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Education For Sustainable Development in Preservice Teacher Program: A Bibliometric Method

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ABSTRACT

Objective: Sustainability education or education for sustainable development is crucial for advancing eco-conscious growth. In this context, the teacher is essential in delivering knowledge and fostering awareness of sustainability among students. As the younger generation, students will contribute to the development of businesses and the country. Consequently, the behavior of the generation should correlate with sustainability principles. Teachers also influence the formation of a young generation equipped with a deep understanding and awareness of sustainability, shaping future behaviors. Based on this discovery, sustainability education for a prospective teacher is essential. Therefore, this study aims to provide a comprehensive analysis of trends related to sustainability education for a preservice teacher. **Method:** The study adopted a bibliometric method using the VOS viewer and analysis tools available on Scopus. The analyzed articles focused on sustainability education for a preservice teacher, published in the Scopus database between 1998 and 2024. **Results:** The results showed that several areas within this field required further publication, offering opportunities for scholars to explore. **Novelty:** The study was the first to explore sustainability education within the context of preservice teacher training.

INTRODUCTION

Climate change is among the most critical global concerns and is expected to dominate discussions in the coming years. However, the impact of global concerns extends beyond climate change, giving rise to severe environmental and social challenges (Kuthe et al., 2019). Global warming, destruction of natural resources, deforestation, severe water and air pollution, high carbon emissions, food shortages, and other threats to the planet's future are increasingly affecting human lives (Grosseck et al., 2019). Despite these growing concerns, little evidence suggests that environmental degradation is slowing. Even in the best-case scenarios, society's current approach to managing Earth's resources appears unsustainable.

Kuthe et al. (2019) proposed that immediate action from all sectors of society was necessary to address the sustainability challenges. In support of this, Grosseck et al. (2019) emphasized the importance of building a more sustainable civilization, lifestyle, and economy. The younger generation also plays an essential part in addressing these challenges as the group will become future leaders, managers, and employees responsible for making ethical and sustainable decisions. Consequently, educating the younger generation who are aware of global challenges and prepared to address today's pressing issues is essential. Many practitioners also consider education central to sustainable development. In this context, providing sustainable education to the younger generation is further essential as education for Sustainable Development (ESD) is crucial in developing a society's capacity to tackle sustainability issues (Brandt et al., 2019).

The need for sustainability knowledge and awareness among the younger generation presents a severe problem. As future citizens, this generation needs to understand sustainable development to effectively contribute to the long-term well-being of the planet and society. Publications showed a general lack of public knowledge about sustainable development and its objectives (Chen et al., 2022). Previous publications further showed that the younger generation in various regions needed more awareness and knowledge of sustainability. For instance, Ebaid (2022) found that approximately 88% of Saudi Arabian students were unfamiliar with "sustainable development." Aikowe and Mazancova (2023) reported poor performance among Nigerian students on a sustainability literacy test, showing low sustainability knowledge and awareness levels. In contrast, Suganya et al. (2024) found that students exposed to sustainability-focused curricula exhibited high awareness of sustainable development, such as responsible waste disposal and a preference for eco-friendly products.

Considering that sustainability knowledge and awareness are critical determinants of sustainable behavior, it is essential to strengthen students' understanding of sustainable development (Alvarez-Risco, 2021). Furthermore, formal and informal education can increase students' sustainability awareness (Aliman et al., 2019). In formal education, the teacher serves as a student role model (Cheung, 2020) and is critical in delivering sustainable development curricula (Pradeep & Pradeep, 2023). The teacher also develops the skills and competencies of the students to achieve sustainability objectives (Ferguson et al., 2021) while promoting awareness for a sustainable future (Şen & Temel, 2024).

Previous publications underscored the importance of universities in fostering public understanding and sustainability awareness. Educational institutions should promote efforts to protect the natural and sociocultural environment while fostering the development of soft skills and competencies in students from middle schools through universities (Agustina et al., 2023). The efforts are often shaped by experience and culture, prompting education to easily integrate the aspects into learning (Piscitelli & D'Uggento, 2022). Considering the essential role of a teacher in delivering sustainability knowledge to younger generations, universities should prioritize developing the competencies through sustainability-targeted programs and curricula. The importance of ESD has increased the need to refocus teacher education. In this context, sustainability education is essential for equipping a teacher with the competencies necessary (Suh et al., 2020). Wang & Shih (2022) emphasized that education significantly influences the development and prosperity of a country, cultivating high-quality instructors as a critical component of an effective education system. The analysis further showed that the quality of a teacher often determines the quality of education, and professional development is closely connected to teaching effectiveness and student learning outcomes.

The academic production on "education for sustainability" has expanded in recent years, reflecting the growing attention the subject has received. Similarly, scholarly publications on sustainability in teacher training education show an increasing trend. Ocaña-Fernández and Fuster-Guillén (2021) asserted that increased scientific publications had made literature reviews increasingly important. The analysis also argues that the proliferation of publications in various formats has created an overwhelming amount of information, making it difficult for professionals to keep up with all relevant literature. This challenge is compounded by limited access to specific journals, lack of time, and sometimes high costs. As a solution, review articles offer a practical way for professionals to stay informed about the latest knowledge and trends in a subject.

The term "sustainable development" was first introduced by the UNWCED in the Brundtland Report, defining it as "development that meets the needs of the present without compromising the ability of future generations to meet personal needs" (UNWCED, 1987). Understanding sustainability from Brundtland's included exploring the Earth's physical condition, such as nature, ecosystem stability, resources, and life, alongside social equity concerns regarding access to planetary and natural resources. The concept of sustainable development has served as the benchmark and driving force behind most global initiatives aimed at achieving social, economic, and environmental objectives, often referred to as the triple bottom line (Gericke et al., 2019). This initiative extends to education, where ESD is instrumental in promoting the concept.

