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ANALYSIS OF EDUCATION FOR SUSTAINABLE DEVELOPMENT RESEARCH HOTSPOTS BASED ON VOSVIEWER AND CITESPACE

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Abstract: *Education for sustainable development (ESD) is the key to the realisation of a sustainable future based on the symbiosis of man and the earth. Although weak ESD based on technocentric has to a certain extent popularised knowledge about the environment and sustainable development and raised people's understanding and awareness of sustainable development, it has failed to fully realise the transformative potential of ESD in promoting social, economic, environmental, cultural and educational change towards a sustainable development path. The purpose of this study is to understand the hotspots and frontiers of ESD research. Methods: Using VOSviewer and CiteSpace software, 1895 English articles on ESD in the Web of Science Core Collection from 2000 to 2023 were analysed for bibliometrics such as country, research institution, author, and keywords. As a result, Germany is the country with the largest number of publications. KARLSTAD UNIV was the most published institution and Niklas Gericke was the most published and cited author. Among the 30 most frequent keywords, the keywords "sustainable development", "education", "environmental education", "higher education" and "students" are broader. While the keywords "knowledge", "competences", "attitudes", " behaviour", "impact", "climate change", "policy", "science", "teachers", "education", "education", "education", "education", "education". "science", "teachers" and "curriculum" reflect some of the current hot topics in the field of ESD. In conclusion, based on the keyword analysis, it can be concluded that the current hotspots of research on ESD are mainly interdisciplinary education research, teacher and policy development research, and students' knowledge, attitudes, and behaviour toward sustainable development.*

Keywords: *Education for Sustainable Development, VOSviewer and CiteSpace, Research Hotspots*

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Introduction

Education is the key to achieving sustainable development, and ESD is an effective way to address the "challenges of an increasingly interconnected planet with a precarious future" (UNESCO, 2022). While weak ESD based on technocentricity has to a certain extent popularised knowledge about the environment and sustainable development and increased understanding and awareness of sustainable development, it has not been able to fully realise the transformative potential of ESD in promoting social, economic, environmental, cultural and educational change towards a sustainable development pathway. To achieve the Sustainable Development Goals (SDG4) on schedule, international organisations represented by the United Nations (UN), the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the European Union (EU), etc., have held many meetings to discuss the future direction of education and ESD and the way forward, to save the future of the next generation.

Education for sustainable development (ESD) is a type of education that aims to develop in students an understanding of and concern for environmental, social, and economic issues of sustainable development, as well as to promote positive action to address these issues (Choi, 2019; Hajdukiewicz, & Pera, 2020). Such education involves not only the transfer of relevant knowledge and skills but also emphasizes the development of values, attitudes, and behaviours that enable students to become global citizens who can participate in and contribute to sustainable development (Pacho, 2021). ESD can be implemented at all educational levels and fields, including school education, university education, vocational education, and community education (Araneo, 2023). It can be implemented through curriculum design, teaching methods, campus activities, social practices, and so on, to cultivate students' comprehensive awareness and ability of sustainable development (Zwolińska et al., 2022). At the same time, the Government, schools, families, and all sectors of society play an important role in promoting education development for sustainable development (Rieckmann, 2018).

The United Nations Transforming Education Summit (TES), to be held in September 2022, will place "learning to live together sustainably" at the heart of its vision for transforming education and the world, emphasising the promotion of sustainable development by reaffirming the centrality of education to the 2030 Agenda for Sustainable Development (Guterres & Secretary-General, 2022), and contributing to the resolution of the global education, ecological and social development crises (Guterres & Secretary-General, 2022). It emphasises that by reaffirming the centrality of education to the 2030 Agenda for Sustainable Development, it will promote the further advancement of education for sustainable development and contribute to solving the global crises of education, ecology, environment, and social development (Guterres & Secretary-General, 2022). "Learning to live together sustainably" implies that countries should reorient ESD towards the "life-centred" values of ESD.

This study analyses the sustainable development teaching literature as a whole through bibliometric methods based on VOSviewer and CiteSpace literature analysis software, reviewing the research process, hotspots, and research frontiers, and providing references for the later research.

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Data and methods

Data sources

The literature in the core collection of Web of Science (WOS) was selected as the data source for the visualisation analysis. The literature was searched by the search formula of "Education for Sustainable Development" with the publication date set from 2000-01-01 to 2023-12-31. The following methods were used to filter the articles: the article type was "article", the language was English, and a total of 1,895 articles were retrieved. The records were finally exported to plain text and tabbed file formats.

Research Methods

The included literature was analysed using the VOSviewer software CiteSpace. Tabular files were imported into the VOSviewer software and analysed visually for Counties, Organizations, and Authors. The exported plain text file was renamed with "download_xxx" and imported into CiteSpace software, and then processed and transformed to obtain a data set that could be analysed by the software for keyword analysis.

