

Review

Mapping the Landscape and Structure of Research on Education for Sustainable Development: A Bibliometric Review

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Abstract: This systematic review of research used science mapping as a means of analyzing the knowledge base on education for sustainable development (ESD) in K-12 schooling. The review documented the size, growth trajectory and geographic distribution of this literature, identified high impact scholars and documents, and visualized the “intellectual structure” of the field. The database examined in this review consisted of 1842 English language, Scopus-indexed documents published between 1990 and 2018. The review found that the knowledge base on ESD has grown dramatically over the past 30 years, with a rapidly accelerating rate of publication in the past decade. Although the field has been dominated by scholarship from Anglo-American-European nations, there is evidence of increasing geographic diversification of the ESD knowledge base over the past 15 years. Citation analyses identified authors who have had a significant influence on the development of this literature. Author co-citation analysis revealed three “schools of thought” that comprise the “intellectual structure” of this knowledge base: Education for Sustainable Development, Developing a Sustainability Mindset, Teaching and Learning for Sustainability. Document content analyses led to the conclusion that the current knowledge base is heavily weighted towards critical, descriptive and prescriptive papers, with an insufficient body of analytical empirical studies. Several recommendations are offered for strengthening this literature.

Keywords: education for sustainable development; sustainability; sustainable development; bibliometric review; science mapping

1. Introduction

Few trends in educational research and practice have emerged over the past 30 years with wider global reach than “education for sustainable development” (ESD). Launched under the rubric of “environmental education” during the 1980s, ESD has gradually incorporated a broader range of concerns that bear upon the social, economic, and environmental sustainability of global society [1,2]. Over time, concerns for health, equity, peace, and social justice have been incorporated into the emerging field of education for sustainable development [3–7]. Spurred on by a series of international policy reports [8–10], ESD has matured not only into a recognized field of education research and practice, but also a key sub-field of sustainability science [1,2,11,12].

To date, published reviews of research on “education for sustainable development” have focused on subsets of the literature such as sustainability in early childhood education [13–15], sustainable

change [16,17], citizenship education [18], teacher education [19–21], and teaching and learning methods [22–26]. While bibliometric reviews have been conducted on the ESD knowledge base in higher education, we propose that there are sufficient differences to warrant a separate examination of ESD in K-12 schools [27].

This systematic review of research sought to document and synthesize patterns in knowledge production on education for sustainable development in K-12 schooling. The review addressed the following research questions:

1. What is the volume, growth trajectory, geographic distribution, and composition of English-language scholarship on education for sustainable development (ESD) in K-12 schools?
2. What authors and articles have evidenced the greatest impact on English-language discourse in education for sustainable education at the K-12 level?
3. What is the intellectual structure of this English-language, ESD knowledge base?

The review employed science mapping to analyze 1842 Scopus-indexed documents published in English [28,29]. Data analyses included descriptive statistics, citation analysis, and co-citation analysis. The analyses sought to gain a comprehensive perspective on the ESD knowledge base in K12 schools since its emergence in the early 1990s.

2. Background

Education for Sustainable Development

In 1987, The Brundtland Commission, or more formally the World Commission on Environment and Development (WCED), was organized to unify countries in a common pursuit of “sustainable development”. The WCED aimed to define the concept of sustainable development, increase global awareness of sustainability-related problems, and prompt action towards the identification and implementation of solutions.

Publication of the Brundtland Commission’s report [10], “Our Common Future”, was followed five years later by the Earth Summit in Rio de Janeiro, Brazil. This is where the term, Education for Sustainable Development (ESD), first emerged in the sustainability lexicon. A related plan, “Educating for a Sustainable Future: Environment Population and Development”, was proposed by the United Nations in the same year [30]. A decade later, in 2002, UNESCO launched the “United Nations Decade of Education for Sustainable Development” (UNDESD).

This evolution in global interest in ESD began with raising awareness, moved to capacity building, then to experimentation, and finally, implementation of recommended practices [31,32]. At the conclusion of the UNDESD, the United Nations launched the 2030 Agenda for Sustainable Development. This Agenda proposed 17 Sustainable Development Goals (SDGs) for worldwide implementation. The fourth SDG focuses on achieving the delivery of “Quality Education” for all youth. More specifically, target 4.7 of the quality education goal stated:

“By 2030, ensure that all learners acquire knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development.” (p. 48) [9]

These historical events highlight the increasingly prominent role that education has assumed in the global movement towards sustainable development. In 2019, ESD is not only accepted as one of the 17 Sustainable Development Goals (SDGs), but also recognized as an instrumental means of accomplishing the other 16 goals [1,33,34]. Over time, a global network of educators and researchers from different disciplines has joined this effort to address the goals of ESD [20,33,35]. This has resulted

in the adoption of numerous policies and programs aimed at enhancing teacher and student knowledge and attitudes in this domain [19–21,36].