Sustainability education and sustainable education are terms often used interchangeably to describe a learning and teaching method that emphasizes environmental, economic, and social sustainability (Tripon et al., 2023). Some scholars also consider sustainability education ESD (Dong et al., 2023). ESD aims to assist students in acquiring the skills necessary to address sustainability-related challenges and engage in sustainable development while critically analyzing the behavior (Brundiers et al., 2021). Additionally, initiatives focused on preserving natural spaces and biodiversity can support education objectives and enhance environmental literacy within communities (Hansmann et al., 2012). Sustainable education further motivates students to critically assess the environmental impact and understand the potential long-term consequences of the actions on the global landscape. It also helps the students develop the skills needed to become effective stewards of the planet, ensuring the sustainability of the resources (Tripon et al., 2023). To prepare the younger generation for future uncertainties, providing the students with the necessary knowledge is crucial, as a lack of knowledge or incorrect information can hinder pro-sustainable development actions (Chen et al., 2022).

In today's world, teachers who are driven and prepared to act as social change agents for sustainability are desperately needed. For young generations to learn how to coexist sustainably (Alkaher et al., 2024), it is crucial and a challenge for all those involved in education to include the Sustainable Development Goals (SDGs) into curricula and teaching methods across all subject areas and teacher preparation programs (Othman et al., 2023). Zguir et al. (2022) further proposed that continuous improvement of teaching quality and teacher preparation was essential in reshaping education systems to familiarize the younger generation with sustainable development and ESD. The article asserts that teacher quality is a crucial driver of transformational change within the education system, and readiness and preparedness are crucial to the success of ESD. Therefore, teachers play a crucial role as ESD educators in shaping students' attitudes toward sustainability and behaviors. Similarly, Parry and Metzger (2023) stated that teachers are widely acknowledged as effective social change agents who implement the Education for Sustainable Development policy in the classroom.

Blom & Karrow (2023) revealed that research in the field of sustainability education for preservice teachers shows an increasing trend, as the impending climate emergency that humanity is facing has led to a rise in the growing popularity of Sustainability Education (Majid et al., 2023). For example, Díaz et al. (2023) researched the mindsets and expertise of lecturers who implement sustainable development activities to modify the curriculum to meet the demands of sustainable development curriculum. However, Duran and Mariñas (2024) found that teachers' exposure to and preparation for sustainability topics was limited, indicating a lack of adequate training and knowledge. Therefore, they suggested that

teacher education programs must be more comprehensive, culturally relevant, and oriented to address and integrate sustainability into teaching practices, emphasizing how comprehensive programs that improve teacher readiness and promote sustainable practices in higher education are necessary. Furthermore, Echegoyen-Sanz et al. (2024) conducted a study in such a field for primary education. Their result study demonstrated a high sustainability attitude among preservice teachers after sustainability teacher training. Moreover, Damoah & Omodan (2023) conclude there is a lack of qualified lecturers in environmental education at education faculties and a framework for environmental education instruction in most colleges examined. In addition, the study's results by Gapol et al. (2024) highlighted the preservice teachers' varied perspectives toward waste management techniques and environmental issues, ranging from pessimism to optimism.

Based on the above background, the following research question arises: Is there still an opportunity to conduct publications on sustainability education for a preservice teacher? Therefore, this study aims to comprehensively analyze trends in sustainable education within teacher training. The article used a bibliometric method, representing the study area's structure by categorizing various elements such as documents, authors, journals, keywords, countries, and years into distinct visualized groups. This bibliometric study, a type of literature review, can offer new insights and serve as a foundation for future publications. According to Snyder (2023), a literature review synthesizes results from previous studies, identifies gaps where further publication is needed, and provides a basis for developing conceptual models that inform policy and practice. Such a type of research on this topic still needs to be explored. This work closes this gap in the body of knowledge.

RESEARCH METHOD

Study Method

Bibliometrics was regarded as a quantitative analysis method (Rodríguez-Ruiz, 2009) that applied mathematics and statistical techniques to bibliographic studies and other forms of written communication. This method was used in information science to examine article patterns within a particular discipline or body of literature, focusing on identifying trends related to publication frequency, author names, citations, and journal coverage. These studies were expected to provide insights into the dynamics of the respective fields. Additionally, bibliometrics, or science mapping, is a quantitative method increasingly used to chart the structure and evolution of scientific subjects and fields of study.

Data and Procedure

This study used the Scopus database due to the provision of high-quality publications. Additionally, Scopus offered various stages that assisted scholars in conducting analyses more efficiently. The first step included establishing search criteria by identifying keywords. The keywords used were "preservice teacher," "sustainable development," and "sustainable education." By using the Boolean operator, the search in the Scopus database was conducted with the following parameters, namely "preservice teacher" OR "preservice teacher" (in the article title field) AND "sustainable development" OR "sustainable education" OR "education for sustainability" (in the title, abstract, and keywords fields). The search covered the article title, abstract, and keyword fields, except for the phrase "sustainable development," which was searched in the title field only without restriction to a particular period.

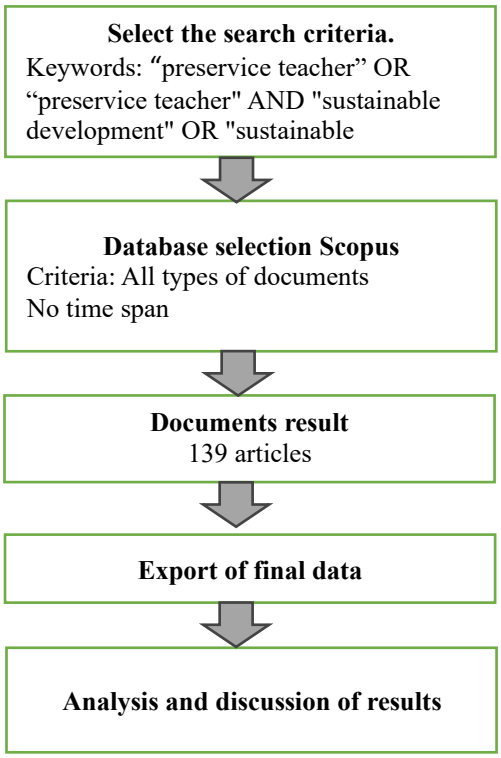

Diagram 1. Study method.
Source: Abad-Segura et al. (2020)

The selected articles from the Scopus database search were then analyzed using VOS viewer version 1.6.18 from Leiden University, The Netherlands, along with the analysis tools provided by Scopus. VOS viewer assisted in conducting co-occurrence analysis and provided visualizations, while the Scopus analysis offered various features such as publication trends by year, country, and author. Following the procedure outlined by Abad-Segura et al. (2020), this study applied the same procedure shown in Figure 1. After the search step, the documents were exported in CSV format to be read and analyzed using a VOS viewer.