Results and Finding

Analysis of the number of publications

The annual publication volume of academic papers can to some extent reflect the stage, status, and development trend of the research field. As shown in Figure 1, from 2000 to 2023, there is an overall increasing trend of interest in ESD research. 2022 has the highest number of publications, with 268, indicating that the field of ESD research is still a good opportunity for development.

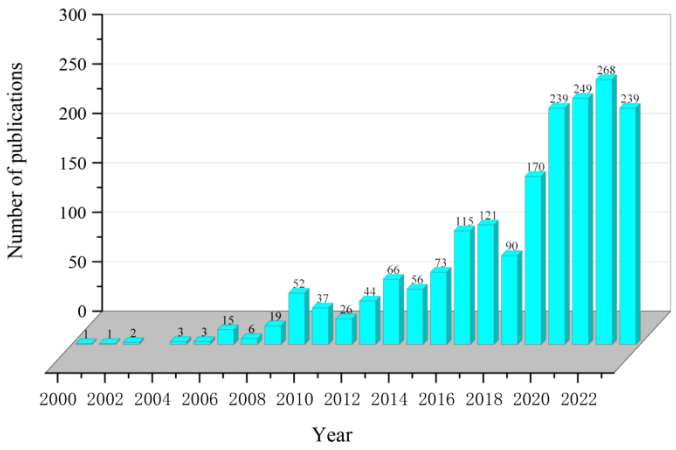

Figure 1: Chronological distribution of ESD research literature

Source: (Author's statistics & Web of Science Core Collection)

Cooperation map of countries and Organizations

Visual analyses of countries and organisations were performed using VOSviewer software, which was set up to select Co-authorship for the Type of analysis and Countries and Organizations for the Unit of analysis. Full counting was used and the threshold of Maximum number of countries per document was set to 25.

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Cooperation map of countries

Taking "Countries" as the node for statistics, and setting the Minimum number of documents of a country to 10, we can obtain the knowledge map of countries in the field of ESD research, as shown in Figure 2. To show the node level and the number of documents more clearly, and to dig deeper into the data information, we analyse the order of the number of documents of the top 10 countries, as shown in Table 1. The analysis data of the number of articles published by countries/regions are the articles published on ESD in the Web of Science Core Collection from 2000 to 2023 in the world. Among them, Germany ranked 1st in terms of the number of publications on ESD, far exceeding other countries and regions (documents: 283, citations: 5541). the rest of the ranking is followed by Spain (documents: 200, citations: 3579), England (documents: 183, citations: 5632), Sweden (documents: 164, citations: 3834), USA (documents: 128, citations: 3834), China (documents: 112, citations: 1091), Australia (documents: 109, citations: 1808), Portugal (documents: 63, citations: 1878), Netherlands (documents: 62, citations: 3190) and Japan (documents: 61, citations: 843).

Table 1: Top 10 Most Prolific Counties and Organisations by Number of Articles

Country	Documents	Citations	Organization	Documents	Citations
germany	283	5541	karlstad univ	27	1016
spain	200	3579	manchester metropolitan univ	27	998
england	183	5632	leuphana univ luneburg	25	1012
sweden	164	3834	univ antwerp	25	1091
usa	128	3264	univ aberta	23	1171
peoples r china	112	1091	free univ berlin	22	328
australia	109	1808	univ aveiro	22	587
portugal	63	1878	uppsala univ	22	817
netherlands	62	3190	univ gothenburg	21	377
japan	61	843	univ Bremen	19	461

Source: ((Author's statistics & Web of Science Core Collection)

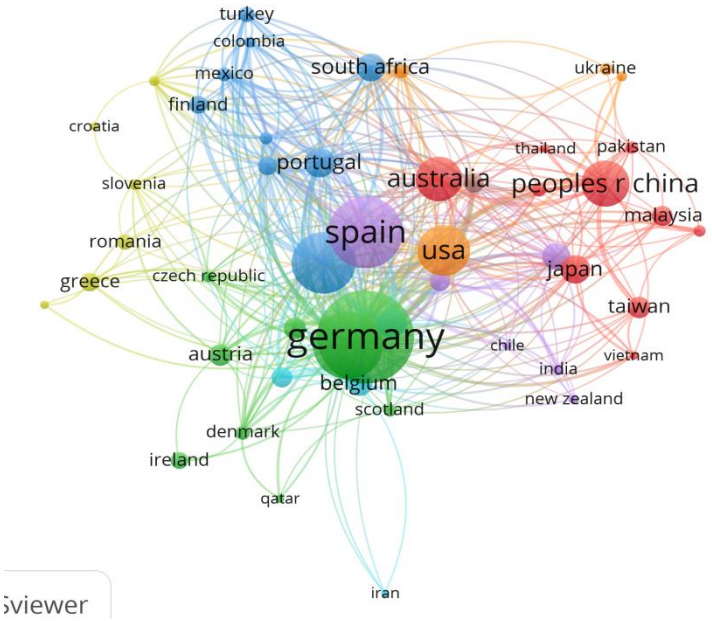

Figure 2: Countries Network Visualization

Source: (Author's statistics & Web of Science Core Collection)