For the purposes of this review, the authors adopted the following conceptual definition of “education for sustainable development” in K-12 schooling. ESD consists of educational programs, curricula, and teaching and learning practices that enhance student values, understanding, and capabilities in relation to the challenges of social, environmental and health sustainability [2,9,12,30]. This definition recognizes the need for both content and processes of education that engage learners in developing a deeper appreciation of how human behavior impacts the sustainability of society and the planet.

3. Method

This review used science mapping to examine trends in ESD-related documents published since the emergence of this movement in the early 1990s. Science mapping involves the analysis of bibliographic data associated with a corpus of documents drawn from a field of study [37]. Science mapping aims to illuminate the evolution and structural composition of a knowledge base [29]. Thus, reviews grounded in science mapping serve a different purpose than reviews that employ narrative synthesis or meta-analysis which seek to integrate substantive findings within a field of research [37].

3.1. Search Criteria and Identification of Sources

The authors selected the Scopus database as the source of documents for this review. Scopus was chosen because it employs a consistent standard in selecting documents for inclusion in its index. Moreover it features a wider range of documents than the Web of Science for reviews of research in education and the social sciences [27,38]. Finally, it offers more sophisticated capabilities for the export of bibliographic data than Google Scholar.

Despite these strengths, Scopus also has a key limitation. Its coverage is concentrated in English language documents. This is relevant for a review of a field such as ESD where research documents may also be authored in other languages (e.g., Chinese, French, Spanish, Bahasa Indonesia, etc.). With this in mind, we acknowledge from the outset that developing a comprehensive global picture of the literature on ESD will require complementary reviews of alternate language literature.

The search for documents in Scopus encompassed journal articles, books, book chapters, and conference proceedings. No boundary was set on the time period of publication; rather, we allowed Scopus to search for the earliest relevant documents and continue up to the end of 2018. The topical focus of the review was delimited to “education for sustainable development in K-12 schooling”. ESD documents with a focus on higher education or sustainability science were excluded. The one exception to this decision rule concerned papers focusing on “teacher training for ESD in higher education programs”, which we deemed directly relevant to the purpose of this review.

We employed a single broad search term (i.e., “education for sustainable development”) rather than a series of discrete search terms that presupposed a particular definition for ESD (e.g., inclusive education, peace education, etc.). The keyword terms used in the Scopus search were as follows:

(TITLE-ABS-KEY ("sustainable development") AND TITLE-ABS-KEY (school) AND NOT TITLE-ABS-KEY ("higher education") AND NOT TITLE-ABS-KEY (university))

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for the document search [39]. PRISMA requires the reviewers to make explicit all steps in the search and screening process (see Figure 1). The initial Scopus search yielded 2066 documents. We excluded 41 documents based on ineligible document type (e.g., notes, editorials). Following this filtering, we inspected the title and abstract of each document to determine its topical relevance. This led to the deletion of an additional 183 documents from the Scopus list. These typically focused on ESD in higher education or peripheral topics (e.g., teaching with IT). The final database was comprised of 1842 Scopus-indexed documents of mixed types, focusing on ESD in K-12 schooling (see Figure 1).