RESULTS AND DISCUSSION

Results

The following parts answer the research question by first describing the result of the study.

Table 1. Number of documents published per year

Year	Documents	Year	Documents
1998	1	2012	3
1999	1	2013	4
2000	0	2014	4
2001	0	2015	7
2002	0	2016	4
2003	0	2017	8
2004	0	2018	4
2005	1	2019	14
2006	1	2020	9

Year	Documents	Year	Documents
2007	4	2021	19
2008	1	2022	18
2009	3	2023	15
2010	2	2024	12
2011	4	**TOTAL**	139

The search showed 139 documents, leading to screening the title to remove irrelevant documents related to the examined topic. However, since the keywords and Boolean operators were effectively used, all articles were relevant to the topic. Table 1 shows that the first publication concerning this topic was published in 1998, but no publications were from 2000 to 2004.

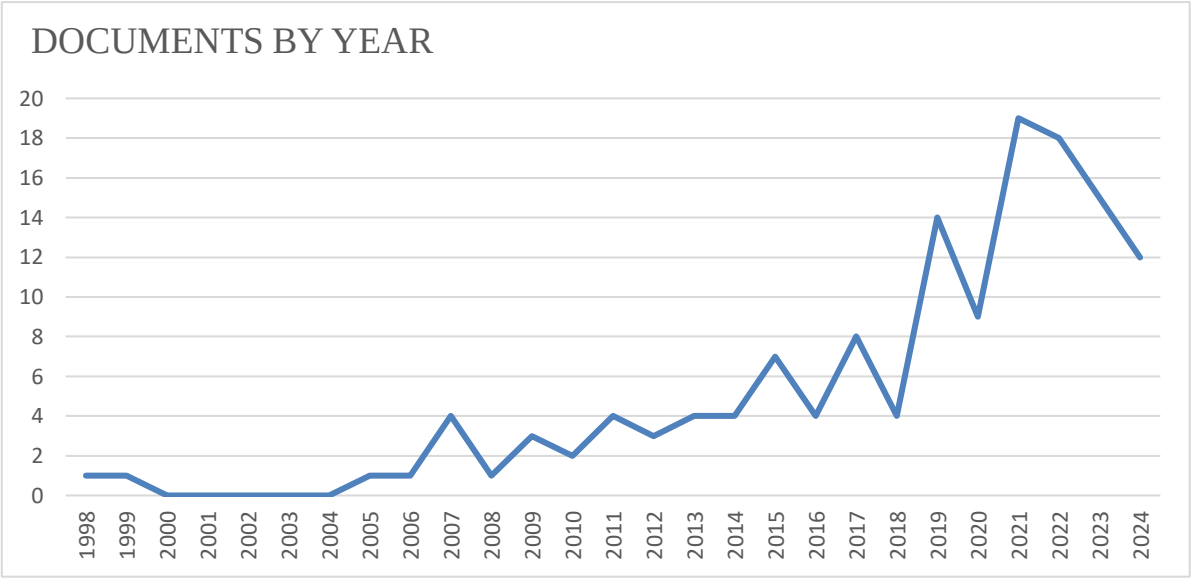

Figure 1. Number of documents published per year.

In 2005, Scopus started publishing on the topic again, showing an increasing trend. The publication trend by year is shown in Figure 1. The most publications occurred in 2021, with 19 documents, and in 2022, with 18 articles. The decline in 2024 was because this study was conducted mid-year.

Table 2. Most used keywords.

Keyword	Occurrences	Total Link Strength
Education	5	12
Education for Sustainability	26	42
END	33	32
END	9	11
Environmental Education	10	24
Higher Education	14	26
Preservice Teacher Education	9	18
Preservice Teacher	21	27
Preservice Teacher Education	6	8
Preservice Teacher	10	12

Keyword	Occurrences	Total Link Strength
Sustainability	13	17
Sustainability Education	7	13
Sustainable Development	16	30
Sustainable Development Goals	7	10
Sustainable Development Goals (SDGs)	5	7
Teacher Education	28	49
Teacher Training	5	10

The author then performed a visual analysis using VOS viewer software. Among the 139 articles, a total of 368 keywords were identified. By selecting the type of analysis and counting method feature provided by the software, the author set a minimum number of keyword occurrences at five. This implied that the software selected keywords that appeared at least five times in an article, as presented in Table 2. These keywords were phrases that represented the focus of the publications. Analyzing these terms provided insights into the study interests developed within the field. The most robust connections were found in teacher education, with 49 link strengths, and education for sustainability, with 42 link strengths.