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Cooperation Map of Organizations

Taking "Organisations" as the node for statistics, and setting the Minimum number of documents of an organization to 10, we can obtain the knowledge graph of Organizations in the field of ESD research, as shown in Figure 3. There are 1,784 Organizations on ESD, and the analysis of the top 10 Organizations in terms of the number of papers published reveals that the research on ESD is mainly conducted by universities and research institutes, and the top 10 research institutes in terms of the number of papers published in Web of Science are shown in Table 1. The 10 institutions with the highest number of publications are karlstad univ, manchester, metropolitan univ, leuphana univ luneburg, univ antwerp, univ aberta, free univ berlin, and univ aveiro. uppsala univ, univ gothenburg. univ aberta has the highest number of citations (citations: 1171).

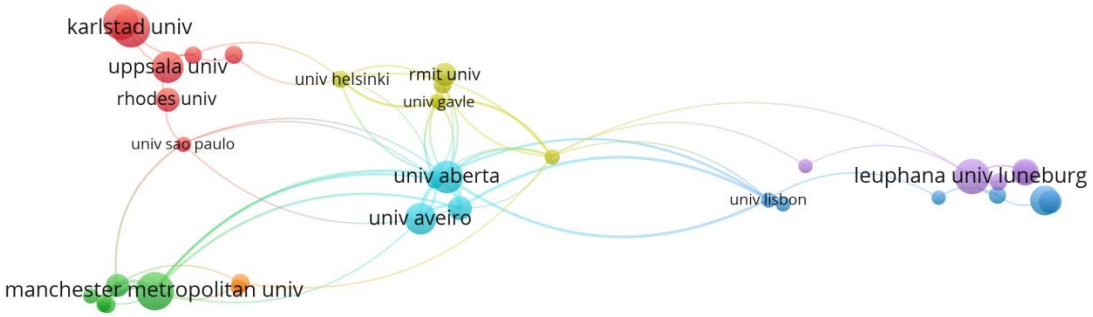

Figure 3: Organizations Network Visualization

Source: (Author's statistics & Web of Science Core Collection)

Research Cooperation Authors

Set VOSviewer to Type of analysis select Co-authorship, Unit of analysis select Authors, use Full counting calculation method, Maximum number of countries per document threshold set at 25 Perform visual analysis. By setting the Minimum number of documents of an Author to 5, the knowledge map of Authors in the field of ESD research can be obtained, as shown in Figure 4. There are 4,382 Authors of ESD research. The research results of ESD cannot be separated from the support of core authors, and the professional scholars in ESD research can be obtained by statistically analysing the comprehensive publication volume and citation frequency indexes of the authors of the literature. According to Price's law (Sun et al., 2021), the minimum standard of core authors' publication :

$$Mp = 0.749\sqrt{Np_{max}}=3.59 \quad (1)$$

Np Max is the number of publications of the author with the highest number of publications (23), and a candidate for the core author is considered to be a core author as long as he/she has more than 4 publications in the relevant field. Based on this criterion, a total of 73 core authors are shown, and Table 2 lists the relevant number of publications and citation frequency of the top 14 core authors in terms of number of publications. The author with the highest number of publications is Gericke, Niklas, with a total of 23 publications. The most frequently cited authors are Lozano and, Rodrigo with 1748 citations.

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Table 2. Number of relevant publications and citation frequency of the top 12 core authors

Author	Documents	Citations	Author	Documents	Citations
gericke, niklas	23	876	kopnina, helen	14	680
barth, matthias	22	1151	rieckmann, marco	13	1384
leal filho, walter	17	875	riess, werner	13	265
van petegem, peter	17	323	boeve-de pauw, jelle	12	429
eilks, ingo	15	348	caeiro, sandra	12	750
boegeholz, susanne	14	200	lozano, rodrigo	12	1748

Source: ((Author's statistics & Web of Science Core Collection)

Analysis of Research Hotspots

Using VOSviewer software to make a keyword co-occurrence map of ESD-related research papers in the Web of Science Core Collection, we carried out a visual analysis of ESD research hotspots, applying two indicators, Links and Total link strength, the higher the value, the stronger the link and co-occurrence strength. The higher the value, the stronger the link and co-occurrence strength (Van Eck, & Waltman, 2022). The co-occurrence analysis of keywords can effectively reflect the hot topics of interest to scholars in the field of education for sustainable development, and provide scholars with a scientific and systematic visualisation map for scientific research. Keywords are highly condensed contents and themes of academic papers, which can reflect the core contents of the articles. Therefore, to better analyse ESD research, with the help of the VOSviewer visual analysis tool, this study collects and analyses the high-frequency keywords of the current ESD research, and tries to show the focuses of the ESD research more clearly through the keyword co-occurrence analysis.

