and “garden” are among the most frequently used keywords.

3.3. The most influential scientific studies on EEE

The top 10 most cited scientific studies on EEE are presented in Table 2.

When Table 2 is analysed, it is seen that the 3 most cited studies are “Beyond stewardship: common world pedagogies for the Anthropocene”, “Revealing the research “hole” of early childhood education for sustainability: a preliminary survey of the literature”, and “Education for sustainable development in early childhood education: a review of the research literature”. The most cited study on EEE belongs to the author “Taylor, A” and the study was published in the journal “Environmental Education Research”.

Table 2. Top 10 most effective scientific studies on EEEEC according to the level of citation

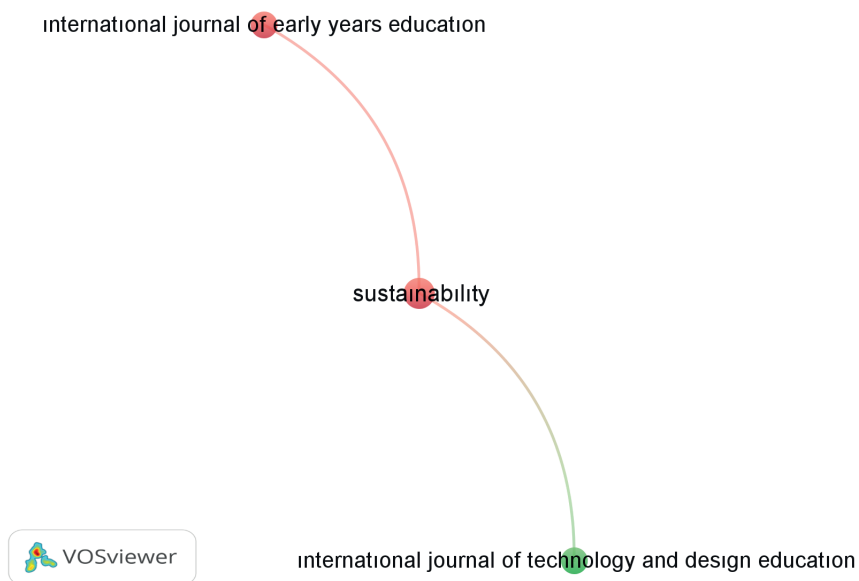
Name of article	Authour(s)	PY	Journal	TC
1- Beyond stewardship: common world pedagogies for the Anthropocene	Taylor, A	2017	Environmental Education Research	154
2-Revealing the research “hole” of early childhood education for sustainability: a preliminary survey of the literature	Davis, J	2009	Environmental Education Research	146
3-Education for sustainable development in early childhood education: a review of the research literature	Hedefalk, M. et al.	2015	Environmental Education Research	96
4-Early childhood environmental education: A systematic review of the research literature	Ardoin, NM & Bowers, AW	2020	Educational Research Review	94
5-Children in nature: sensory engagement and the experience of biodiversity	Beery, T. & Jorgensen, KA	2018	Environmental Education Research	77
6-Envisioning Black space in environmental education for young children	Nxumalo, F & Ross, KM	2019	Race Ethnicity and Education	69
7-Toward a model for early childhood 8-environmental education: foregrounding, developing, and connecting knowledge through play-based learning	Cutter-Mackenzie, A & Edwards, S	2013	Journal of Environmental Education	61
8-Sustainability education in early childhood: An updated review of research in the field	Somerville, M & Williams, C	2015	Contemporary Issues in Early Childhood	53
9-Environmentalising early childhood education, curriculum through pedagogies of play	Edwards, S & Cutter-Mackenzie, A	2011	Australasian Journal of Early Childhood	53
10-Curriculum analysis and education for sustainable development in Iceland	Jóhannesson, et al.	2011	Environmental Education Research	49

3.4. Analysis of Sources

The most active journals related to scientific studies on EEEEC are presented in Table 3 and the source network analysis is presented in Figure 3.

Table 3. The top 10 most influential scientific journals according to the level of citations related to EEEEC

Source	NP	TC	TL	C	CQ	PYS
Australian Journal of Environmental Education	7	14	2	ESCI	Q2	1984
Environmental Education Research	3	4	2	SSCI	Q1	1995
Sustainability	6	16	2	SSCI	Q2	2009
International Journal of Early Years Education	1	7	1	ESCI	Q2	1993
International Journal of Technology and Design Education	1	13	1	SSCI	Q2	1990
Contemporary Issues in Early Childhood	1	0	0	ESCI	Q2	1990
Curriculum Journal	1	0	0	ESCI	Q2	1990
Early Childhood Education Journal	1	2	0	SSCI	Q1	1973
Education 3-13	1	1	0	ESCI	Q3	1973
Education Sciences	1	0	0	ESCI	Q1	2011

**Figure 3. Citation network analysis of journals published within the scope of scientific studies related to EEEEC**

When the journals in which scientific studies on EEEEC were published were examined, it was determined that the most effective journals were “Australian Journal of Environmental Education”, “Environmental Education Research”, “Sustainability”, “International Journal of Early Years Education”

and “International Journal of Technology and Design Education”. When the citation network analysis is analysed, the journals “Sustainability”, “International Journal of Early Years Education” and “International Journal of Technology and Design Education” come to the fore.