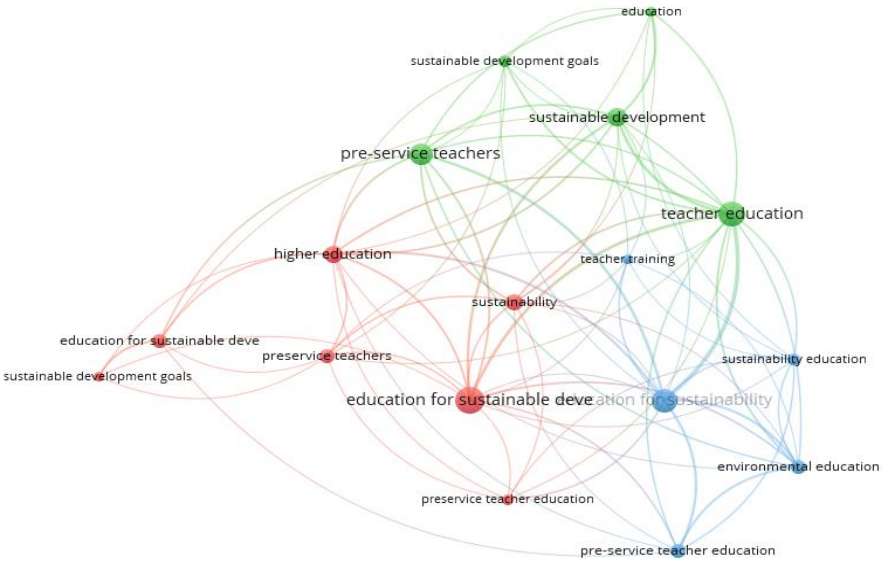

Figure 2. Keyword Co-Occurrences.

Figure 2 shows a network visualization of keyword co-occurrences using a VOS viewer, outlining the primary terms used during the study period. Three main clusters were identified based on the colors of the lines and dots. The first cluster (red) included ESD, higher education, preservice teacher, preservice teacher education, sustainability, and sustainable development goals. The second cluster (green) focused on education, a preservice teacher, sustainable development, sustainable development goals, and teacher education. The third cluster (blue) represented ideas related to ESD, environmental education, preservice teacher education, sustainability education, and teacher training.

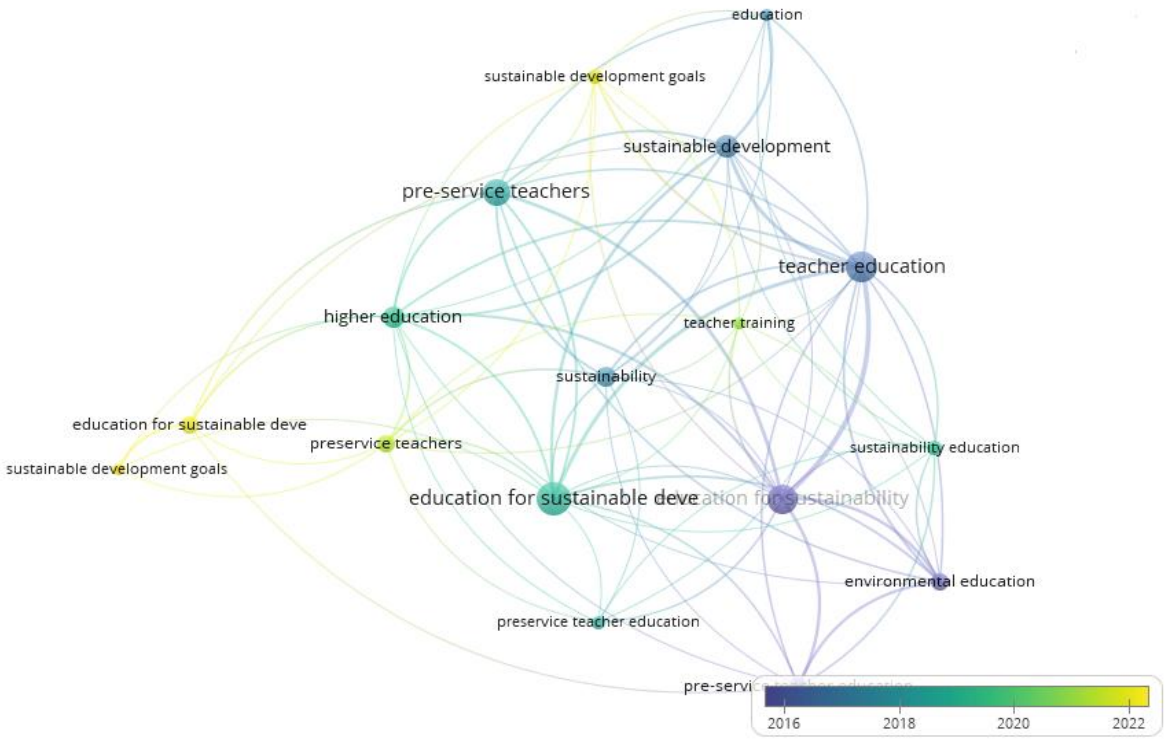

Figure 3. Overlay visualization of keywords.

Figure 3 shows the most frequently used keywords during specific periods. According to the colors, the main keywords appeared most frequently in articles from 2016 to 2018, 2018 to 2020, and 2020 to 2022. From 2016 to 2018, the most common keywords were teacher education, education for sustainability, sustainable development, and preservice teacher. From 2018 to 2020, frequently occurring keywords included ESD and a preservice teacher, with smaller dots representing higher education and preservice teacher education. The dots in the 2020 to 2022 time frame were smaller, showing that these keywords appeared less frequently.