Keywords Network Visualization

Through the use of VOSviewer to analyse the maps by analysis, VOSviewer is set to: Type of analysis choose Co-occurrence, Unit of analysis choose All keywords, use Full counting calculation method to get 5194 keywords. The Minimum number of occurrences of a keyword was set to "31 times", and 47 eligible keywords were divided into 4 Clusters, forming 945 links, and the total link strength was 7593. The keyword co-occurrence mapping in the field of ESD research is shown in Figure 4.

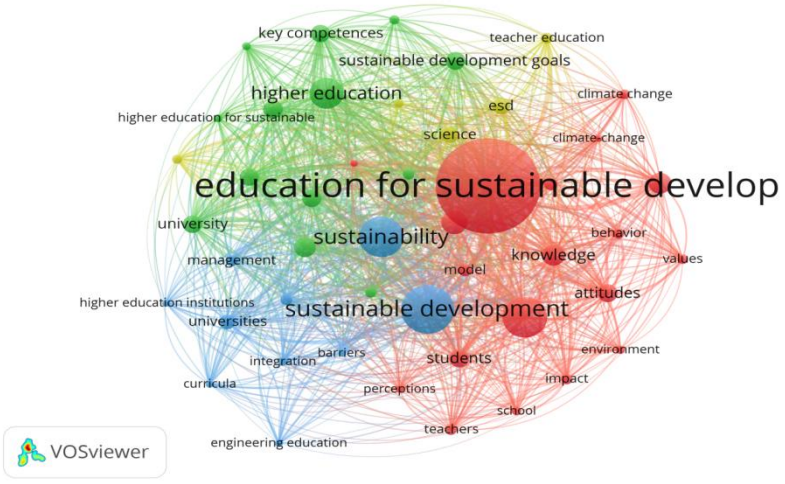

Figure 4: Keywords Network Visualization

Source: (Author's statistics & Web of Science Core Collection)

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The keywords of the papers in the field of education for sustainable development from 2000 to 2023 were exported to Excel software and reordered according to the frequency of occurrence, and the top 20 high-frequency keywords were selected to get the frequency table of high-frequency keywords of hot spots of research on education for sustainable development (Table 3). According to the results of the study, the research hotspots of ESD from 2000 to 2023 mainly focus on the following keywords: sustainable development, education, sustainability, higher education, knowledge, environmental education, competitiveness, education, and education. education, competences, framework, and students.

Table 3. ESD High Frequency Keywords 2000-2023

No	Keyword	Occurrences	Total link strength
1	education for sustainable development	877	1884
2	sustainable development	375	1021
3	education	301	792
4	sustainability	301	920
5	higher education	216	712
6	knowledge	132	499
7	environmental education	129	326
8	competences	122	462
9	framework	110	444
10	students	110	432
11	sustainable development goals	110	322
12	attitudes	108	412
13	university	105	405
14	curriculum	104	371
15	higher-education	103	403
16	key competences	103	398
17	science	98	323
18	universities	82	327
19	environmental-education	70	211
20	model	68	221
21	management	62	238
22	teacher education	58	165
23	challenges	57	223
24	teachers	56	179
25	impact	55	187
26	implementation	55	247
27	behavior	54	196
28	policy	53	160
29	values	50	162
30	climate change	48	128

Source: ((Author's statistics & Web of Science Core Collection)

Keywords with strongest citation bursts

When analysing the keywords, set the parameters as follows: Time slicing is set to "2000-2023", Years Per Slice is set to "4 years", and "g-index" is used as the data selection criterion for time slicing. To include more or fewer nodes, increase or decrease the scale factor k=25, Pruning is

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set to Pruning sliced networks, and Pruning is set to Pruning sliced networks. "To include more or fewer nodes, increase or decrease the scale factor k=25, Pruning check the box of Pruning sliced networks, and perform keyword analysis. The keywords are analysed in the form of Pruning sliced networks. Use the Burstness function, set the parameter y [0,1] to 0.7, and generate the Top 25 keywords with the strongest citation bursts.