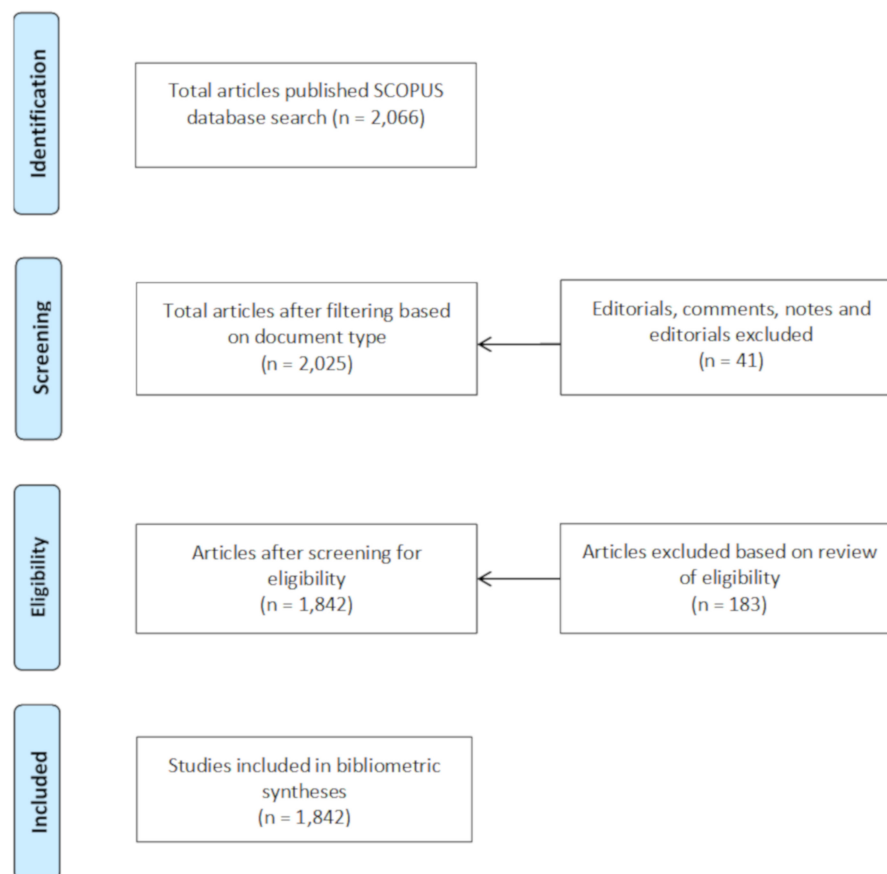


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram detailing steps in the identification and screening of sources for review of education for sustainable development [39].

3.2. Data Analysis

Meta-data related to the 1842 ESD documents were exported from Scopus into a master Excel file. Excel was used to conduct descriptive statistical analyses aimed at documenting the landscape of ESD scholarship (e.g., growth trajectory, geographical distribution, types of research papers). Data in the master Excel file were subsequently uploaded into VOSviewer, a bibliometric software package used for science mapping [28]. Bibliometric analyses conducted in VOSviewer included author and document citation analysis, and author co-citation analysis.

Citation analysis has long been employed to identify prominent authors and documents within domains of knowledge [37]. Citation analyses, conducted in VOSviewer, computed the frequency with which authors and documents in the review database (i.e., the 1842 documents) had been cited in other Scopus documents. We refer to these as “Scopus citations” since the citations are limited to citations by documents covered in the Scopus index.

Author co-citation analysis was used to generate “co-citation counts” and to visualize the intellectual structure of the literature in a network map [29,37]. Author co-citation is the frequency with which two authors are cited together in the “reference lists” of documents in the review database [40]. A key differentiating feature of co-citation analysis is the source of citation data. Thus, unlike citation analysis, the results are not bounded by the scope of the source index (i.e., Scopus).

Co-citation analysis also has the ability to “visualize similarities” among authors. Small [40] proposed that when two authors are frequently cited together by other authors (i.e., co-cited), they tend to share an intellectual similarity. VOSviewer creates matrices of co-citation frequencies as the input for co-citation mapping and the “visualization of similarities” or VOS [28]. In this review, author

co-citation analysis was used to visualize relationships among frequently co-cited authors in the K-12 ESD knowledge base [28,37,41].

4. Results

In this section of the paper, we present our results. Findings are presented sequentially with respect to each of the research questions.

4.1. Topographical Landscape of the ESD Knowledge Base

The first research question focused on documenting the volume, growth trajectory, geographical distribution and types of papers comprising the ESD knowledge base. The 1842 Scopus-indexed documents consisted of 1408 journal articles, 203 book chapters, 195 conference papers, and 36 books. The journal articles were published in 397 different journals specializing in general education, environmental education, science education, geography, sustainability, and cultural studies (not tabled). For example, diverse journals publishing articles on ESD in K-12 schools included *Environmental Education Research*, *International Review of Education*, *Journal of Cleaner Production*, *International Journal of Early Childhood*, *Research in Science Education*, *Teaching Geography*, *BMC Public Health*, and *the International Journal of Engineering Education*. This breadth of journal foci suggests that the use of ESD in K-12 schools has attracted significant cross-disciplinary interest among scholars and practitioners.

As indicated in Figure 2, 31 Scopus-indexed ESD documents were published during the 1990s [42–44]. A trend of gradual growth in scholarly publication continued until 2005 when the launch of the UNDESD sparked a sudden increase in ESD publications (see Figure 2). During the UNDESD, 890 documents were published in Scopus-indexed sources. This growth trend has accelerated further in recent years with 688 documents published between 2015 and 2018.