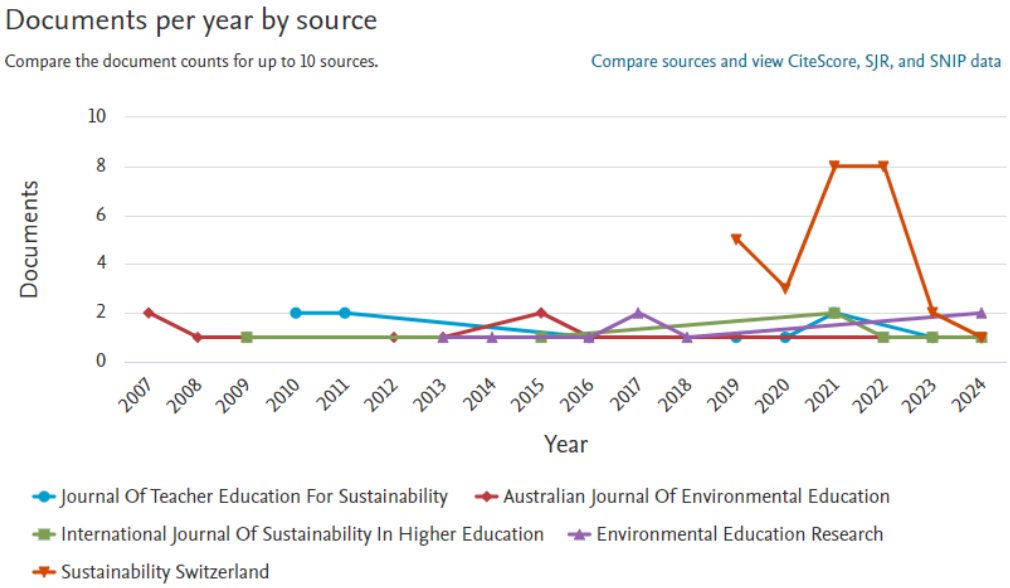

Figure 4. Document source title.

Figure 4 shows that specific journals are often published on sustainability education in teacher education. Between 2004 and 2024, the journals most frequently published on this topic included the Journal of Teacher Education for Sustainability, the Australian Journal of Environmental Education, the International Journal of Sustainability in Higher Education, and Environmental Education Research and Sustainability Switzerland. Table 3 further shows the ten document sources that published the most.

Table 3. Document source

Source	Documents
Sustainability Switzerland	27
Journal Of Teacher Education for Sustainability	10
Australian Journal of Environmental Education	9
Environmental Education Research	8
International Journal of Sustainability in Higher Education	7
Education Sciences	5
Australian Journal of Teacher Education	4
International Research in Geographical and Environmental Education	3
Journal of Cleaner Production	3
Ensenanza De Las Ciencias	2

Sustainability in the preservice teacher field was mostly in article form (87,8%), as shown in Figure 5, followed by book chapters, conference papers, reviews, and books, respectively. The areas most frequently discussed in these publications included social sciences, environmental science, energy, computer science, and engineering, with more than ten publications each, as shown in Figure 6.

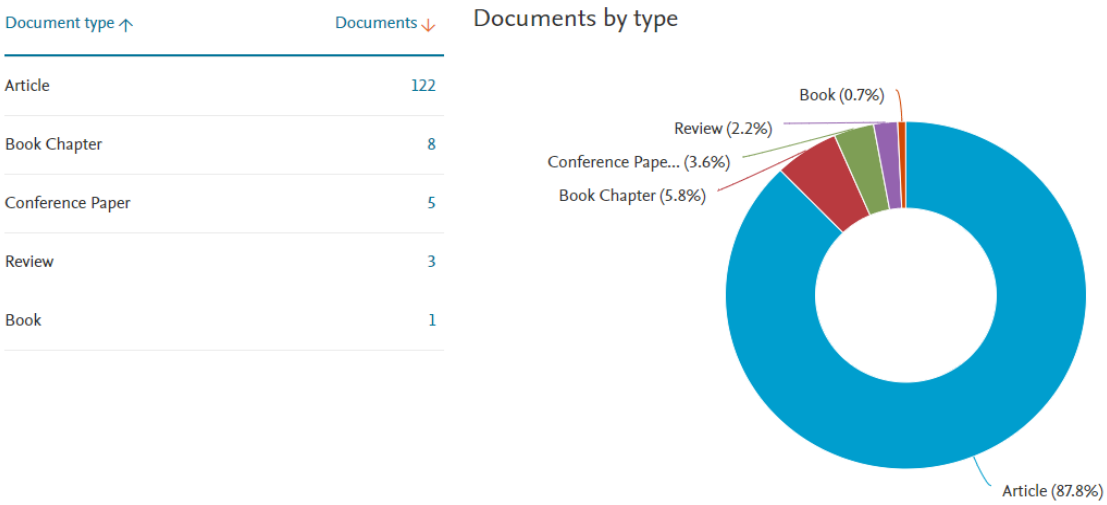

Figure 5. Document type.

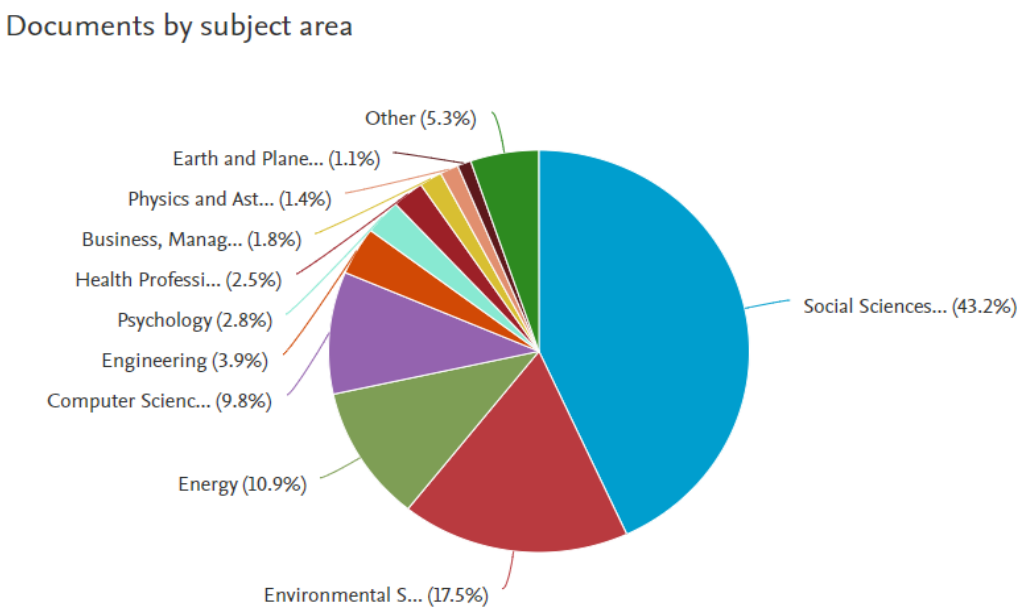

Figure 6. Publication by subject area.