The "year of emergence" represents the time when the mutability of the subject term changed significantly, which can be summarised as the research frontiers within that time period. Keywords with citation bursts indicate that the keyword has a high citation rate in the given period, which can test whether the ESD research field is popular and highlights emerging topics in the given period. By looking at the keywords, more keywords have emerged between 2000-2017, Such as sustainable development (strength, 15.55; time span, 2000-2015), environmental education (strength, 14.96; time span, 2000-2017), ecology (strength, 2.88; time span, 2006-2017), climate change (strength, 3.24; time span, 2009-2011), biodiversity education (strength, 2.53; time span, 2009-2015).

The keywords that emerged between 2010-2019 were mainly engineering education (strength, 4.31; time span, 2010-2013), indicators (strength, 2.94; 2011-2017), corporate social responsibility (strength, 2.91; time span, 2011-2017) and social responsibility (strength, 2.91; time span, 2011-2017). responsibility (strength, 2.91; 2011-2017), sustainability in higher education (strength, 4.22; 2013-2015), lesson plan (strength, 2.96; 2012- 2015), tool (strength, 2.96; 2012- 2015), and keywords (strength, 4.31; time span, 2010-2013). 2015), tool (strength, 2.55; 2012-2015), socioscientific issue (strength, 2.53; 2013-2017), sustainability (strength, 2.44; 2013-2017), higher education (strength, 4.21; 2014-2017), university (strength, 3.85; 2014-2015), staff (strength, 3.15; 2015-2019), sustainability consciousness (strength, 2.93; 2014-2017), environmental management (strength, 2.75; 2015-2019), ecological paradigm (strength, 2.75; 2015-2019), sustainable consumption (strength, 2.6; 2014-2019), policy (strength, 2.59; 2015-2017), un decade (strength, 2.69; 2016-2017).

The keywords that emerge between 2020-2023 are mainly primary education (strength, 3.69; time span, 2020-2021), sustainable development goals (strength, 3.56; time span, 2020-2023), and learning outcm (strength, 3.56; time span, 2020-2023). 2023), sustainable development goals (strength, 3.56; time span, 2020-2023), and learning outcm (strength, 2.46; time span, 2020-2021).

Keywords with the strongest citation bursts show that research in the field of ESD research is getting earlier and earlier, at the beginning of 2000-2019 the main research hotspots were in higher education. after 2000, research hotspots appeared in primary education. Combining keywords Network Visualization and keyword time zone analysis, the research of environmental education, sustainable development, higher education, and its environmental knowledge in ESD will still be the research hotspot.

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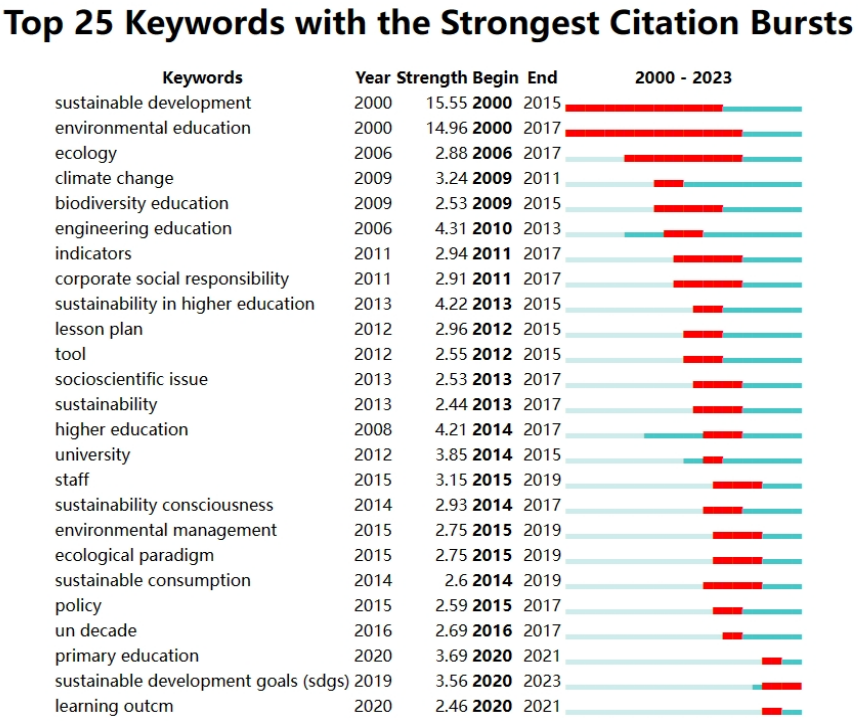

Figure 5: Keywords with strongest citation bursts

Source: (Author's statistics & Web of Science Core Collection)