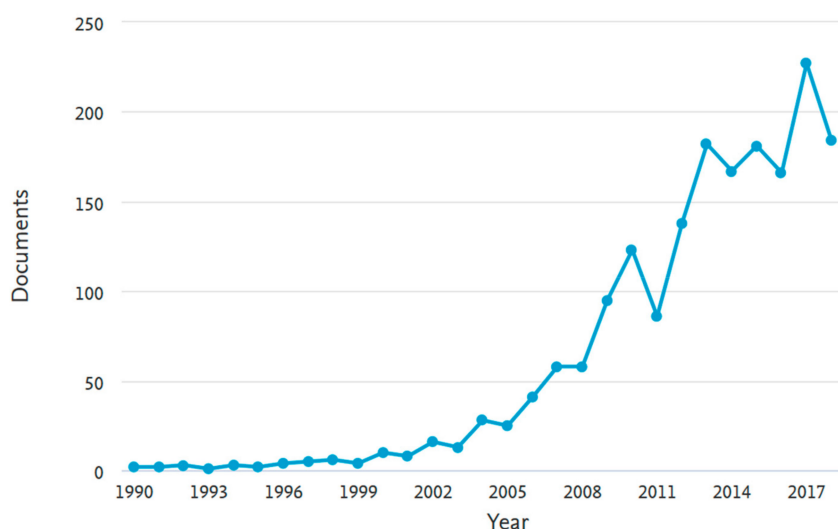


Figure 2. Growth trajectory of the literature on education for sustainable development in K-12 schooling, 1990–2018 ($n = 1842$).

Our next analyses examined the geographic distribution of the ESD literature. The heat map in Figure 3 shows that this is becoming a global literature. Nonetheless, authorship of publications on ESD has been concentrated in economically developed, Anglo-American-European societies. Leading contributors to the ESD knowledge base have come from the United Kingdom (272), United States (281), Australia (205), Sweden (122), Germany (119), and Canada (94), and Netherlands (72). In contrast, only 25% of these ESD documents were authored in developing societies. At the same time, we also observed an increasing proportion of studies coming from Asia (e.g., China, Japan, Malaysia, Hong Kong, India, Israel, Thailand, and Indonesia), Africa (e.g., South Africa, Nigeria, Kenya, and Tanzania),

and Latin America (e.g., Brazil) in recent years. Indeed, over 80% of the documents authored in developing societies were published since 2010.

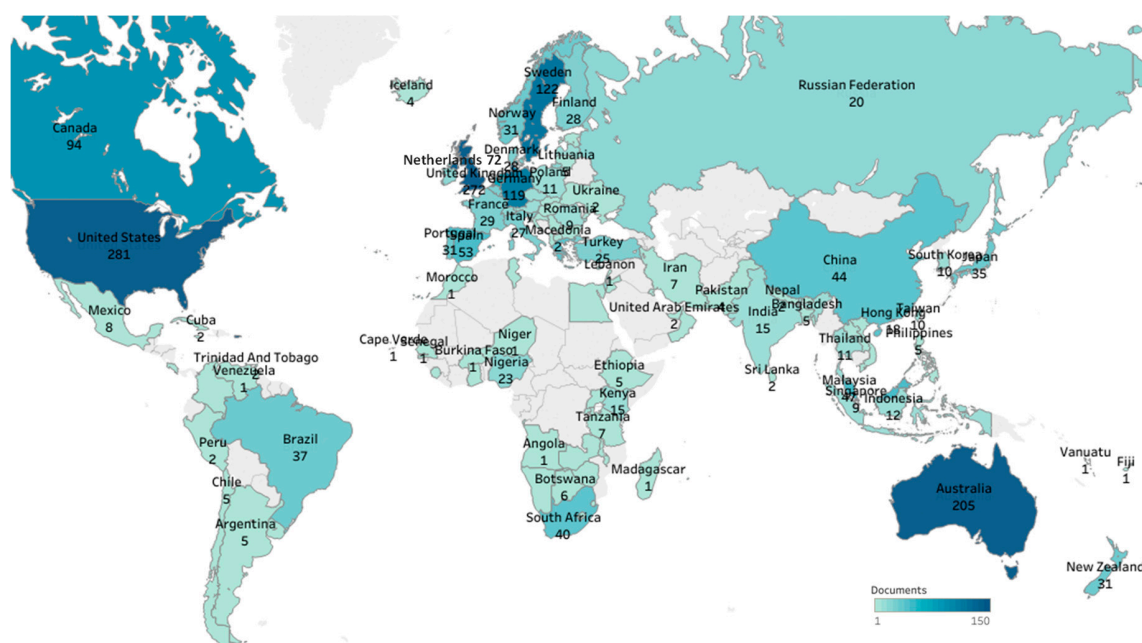


Figure 3. Global distribution of literature on education for sustainable development (ESD) in K-12 schools, 1990–2018 ($n = 1842$).