Table 4 showed that the fields with five or fewer publications included Business, Management and Accounting, Physics and Astronomy, Earth and Planetary Sciences, Multidisciplinary, Agricultural and Biological Sciences, Arts and Humanities, Economics, Econometrics and Finance, Mathematics, Medicine, Biochemistry, Genetics and Molecular Biology, and Chemistry. From 1998 to 2024, only five or fewer academic articles were published on sustainability education for a preservice teacher in these subject areas. This suggested the areas were under-researched, presenting significant opportunities for further articles and publication.

Table 4. Publication by subject area

Subject area	Documents
Social Sciences	123
Environmental Science	50
Energy	31
Computer Science	28
Engineering	11
Psychology	8
Health Professions	7
Business, Management and Accounting	5
Physics and Astronomy	4
Earth and Planetary Sciences	3
Multidisciplinary	3
Agricultural and Biological Sciences	2
Arts and Humanities	2
Economics, Econometrics and Finance	2
Mathematics	2
Medicine	2
Biochemistry, Genetics and Molecular Biology	1
Chemistry	1

The articles originated from various countries and territories worldwide. Studies were most frequently conducted in Australia, Spain, Turkey, and the United Kingdom. The number of articles published per country is presented in Table 5. Considering Turkey as a European country, Indonesia evolved as the most frequently researched Asian country on this topic. However, from 1998 to 2024, only six publications were produced, a relatively low number. Publication on this subject in the Indonesian context further remained largely unexplored.

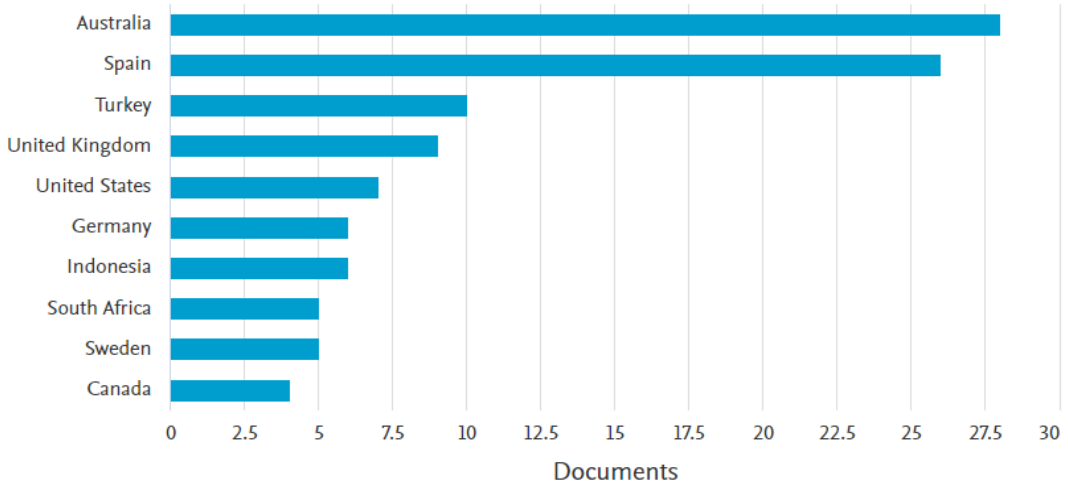

Figure 7. Documents by country or territory.

Table 5 further showed that preservice teacher sustainability education studies were still seldom conducted in many countries, particularly Asia. Surprisingly, only two publications on this topic were from Finland, a country often regarded as having the best education system (Kilag et al., 2023). Therefore, opportunities for publication in countries where studies on this topic were rare remained abundant. There was still significant potential for collaboration with scholars from countries with low publication rates.

Table 5. Documents by country or territory.

Country	Documents	Percentage	Country	Documents	Percentage
Australia	28	20%	Norway	2	1%
Spain	26	19%	Philippines	2	1%
Turkey	10	7%	Viet Nam	2	1%
United Kingdom	9	6%	Argentina	1	1%
United States	7	5%	Austria	1	1%
Germany	6	4%	Belgium	1	1%
Indonesia	6	4%	China	1	1%
South Africa	5	4%	Hong Kong	1	1%
Sweden	5	4%	Hungary	1	1%
Canada	4	3%	India	1	1%
Pakistan	4	3%	Jamaica	1	1%
Chile	3	2%	Lithuania	1	1%
Greece	3	2%	Malaysia	1	1%
South Korea	3	2%	Malta	1	1%
Switzerland	3	2%	Morocco	1	1%

Country	Documents	Percentage	Country	Documents	Percentage
Taiwan	3	2%	Netherlands	1	1%
Finland	2	1%	New Zealand	1	1%
France	2	1%	Poland	1	1%
Ireland	2	1%	Romania	1	1%
Israel	2	1%	Saudi Arabia	1	1%
Italy	2	1%	Slovenia	1	1%
Latvia	2	1%	Undefined	2	1%

Figure 8 shows that Davis J.M from the Faculty of Education, Early Childhood, Queensland University of Technology, Brisbane, Australia, and Ferreira J. A from Southern Cross University, Gold Coast, Queensland, Australia, produced the most significant articles. The list of prolific authors with many publications on this topic also included (1) Evans N. S from the College of Arts, Society and Education, Division of Tropical Environments, James Cook University, Cairns, Australia, (2) Kennelly J from the University of New England, United Kingdom, (3) Nousheen A from National University of Modern Languages, Islamabad, Pakistan, (4) Ryan L. from Sustainability Education, Faculty of Arts and Business, University of the Sunshine Coast, Sippy Downs, QLD, Australia, and (5) Taylor N from School of Education, University of New England, Armidale, Australia. These authors were key contacts for scholars interested in discussing education for sustainability in the preservice teacher field.