Discussion

Distribution of publications

In terms of the distribution of publications by country, developed countries such as the US and Europe publish more ESD papers. between 2020 and 2023, the country with the highest number of publications is Germany, the institution with the highest number of publications is karlstad univ, but the most cited institution is the univ aberta. the most cited institution is Niklas Gericke, an active researcher in the field of ESD. Niklas Gericke is an active researcher in the field of Education for Sustainable Development. He is also the director and head of research at the SMEER Centre (Centre of Science, Mathematics, Engineering Education Research), which is the coordinating body for educational research in the natural sciences, mathematics, and technical disciplines at Karlstad University. 2012-2015 Niklas Gericke led the research committee. In 2012-2015, Niklas Gericke led the Research Council-funded project 'Investigating the underlying factors contributing to schools' success in education for sustainable development'. sustainable development", which used large-scale quantitative methods to map and analyse student-level influences on the implementation of sustainable development in Swedish schools. In addition, the importance of school leadership and organisation was examined to identify structural factors influencing the implementation process. Based on the results of this study, Niklas Gericke initiated a major practice-related research and development project funded by the Swedish Institute for Educational Research called 'Education for Sustainable Development: A Longitudinal Implementation Study'. The study, as the title suggests, focuses on the implementation process over time. In 2018, Niklas Gericke was awarded a Research Council-funded project in collaboration with Farhana Borg, project leader at Dalarna University, which aims to study the impact of eco-certified pre-schools on children's awareness of sustainable development. schools on the importance of children's awareness of sustainable development.

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Research Hotspots for ESD

Keywords are the words that reveal the topic of the paper, and they are the core summary of the center of the article. Analysing keywords is beneficial to the study of hotspots in the field (Guo & Zhang, 2022). Of the 30 most frequent keywords, the keywords "sustainable development", "education", "environmental education", "higher education", and "students" are broader. While the keywords "knowledge", "competences", "attitudes", " behaviour", "impact", "climate change", "policy", "science", "teachers", "curriculum". "science", "teachers", "curriculum" reflect some of the current hot topics in ESD. Based on the keyword analysis, it can be concluded that the current hotspots of research on ESD are mainly interdisciplinary education research, teacher and policy development research, and research on students' knowledge, attitudes, and behaviours toward sustainable development. mainly interdisciplinary education research, teacher and policy development research, and students' knowledge, attitudes, and behaviour toward sustainable development.

Interdisciplinary Education Research

According to UNESCO, (2021), students' knowledge of environmental and earth sciences has stagnated since 2015, with only about 30 percent of students achieving proficiency; at the same time, many countries still do not have climate action as a core part of their curricula. One of the reasons for these problems is that the broad and dynamic nature of the concept of sustainable development has resulted in a wide range of content and areas of education for sustainable development. In other words, strategies such as interdisciplinary integration, multidisciplinary penetration, whole-institution and whole-school innovations, and cross-sectoral co-operation are necessary to promote quality and holistic ESD (Spychalski, 2023). This places higher demands on educational policymakers, school administrators, and teachers, including the ability to integrate global perspectives with local issues, to take "improving the lives of children and youth" as a core vision, to reflect on, examine, and reconstruct existing educational goals, contents and methods holistically, and to integrate sustainable development concepts, issues, principles, and spirit into school-based approaches. It is a new challenge for them to reflect on and reconstruct the original educational goals, contents, and methods, and to integrate the concepts, issues, principles, and spirit of sustainable development into the educational and teaching activities according to the school's needs (Leicht et al., 2018). On the other hand, globally, textbooks are the first and sometimes the only books that young people read in many countries and regions. Therefore, false information about environmental and sustainable development issues in textbooks and stereotypes of people in developing countries can seriously hinder the formation and construction of learners' sustainable development literacy (UNESCO, 2021). Therefore, based on restructuring curriculum policies and systems, relevant organisations should re-examine, re-evaluate, and build textbooks based on the values of "a holistic worldview" and "community of life", incorporating objective knowledge and information on environment and sustainable development, and through the use of "cross-cultural, interdisciplinary, and local knowledge". Through cross-cultural, interdisciplinary, and localised contextual learning, learners develop the awareness and values to learn and act for our common planet. Overall, the commitment of researchers to develop interdisciplinary approaches to education that integrate all aspects of sustainable development (environmental, economic, social, and scientific) into teaching and learning to develop the capacity of students to comprehensively understand and address the challenges of sustainable development is one of the current hotspots of research on ESD.

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Teacher and Policy Development Reseach

Teacher communities are both key actors in the implementation of ESD policies and creative agents of change in ESD. UNESCO specifies that teachers are "professional constructors and disseminators of knowledge for a sustainable future", "facilitators of change for learners" and "key agents in the transformation of learners towards sustainable lifestyles". The teacher's attitude can be said to be the key to the transformation of learners into sustainable lifestyles. It can be said that teachers' attitudes, abilities, and actions determine the effectiveness of ESD change in schools. However, a general lack of qualified teachers and a significant lack of teacher ESD literacy hinder the role that teachers should play as co-facilitators of ESD change. 2021, statistics from the Organisation for Economic Co-operation and Development (OECD) show that, compared to the OECD average student-teacher ratio of 15:1 at the primary school level, in countries such as India, Mexico, and Brazil, the student-teacher ratio is more than 23:1 (Unesco, 2020). The serious shortage of qualified teachers is a constraint to the overall promotion of ESD in these regions. At the same time, teacher education and training in most countries and regions lacks content and training related to sustainable development, resulting in a lack of knowledge and capacity for future education. Only about 7 percent of countries have fully integrated ESD into the content of teacher education. Many teachers feel that they are not adequately prepared to teach sustainable development topics (Hutchings, 2017).