Next, we examined the “types of research papers” that comprise the ESD literature. Any scientific literature is comprised of a distribution of conceptual, commentary (i.e., critique, personal experience, prescriptive), empirical (data-based studies), and research review papers. Although there is no optimal distribution that applies to all literatures, the balance among these types of research papers can offer insight into the status of the current knowledge base and suggest implications for further development.

Given the large number of documents in our ESD database, we coded and analyzed a sample of papers rather than the full database. We used Cochrane's formula [45] to calculate the sample size of documents needed to obtain a 95% confidence interval. Then we randomly selected and coded 288 of the documents as one of the four types of documents specified above. We found that the Scopus-indexed ESD literature consisted of 43.9% commentaries, 37.1% empirical studies, 17.7% conceptual essays, and 1.3% reviews of research. This distribution suggested a surprisingly low proportion of empirical studies compared with other education literatures [46].

We conducted further analysis of the empirical studies in this sample of ESD research in order to identify the distribution of research methods employed in this literature. The results indicated a distinct preference for qualitative and descriptive quantitative research methods (i.e., tests showing mean and distributions). In total, only five percent of the full ESD corpus consisted of studies that used quantitative methods capable of testing hypotheses or assessing the impact of ESD programs, curricula, and teaching methods (not tabled). Notably, however, 71% of the studies that used inferential statistics were conducted in the last decade. This compared with none during the 1990s and 29% during the 2000s. While descriptive studies (i.e., qualitative and descriptive quantitative) have a useful place in any knowledge base, the advancement of knowledge also requires a critical mass of inferential studies that examine the effectiveness and impact of programs and practices [46,47].

4.2. Analysis of Influential Authors and Documents

The next analyses documented author contributions to the ESD knowledge base from the perspectives of “productivity” and “citation impact”. As indicated in Table 1, Wals (20), Kopnina (18),

Tilbury (14), Davis (14), Gericke (14), and Bögeholz (14) have been the leading contributors to this literature in terms of the number of authored papers in our review database. The most “influential scholars” in the ESD literature, measured by total Scopus citations, were Wals, Tilbury, Kopnina, Jickling, Sterling, Davis, and Öhman, each of whom achieved over 200 Scopus citations from their ESD publications (see Table 1). Consistent with the earlier geographical analysis, the 20 most highly-cited ESD authors all came from Anglo-American-European societies. None were associated with institutions in developing societies.

Table 1. Rank order of the 20 most cited authors publishing two or more documents on ESD in K-12 schools, 1990–2018.

Rank	Author	Nation	Focus	Documents	Scopus Citations	CPDs ¹
1	Dobson, A.	UK	Social/ESD	2	665	333
2	Hargeaves, A.	USA	ESD	5	588	118
3	Wals, A.	Netherlands	ESD	20	578	28.9
4	Tilbury, D.	UK	ESD	14	359	25.6
5	Kopnina, H.	Netherlands	Env. Education	18	317	17.6
6	Jickling, B.	Canada	Env. Education	6	314	52.3
7	Sterling, S.	UK	ESD	10	292	29.2
8	Davis, J.	Australia	Env. Education /ESD	14	230	16.4
9	Öhman, J.	Sweden	Env. Education	10	230	23.0
10	Scott, W.	UK	ESD	8	183	22.9
11	Eilks, I.	Germany	Science Education	12	180	15.0
12	Bögeholz, S.	Germany	Science Education	14	161	11.5
13	Gericke, N.	Sweden	Science, ESD	14	156	11.1
14	Gough, A.	Australia	Env. Education/ESD	10	131	13.1
15	Burmeister, M.	Germany	Science ESD	6	131	21.8
16	Schnack, K.	Denmark	Education	2	128	64.0
17	Jacobson, S.	USA	Env. Education	2	127	64
18	Rauch, F.	Austria	ESD	6	119	19.8
19	Dillon, J.	UK	Education	4	107	26.8
20	Reid, A.	Australia	Env. Education	9	106	11.8

¹ CPDs—citations per document.