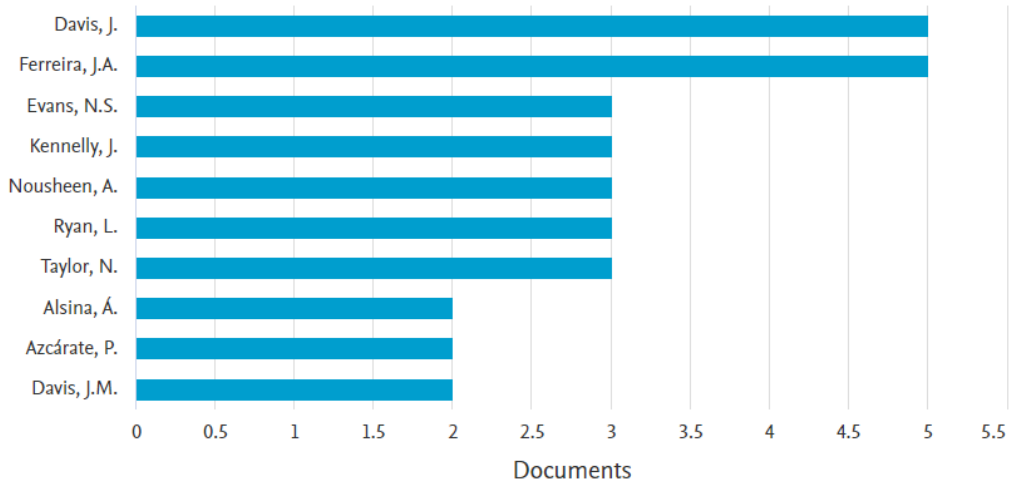

Figure 8. Documents by author.

The most cited documents with 300 or more citations are listed in Table 6. The top three most cited articles were authored by Evans et al. (2017), Nousheen et al. (2020), and Lee & Hwang (2022). The article by Evans et al. (2017), with 131 citations, was the most cited document.

Table 6. Most cited document.

Cited	Authors	Year	Title of article
131	Evans N.S.; Stevenson R.B.; Lasen M.; Ferreira J.-A.; Davis J.	2017	Methods to embedding sustainability in teacher education: A synthesis of the literature

Cited	Authors	Year	Title of article
119	Nousheen A.; Yousuf Zai S.A.; Waseem M.; Khan S.A.	2020	ESD: Effects of sustainability education on preservice teachers' attitude towards sustainable development (SD)
109	Lee H.J.; Hwang Y.	2022	Technology-Enhanced Education through VR-Making and Metaverse-Linking to Foster Teacher Readiness and Sustainable Learning
94	Ferreira J.-A.; Ryan L.; Tilbury D.	2007	Mainstreaming ESD in initial teacher education in Australia: A review of existing professional development models
66	Jeronen E.; Palmberg I.; Yli-Panula E.	2017	Teaching methods in biology education and sustainability education, including outdoor education for promoting sustainability—a literature review
54	Stir J.	2006	Restructuring teacher education for sustainability: student participation through a "strengths model"
51	Dyment J.E.; Davis J.M.; Nailon D.; Emery S.; Getenet S.; McCrea N.; Hill A.	2014	The impact of professional development on early childhood educators' confidence, understanding, and knowledge of education for sustainability
50	García-González E.; Jiménez-Fontana R.; Azcárate P.	2020	Education for sustainability and sustainable development goals: Preservice teachers' perceptions and knowledge
49	Tomas L.; Girgenti S.; Jackson C.	2017	Preservice teachers' attitudes toward education for sustainability and the relevance to the learning: implications for pedagogical practice
48	Cebrián G.; Pubill M.J.	2014	Professional competencies in education for sustainability: An exploratory study of student teachers' views
46	Effeney G.; Davis J.	2013	Education for sustainability: A case study of preservice primary teachers' knowledge and efficacy
44	Merritt E.; Hale A.; Archambault L.	2019	Changes in preservice teachers' values, sense of agency, motivation and consumption practices: A case study of education for sustainability course
39	Alsina Á.; Mulà I.	2019	Advancing towards a transformational professional competence model through reflective learning and sustainability: The case of mathematics teacher education
35	Manasia L.; Ianos M.G.; Chicioreanu T.D.	2020	Preservice teacher preparedness for fostering ESD: An empirical analysis of central dimensions of teaching readiness
34	Sureda-Negre J.; Oliver-Trobat M.; Catalan-Fernández A.; Comas-Forgas R.	2014	Environmental education for sustainability in the curricula of primary teacher training in Spain
34	Andersson K.	2017	Starting the pluralistic tradition of teaching? Effects of ESD on preservice teachers' views on teaching about sustainable development
32	Karpudewan M.; Ismail Z.H.; Mohamed N.	2009	The integration of green chemistry experiments with sustainable development concepts in preservice Teachers' Curricula: Experiences from Malaysia

Cited	Authors	Year	Title of article
32	O'Gorman L.; Davis J.	2013	Ecological footprinting: The potential as a tool for change in preservice teacher education
31	Brandt J.-O.; Barth M.; Merritt E.; Hale A.	2021	A matter of connection: The 4 Cs of learning in preservice teacher education for sustainability

Highly cited articles showed a high level of attention, implying that many scholars were interested in the specific topics covered in the documents. These topics were often considered hot or evolving fields of publications. Therefore, academics looking to conduct analysis could find inspiration in them. Interestingly, several highly cited articles were written by single authors, suggesting opportunities for collaboration among scholars interested in sustainable education for preservice teachers.