To fully reinvigorate teachers' motivation to take action in integrating ESD into education systems and to unleash their creative potential to participate in transforming ESD systems, there is an international consensus that professional training and learning programs for teachers, as well as other educators, in the field of ESD, can no longer be neglected or postponed. Building on this consensus, UNESCO proposes to incorporate "systematic and comprehensive ESD competencies" into pre-service education, in-service training, and professional assessment of teachers, to strengthen teachers' capacity to lead their students to transform themselves and to encourage and support them to actively adopt and apply transformative and innovative pedagogical approaches to empower their students to To empower students to become builders and agents of social change for sustainable development. The Summit on Educational Transformation has also proposed that action should be taken in four areas, namely, enhancing teachers' transformative pedagogical skills, reshaping teacher recruitment and promotion mechanisms and working conditions, establishing effective accountability, and involving teachers in the formulation of curricular and pedagogical reform policies, so that teachers can contribute to the transformation of education based on their transformation, promote the production of knowledge, and positively guide the holistic development of children. The European Union has also begun work on the establishment of an online working group on digital education and training for sustainable development (ESD), which calls for and supports the active participation of all teachers to enhance their overall capacity for ESD. The researcher explores ways to increase teachers' awareness and competence in ESD, as well as best practices in designing and implementing relevant programs.

Students' knowledge, attitudes, and behaviour towards sustainable development

As the front line of implementation of education for sustainable development, schools should assume the responsibility of the times to empower all learners to "learn to live together". To this end, the international community has stated that schools should be comprehensively rebuilt so that schools at all levels and in all types of settings become "living laboratories" for integrating the principles of sustainable development, examples of environmental stewardship, and centers of excellence in building a social culture of sustainable development. Therefore, the study of

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students' knowledge, attitudes, and behaviours towards sustainable development is an important branch of the field of education for sustainable development, which involves the extent to which students understand the concept of sustainable development, their attitudes towards environmental, social and economic issues, and the sustainable behaviors they adopt in their daily lives.

First, is environmental literacy. Environmental literacy involves students being able to explain human-earth interactions and their impacts, being able to systematically assess and reflect on environmental issues in the light of available evidence, and taking reasonable action to protect the environment accordingly. Students are also able to explore integrated solutions to environmental problems with strong personal values and beliefs and are tolerant and respectful of other diverse perspectives and ideas (White et al., 2023). The researcher explores the extent of student's understanding of concepts related to sustainable development, including the level of knowledge of environmental, social, and economic aspects. This may involve the level of understanding of relevant scientific knowledge, policies, and practices, as well as their level of awareness of the goals and challenges of sustainable development.

Secondly, attitudes and values. The researcher investigates students' attitudes and values toward environmental, social, and economic issues the relationship between these attitudes and values, and their level of knowledge of sustainable development. For example, whether they agree with the principles of sustainable development and whether they are willing to contribute to the SDGs. Thirdly, behaviour and practice. The researcher examines the sustainable behaviours adopted by students in their daily lives, such as saving energy, reducing waste, and using renewable resources. This may involve aspects of their lifestyles, purchasing decisions, and social participation, as well as the relationship between these behaviours and their level of knowledge and attitudes.

Fourthly, educational interventions and impact assessment. Researchers have conducted studies targeting educational interventions, such as curriculum design, teaching methods, and campus activities, to improve students' knowledge, attitudes, and behavioural levels toward sustainable development.

The above research hotspots reflect the diversity and complexity of the ESD field, and at the same time provide important theoretical and practical support for promoting the development of ESD.

Conclusion

With the help of the VOSviewer measurement tool, this study measured and classified the literature related to the field of digital clothing in the WOS database, and described the research status, research hotspots, and development trends in the field of education for sustainable development from 2000 to 2023. From the analysis of the trend of publications and the distribution of cooperation between countries and organisations, it can be seen that there is a rising trend of ESD-related research between 2000 and 2023. The country with the largest number of articles is Germany (383 articles); the organisation with the largest number of articles is karlstad univ (27 articles), and the author with the largest number of articles is Niklas Gericke (23 articles). Visual analyses of ESD are important at the intersection of sustainable development and education and have had a positive impact on all aspects of social sustainability and environmental education.