3.5. Analysis of Authors

The citation network analysis of the authors who published on EEEEC is presented in Figure 4. Considering the network analysis of the authors publishing within the scope of EEEEC, it was determined that “Alsina, A.”, “Rodrigues-Silva, J.”, “Campbell, C.”, “Ebrahim, N.A.”, Jamali, F., Jamali, S.M., “Speldeinde, C.”.

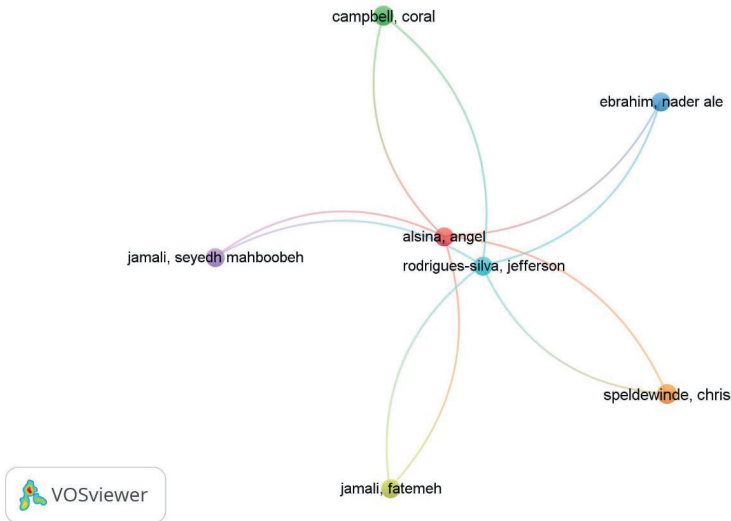


Figure 4. Network analysis of authors publishing within the scope of scientific studies related to EEEEC-related publication

3.6. Analysis of Countries

Scientific studies published within the scope of EEEEC have been analysed and the most active cooperating countries and the publication network are presented in Figure 5.

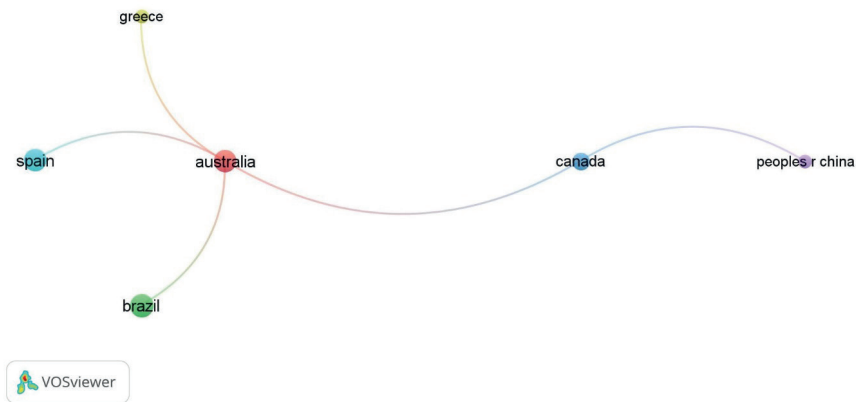


Figure 5. The countries with the highest number of active collaborators in scientific studies related to EEEEC

Australia, Canada, Brazil, Brazil, Greece, China and Spain are the countries that are most active in scientific studies related to EEEEC.

4. Conclusion and Discussion

In this study, a bibliometric analysis was conducted on the studies on EEEEC in the WoS database. The research data was conducted between 1980 and November 2024 and 191 articles on EEEEC from 97 different journals were analysed in terms of publication year and number of citations, keywords of published articles, most effective article, journal, author and country collaborations.

When the number and attribution of the studies by years were analysed, it was determined that there was a leap in the studies in 2010 and the number of studies with EEEEC increased after 2010. Although there has been an increase in the number of articles in the last 5 years, a noticeable decrease in the number of EEEEC studies was observed in 2019 after 2018. After 2019, although the number of articles increased, it took until 2021 to recover. This may indicate that the article production performance of researchers is under the influence of COVID-19 (Fauzi & Khusuma, 2020; Sari, Purnomo, & Hariyono, 2023). Apart from this, it is another striking result that the most studies and citations are in 2022 and 2024. Considering that 2024 is not completed and some of the journals publish in December, it can be said that the most publications and citations will be in 2024. This finding is in parallel with the finding of Ardoin and Bowers (2020) in their systematic analysis

of early childhood environmental education (ECE) that more studies were conducted with ECE in the last 5 years compared to previous years. This increase shows that the subject of ECE has attracted more attention in recent years and has been addressed more by researchers. Similar studies are found in the literature that the number and attribution of environmental education studies increase as the years increase (Arias-Chávez, et al., 2022; Arya et al., 2024; Kurtulus & Tatar, 2021; Liu et al., 2024; Onopriienko et al., 2021).