Discussion

Research Trend

The younger generation is poised to become future leaders who will address the consequences of environmental inaction. Therefore, creative and practical methods for teaching climate change are essential for youth worldwide, as the younger generation will have to confront the unpredictable outcomes of climate change caused by the elders (Rousell & Cutter-Mackenzie-Knowles, 2020). Considering a teacher's critical role in successfully adopting and implementing ESD, education, and teaching is crucial in advancing sustainable education (Fischer et al., 2022).

Using the search method outlined by Abad-Segura et al. (2020), the author analyzed 139 articles on ESD for a preservice teacher from 1998 to 2024. Among these articles, three documents focused on the sustainability competency of the future teacher, specifically publications by Karpudewan (2024), Pazilah et al. (2024), Chen & Lin (2021), Sperling et al. (2019), and Ndlovu et al. (2013). Additionally, three articles explored preservice teacher sustainability awareness, including Putri et al. (2022), Echegoyen-Sanz & Martín-Ezpeleta (2021), and Sunthonkanokpong & Murphy (2019).

Based on the examined country data, only a few published articles were found in Asia despite being the world's biggest emitter of greenhouse gases (Yuniasih et al., 2020). Despite being the fifth largest contributor to global GHG emissions from human economic activities, Indonesia has only produced six articles on this topic (Saraswati et al., 2021). Addressing environmental challenges that can lead to social issues requires education on sustainability. Sustainable education aims to redesign society to correlate with and respect natural laws, order, and the intrinsic value of life (Marouli, 2021). Therefore, significant opportunities remain for publication within the Indonesian context.

Future Research Opportunity

The Scopus analysis showed that, despite six documents being listed on the topic in Indonesia, only four were directly relevant. Putra et al. (2021) examined the Indonesian biology student-teacher level of sustainability awareness, specifically on emotional, attitude, and practical aspects. Furthermore, Saiful & Setyorini (2022) created an ecocriticism course and examined the effects on preservice English teacher's pedagogical content knowledge of sustainability (PCKS), aiming to address the gap in how to improve PCKS. Fakhrudin et al. (2021) also evaluated the perspectives of a preservice teacher on the relationship between science, technology, engineering, and mathematics implementation in education to support ESD. Additionally, Rifai & Andreani (2021) analyzed whether a group

of preservice English teachers was prepared to implement Content and Language Integrated Learning focusing on food sustainability in the classes. Sulistiyo et al. (2023) and Qin et al. (2022) finally discussed topics unrelated to sustainability education for a preservice teacher.

The results showed that Business, Management, and Accounting had only 11 documents published from 1998 to 2024. Five of these documents are scholarly articles; the rest are book chapters and conference proceedings, suggesting ample opportunities for further examination. Cho and Costa (2024) suggested the urgent need for more advanced sustainable accounting and management courses. These courses should cover more than theories, concepts, frameworks, standards, and principles, enabling students to apply the skills in a managerial context and become more competitive in a sustainable job market (Cho & Costa, 2024).

Based on deeper analysis through abstract reading, none of the five articles in the business, management, and accounting field address issues directly related to the disciplines. For example, Brandt et al. (2021) established a connection between the student-teacher learning outcomes and process, particularly in specific courses offered in teacher education for sustainability (TEfS) at Arizona State University. Similarly, Nousheen et al. (2020) examined how a course on ESD affected the attitudes of the student-teacher toward sustainable development in education programs in Pakistan. Kalsoom and Khanam (2017) used action studies at the Institute of Education, Lahore College for Women University, Pakistan, to raise teacher awareness of sustainability through inquiry-based learning. Pérez-Rodríguez et al. (2017) developed and validated a scale for Environmental Education in Spain to study the perspectives of a teacher on responsibility, commitment to sustainability, and participation in Environmental Education. Lastly, Bauermeister and Diefenbacher (2015) trained a preservice teacher in understanding and incorporating the fundamental principle of sustainability, which included a comprehensive notion of sustainability to enhance the ability to understand and live harmoniously in societies.

None of the studies directly address business, management, and accounting issues. Therefore, significant opportunities remain for publication on sustainability education for a preservice teacher in the fields. Considering the pressing need for more advanced courses in sustainable accounting and management, publication on student-teacher in this area is critically important.

CONCLUSION

This study aimed to explore the trends and opportunities for publications in sustainability education within the preservice teacher field, providing a comprehensive overview from 1998 to 2024. The analysis included a bibliometric method of 139 articles from the Scopus database. Key elements contributing to the study focus were identified, including the number of authors, affiliations, countries, source titles, and the subject areas associated with these articles. The search criteria were further set without a specific time limit. **Fundamental Results**: The document search results showed that the earliest publication in this field appeared in 1998. Although there was a publication gap from 2001 to 2004, the trend from 2005 to 2024 steadily increased. Social Sciences and Environmental Science evolved as the primary subject areas that contributed to most publications—despite being part of social science, fields such as business, management and accounting, arts and humanities, economics, econometrics, and finance had only a few publications, suggesting that there was still significant potential for further examination. Furthermore, the analysis of

education for sustainability in a preservice teacher context was primarily conducted in Australia (20%), Spain (19%), and Turkey (7%) with Asian countries receiving very little attention. Conducting publications in these underrepresented regions could offer valuable contributions to the field. **Implications**: For the Indonesian context, the practical implication of this study lies in motivating policymakers to develop regulations that support the implementation of sustainability education for a preservice teacher. The theoretical implication emphasized an urgent need for Indonesian scholars to focus on studies in sustainability education for a preservice teacher, particularly in the accounting field. **Limitations:** This study possessed several limitations that could be used as the basis for further publications. First, as described earlier, the keywords used in this study could lead to different results when other keywords referring to similar terms were hired. Second, this analysis used the VOS viewer and Scopus analysis tools, while future publications could use other software such as Biblioshiny or Atlas for more in-depth analysis. Third, the study relied solely on the Scopus database, as subsequent articles could incorporate additional databases to capture a broader range of data and offer a more comprehensive trend analysis. Finally, it used only the quantitative bibliometric method, suggesting that future publications could combine the study with other methodologies for a more holistic approach.

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