Next, we turned to citation analysis of documents to ascertain the most influential research papers in the K-12 ESD literature (see Table 2). First, we noted that even among the 20 most frequently cited documents, the magnitude of Scopus citations was relatively low. This suggests that this literature has yet to gain a wider impact. Second, the highly-cited documents in Table 2 are again dominated by Anglo-European scholars. Third, although the highly-cited documents reflect the roots of ESD in environmental education [33,44,48,49], they also include other foci encompassed in our conceptual definition of ESD. These include general school education [44], health education [3,4], as well as specialized subjects such as science and citizenship education [50].

Finally, we noted that conceptual papers dominate this list. Only three of the papers in Table 2 were empirical studies and none were reviews of research. This was surprising since research reviews often dominate lists of highly-cited documents in bibliometric reviews. The paucity of research reviews is likely related to the relatively low number of empirical studies. Without a critical mass of empirical research, scholars there is only a limited basis for research reviews.

Table 2. Rank order of the 20 most highly-cited K-12 ESD documents, 1990–2018.

Rank	Document	Nation	Topic	Type ²	Scopus Citations ¹
1	Dobson. (2003). Social justice and environmental sustainability: Ne’er the twain shall meet. [18]	UK	Citizen	Con	522
2	Hargreaves and Shirley. (2009). The fourth way: The inspiring future for educational change. [51]	USA	Change	Con	250
3	Keesstra. (2016). The significance of soils and soil science towards realization of UN SDGs. [52]	NETH	Science	Com	250
4	Hargreaves and Goodson. (2006). Educational change over time? [17]	USA	Change, ESD	Emp	189
5	Tilbury. (1995). Environmental education for sustainability. [44]	UK	Env Ed	Con	177
6	Jickling and Wals. (2008). Globalization and environmental education [33]	CAN	Env Ed	Con	176
7	Wals. (2007). Learning in a changing world and changing in a learning world. [53]	NETH	ESD	Con	151
8	Dobson. (2007). Environmental citizenship: towards sustainable development. [54]	UK	Env Ed	Con	143
9	Jacobson et al. (2007). Conservation education and outreach techniques. [48]	USA	Env Ed	Com	126
10	Gough and Scott. (2003). Sustainable development and learning. [25]	UK	ESD	Con	119
11	Hoelscher et al. (2004). School-based health education programs can be maintained over time. [4]	USA	Health	Emp	115
12	Mogensen and Schnack. (2010). The action competence approach and the “new” discourses of ESD. [55]	DEN	Env Ed	Con	105
13	Jickling. (1992). Why I don’t want my children to be educated for sustainable development. [56]	CAN	ESD	Com	102
14	Hargreaves and Fink. (2004). The seven principles of sustainable leadership. [57]	USA	ESD	Con	101
15	Barry et al. (2013). A systematic review of effectiveness of mental health interventions for young children. [3]	IRE	Health	Rev	100
16	Kopnina. (2012). ESD: The turn away from “environment” in environmental education? [49]	NETH	Env Ed	Emp	99
17	Oulton et al. (2004). Controversial issues—teachers’ attitudes and practices in citizenship education. [50]	UK	Citizen Ed	Com	95
18	Dale and Newman. (2005). Sustainable development, education and literacy. [58]	CAN	ESD	Con	94
19	Sterling, S. (2010). Learning for resilience, or the resilient learner? [59]	UK	Env	Con	82
20	Burmeister et al. (2012). Education for Sustainable Development (ESD) and chemistry education. [60]	GERM	Science	Con	70

¹ SCOPUS citations at the time we conducted the review. ² Type of document: con—conceptual, com—commentary, emp—empirical, rev—review.

4.3. Intellectual Structure of the ESD Knowledge Base

Our third research question sought to illuminate the intellectual structure underlying published ESD theory and research. Using a threshold of 50 co-citations, VOSviewer generated a co-citation

map that displays the 94 most frequently “co-cited authors” in the ESD literature (see Figure 4). Size of the author “nodes” on the co-citation map in Figure 4 reflects the magnitude of author citations in the reference lists of the review documents. Proximity of author nodes indicates the frequency of co-citation and, therefore, the degree of intellectual affiliation between authors. The colored clusters of authors represent the conceptual pillars or “schools of thought” that make up the ESD knowledge base [29,37].