Keyword analysis is an important tool for understanding the main topics of studies related to EEEEC and the relationships between these topics. In our study, keywords such as “early childhood education”, “environmental education”, “sustainability” and “sustainable development” were prominent. Wu et al. (2022) state that the co-occurrence of keywords and network analysis can help researchers to comprehensively understand the relationship between keywords. In the analysis of Arias-Chávez, et al.’s (2022) bibliometric study on environmental education, it was determined that the most used keywords were “environmental education, sustainability and sustainable development”. Studies on environmental education in the literature support the findings of the keyword analysis of the research (Arya et al., 2024; Lasino, Rukmana, Mokodenseho, & Aziz, 2023; Lima Ho et al., 2023; Liu et al., 2024; Sari, Purnomo, & Hariyono, 2023).

The analysis of the most cited studies shows which studies are the most influential in the field of EEEEC and in which journals these studies are published. It was determined that the top ten most cited studies were between 2011-2020 and the most cited study was “Beyond stewardship: common world pedagogies for the Anthropocene” in 2017. After this study, “Revealing the research “hole” of early childhood education for sustainability: a preliminary survey of the literature” in 2009, “Education for sustainable development in early childhood education: a review of the research literature” in 2015 and “Early childhood environmental education: A systematic review of the research literature” in 2020.

Journal and author analyses help to identify the most influential journals and researchers in the field of EEEEC. In our study, journals such as “Australian Journal of Environmental Education” and “Environmental Education Research” stand out. Similarly, authors such as “Alsina, A.” and “Rodrigues-Silva, J.” are among the authors who contribute the most to the field of EEEEC. The studies of these authors make important contributions to environmental education and sustainability in early childhood. Karakuş and Polat (2021) identified “Environmental Education Research”, “Journal of Environmental Education”, “Sustainability”, “Australian

Journal of Environmental Education” among the most effective journals in environmental education. Similar findings are found in terms of the most effective journals in bibliometric studies on environmental education (Arias-Chávez, et al., 2022; Arya et al., 2024; Kurtulus & Tatar, 2021; Liu et al., 2024; Ok, 2022).

Analyses of cooperation between countries identify the countries that cooperate the most and are the most effective in the field of EEEEC. In our study, countries such as “Australia”, “Canada” and “Brazil” stand out. Karakuş and Polat (2021) determined that Brazil and USA are the most active countries in the bibliometric analysis of environmental education. In a study conducted by Sivasamy and Vivekanandhan (2015) based on the Scopus database, it was determined that the most publications in the field of environmental education came from the United States, followed by Brazil. In the bibliometric analysis study conducted by Kurtulus & Tatar (2021) on environmental education, it was determined that USA, United Kingdom, Brazil, Australia and Canada were among the most collaborating countries, respectively. In the study conducted by Arias-Chávez, et al. (2022) on environmental education, it was determined that the most effective countries and the countries that cooperate the most are USA and Australia. Ok (2022), in his bibliometric analysis of nature and environmental education, determined that USA, England, Australia and Canada were the most collaborating countries. When evaluated with the findings of the study, it shows that USA has a limited number of studies in environmental education in early childhood compared to other top-ranked countries. On the other hand, Australia and Canada are among the effective countries in terms of environmental education in early childhood. Here, it is determined that there are imbalances in the studies of the countries. Especially with the development of technology, individuals’ interactions with nature are decreasing day by day. To increase the interaction of individuals with nature, countries should carry out more studies with EEEEC in more cooperation (Arts, Van der Wal, & Adams, 2015; Hajj-Hassan, Chaker, & Cederqvist, 2024; Liu et al., 2024).

This study comprehensively analysed the trends of scientific publications and citations in the field of early childhood environmental education (ECE) over time. It shows that ECE has attracted a great deal of attention especially since 2010 and the number of publications and citations in this field has increased significantly. It can be said that although the number of environmental education in early childhood and citations have increased over the years, it is still not at the desired level. At this point, more studies are recommended. Keyword, author, journal and country analyses revealed

which topics, researchers and publication organs are prominent in the field of ECE. These findings, which are generally consistent with other studies in the literature, emphasise that EEEEC has an increasing importance in the academic field and that research in this field will continue in the future. This study demonstrates once again the importance and impact of EEEEC and shows that research in this field plays a critical role in terms of sustainability and raising environmental awareness.

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