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According to the Secretary-General of the United Nations, humanity is faced with a "stark and urgent choice" between "business as usual" and "collapse" or "working together" and "breakthrough", and it is up to us (UN, 2021). "It is up to us to make the "stark and urgent choice" (UN, 2021). To this end, the international community has put forward a core vision of redefining the values of ESD, with the overarching goal of "learning to live together sustainably", and has called on all countries to take immediate action to transform their ESD systems so that ESD can contribute to "the common well-being of people and the planet". "Stresses It was emphasised that countries should mainstream ESD into all levels of education, training, learning, and action for sustainable development by strengthening the status of ESD. At the same time, international agencies, represented by UNESCO, have also stressed that countries should focus on revisiting the framework and content of curricula at all levels and in all categories based on the concepts and principles of the Earth's living community, eliminating social and natural colonial values in knowledge and curricula, and reshaping the importance of knowledge of the environment and sustainable development in the core curricula; and that countries should rebuild their schools to empower all learners with the attitude of "learning to live together". Countries should rebuild schools to empower all learners with the attitude of "learning to live together", value knowledge and skills, improve people's sustainable development literacy in all aspects, and reshape the harmonious symbiotic relationship between human beings and between human beings and nature.

Suggestions

To implement the goals of education for sustainable development, the international community has proposed that countries create coherent and effective teacher education systems for sustainable development and unleash the full potential of the teacher community as "agents of change in education for sustainable development". In the future, with the overarching goal of "moving towards a just and sustainable future", ESD will embark on an all-encompassing, in-depth, and systematic journey of change, to enhance the resilience and inclusiveness of the ESD system, and effectively fulfill its key role in promoting the achievement of the 2030 Global Goals for Sustainable Development and contributing to the transformation of sustainable societies. The key role of ESD in contributing to the achievement of the 2030 global sustainable development goals and the transformation of societies for sustainable development can be realized by making ESD systems more resilient and inclusive. Researchers can conduct in-depth studies on the current research hotspots in light of the ESD goals and in conjunction with the hotspots of this study, and at the same time, they can conduct additional studies on some imperfections.

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References

Araneo, P. (2023). Exploring education for sustainable development (ESD) course content in higher education; a multiple case study including what students say they like. Environmental Education Research, 1-28.

Choi, M. Y. (2019). Sub-Education policy review report: Education for sustainable development.

Guo, L., & Zhang, W. (2022). Knowledge mapping of population health: a bibliometric analysis. Heliyon, 8(12).

Guterres, A., & Secretary-General, U. N. (2022). Secretary-General, at Transforming Education Summit, Urges Greater Commitment to Make Schools Safe, Support Lifelong Learning, Increase Resources for Students.

Hajdukiewicz, A., & Pera, B. (2020). Education for sustainable development−the case of massive open online courses. Sustainability, 12(20), 8542.

Hutchings, J. (Ed.). (2017). Accountability in education: meeting our commitments. Unesco Publishing.

Leicht, A., Heiss, J., & Byun, W. J. (2018). Issues and trends in education for sustainable development (Vol. 5). UNESCO publishing.

Pacho, T. O. (2021). Role of global citizenship education in sustainable development. Journal of Research Innovation and Implications in Education, 5(4), 173-182.

Rieckmann, M. (2018). Key themes in education for sustainable development. Issues and trends in education for sustainable development, 5, 61-84.

Spychalski, B. (2023). Holistic Education for Sustainable Development: A Study of Shaping the Pro-Quality Attitude of Students in the Polish Educational System. Sustainability, 15(10), 8073.

Sun, X., Jing, S., & Sun, J. (2021). Analysis of Hot Spots and Trends of Cultural Security Research Based on Citespace. Journal of Networking and Telecommunications, 3(1), 19-22.

UN. (2021). Secretary-General's report on "Our Common Agenda". New York: United Nations Publications.

Unesco. (2020). Education for sustainable development: A roadmap. Transforming Our World: The 2030 Agenda for Sustainable Development A/RES/70/1, available online at.

UNESCO. (2021). Learn for our planet: A global review of how environmental issues are integrated in education.

UNESCO. (2022). Global Education Monitoring Report 2021/2: Non-state Actors in Education: Who Chooses? Who Loses?. UN.

Van Eck, N. J., & Waltman, L. (2022). VOSviewer manual.

White, P. J., Ardoin, N. M., Eames, C., & Monroe, M. C. (2023). Agency in the Anthropocene: Supporting document to the PISA 2025 Science Framework.

Zwolińska, K., Lorenc, S., & Pomykała, R. (2022). Sustainable development in education from students' perspective−Implementation of sustainable development in curricula. Sustainability, 14(6), 3398.