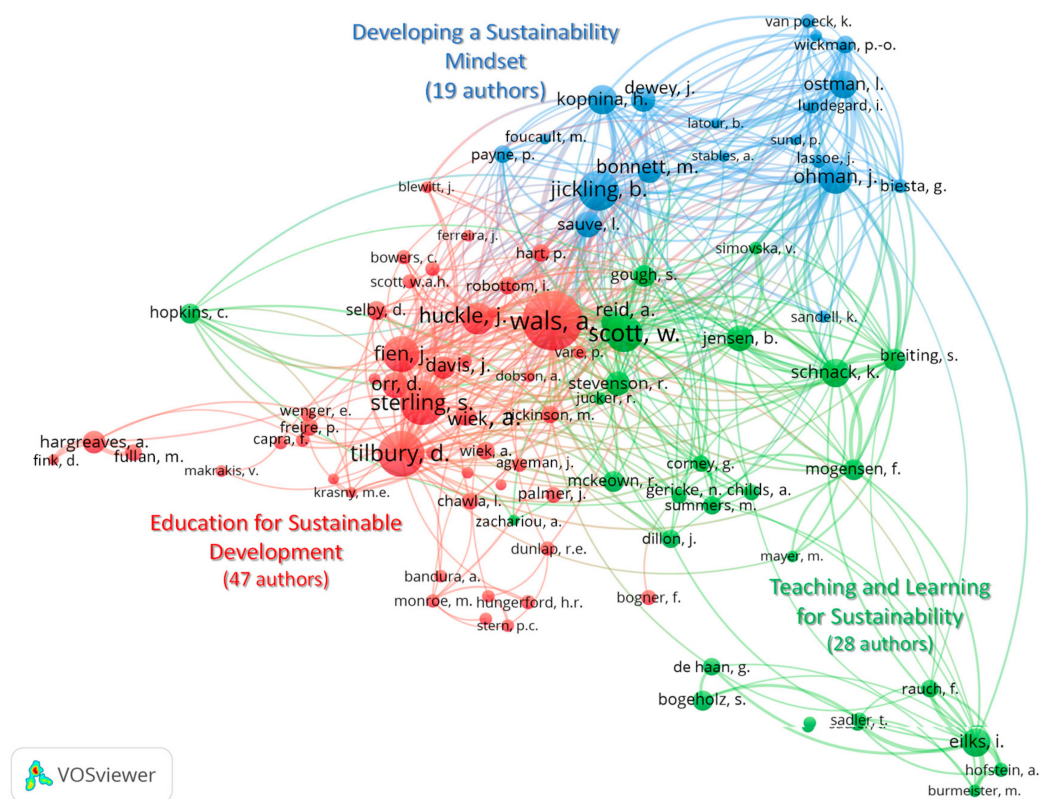


Figure 4. Author co-citation map showing the key authors and schools of thought in the literature on education for sustainable development (author co-citation network; 53,696 authors; threshold of 50 citations; display 94 authors; 3 clusters; 3622 links).

The co-citation map in Figure 4 shows three distinctive, but interconnected “schools of thought” in the ESD knowledge base: Education for Sustainable Development, Teaching and Learning for Sustainability, and Developing a Sustainability Mindset. As indicated on the map, these schools vary in terms of the number of scholars, author dispersion, author prominence, and density of links among authors both within and between clusters.

The red cluster represents a school of authors who have written broadly on Education for Sustainable Development. Not only is this the largest school within the ESD knowledge base, but it also contains several of the most frequently co-cited authors in this literature (i.e., Wals, Tilbury, Sterling, Huckle, Scott, Fien, Reid). Its “central location” on the map suggests that this school is the “conceptual anchor” of the ESD literature. This is reflected in publications that have offered definitions of education for sustainable development [25,43,44,59,61], and charted its evolution [1,30].

The central location of Wals, Scott, and Reid on the map and the density of their cross-cluster linkages highlight their role as “boundary spanning scholars” who have integrated conceptual contributions across all three of the schools. A small sub-school in the left-hand region of the school consists of scholars who have focused on leadership and change for ESD (i.e., Hargreaves, Fullan, Fink) [16,17,51,57].

The green cluster is comprised of scholars who have focused on “Teaching and Learning for Sustainability”. It is interesting to note that most of the empirical papers in this sub-school were

qualitative or quantitative-descriptive studies. Relatively few empirical studies have examined the impact or effectiveness of different ESD curriculum, teaching, and learning methods. As suggested by the dispersion of authors within this school, this school is comprised of three sub-clusters which reflect discrete but related lines of inquiry.

The first line of inquiry has examined how teachers organize the curriculum in teaching for sustainability and overcome obstacles to integrating ESD into their classrooms [36,60,62]. This sub-school includes studies of teacher and student knowledge and attitudes as well as alternative approaches to curriculum design and teaching and learning methods [48,63–65]. Again, as noted above, this line of inquiry is dominated by descriptive and prescriptive papers, with a lack of strong evaluative research that offers insights into the efficacy of different approaches to teaching and learning for sustainability [13,24,26].

A second sub-school concerns the preparation and training of teachers with the knowledge and attitudes needed to teach sustainability content [66–69]. Research conducted within this sub-school has theorized on the ESD-related competencies needed by teachers [69], explored different models of teacher education for sustainability [21,67], and examined the efficacy of teacher education programs focusing on sustainability [19,68]. This research finds that the whole school, action research, and adaptation models have gained the greatest acceptance [19–21,67].

The third sub-school consists of scholars who have developed “action competence” as a focus for ESD in K-12 education. The key scholars representing this sub-school include Jensen, Mogensen, Breiting, and Schnack. Jensen and Schnack defined action competence as education that, “builds up students’ abilities to act—their action competence—with reference to environmental concerns” [70]. Rather than seeing the goal of ESD as only changing individual behavior, proponents of this school highlight the goal of enabling students (citizens) to change structural features of society that cause environmental and social problems that threaten sustainability [55,70–72].

The blue cluster represents a school of thought focused on Developing a Sustainability Mindset. Led by Jickling, Kopnina, Öhman, Bonnett, Dewey, Ostman, and Wickman, this school emphasizes the social, ethical, political, and moral dimensions of ESD [5,7,61,73,74]. The genesis of this cluster can be traced to the research of scholars such as Jickling and Kopnina on environmental education [26,49,56,75,76]. Authors writing in this school view the goal of ESD as creating a consciousness or mindset among learners that will overcome taught biases and inform future decision-making in their lives [77]. Although none of his writings were included in our database, John Dewey’s location in this cluster highlights his influence on the scholars in this school. More specifically, Dewey’s conceptions of education for democracy [78] and experiential learning [79] have shaped this school’s conceptualizations of ESD.

5. Discussion

This systematic review of research sought to document and synthesize research trends in the knowledge base on education for sustainable development in K-12 schooling. The review used science mapping to examine 1842 Scopus-indexed documents published over the past 30 years. In this closing section, we highlight the limitations of the review, interpret the main findings, and discuss implications for future research.

5.1. Limitations of the Review

We reiterate that bibliometric analysis does not focus on substantive findings reported by documents. Rather this method was used to document and analyze trends in ESD knowledge production. Therefore, this review did not synthesize the results of ESD studies.

Another limitation arises from our decision to limit the review to sources included in the Scopus database. This impacted the validity of the review in two specific ways. First, while Scopus offers broad coverage of peer-reviewed journals, it is less comprehensive in its coverage of books, book chapters, and conference reports. Second, the review’s focus on English language sources meant that documents

published in other languages were not included in our analysis of the literature (e.g., Chinese, French, Spanish, Portuguese, Malay). This is a potentially significant limitation in light of the finding that the reviewed literature was heavily weighted towards documents authored in developed Western countries. Readers should interpret our results with these limitations in mind.

5.2. Interpretation of the Findings

The review identified a moderately sized corpus comprised of 1842 Scopus-indexed, ESD-related documents published between 1990 and 2018. The recent growth trajectory in ESD scholarship has been one of rapid ascent suggesting that it is a literature of recent vintage. The roots of this literature in environmental education were apparent in early ESD documents published during the 1990s. Nonetheless, as the ESD literature grew during the 2000s, it attracted scholars from more diverse fields such as health education [3], science education [80], and inclusive education [49]. This evolution is consistent with trends in the broader literature on sustainable development whereby scholars increasingly focus on social as well as environmental concerns [27,41,81].

The data presented in this review suggest that ESD is gaining interest among a global community of scholars. This is due, in part, to the efforts of international organizations (e.g., United Nations, UNESCO, OECD). At the same time, however, we found that the ESD literature is concentrated in Anglo-American-European societies. This finding was affirmed in both geographical and citation analyses. For example, we found that only 25% of the ESD literature was authored in developing societies and no highly-cited authors or documents came from a developing society (see Table 1 Table 2). European scholars have generally led the way in the development of discourse on ESD.

This geographical imbalance in the ESD literature is problematic for several reasons. First, international assessments have concluded that sustainability challenges will have the most severe effects in developing societies [34,82]. The lack of information on how educational content, processes, and systems can be adapted to support sustainability solutions in developing societies places them at a disadvantage. This problem is exacerbated by the observation that “interpretations” of ESD and related “solutions” sourced from developed societies (e.g., Sweden, Germany, UK, USA, Australia) may not always “fit” or be deemed practical in developing societies [83,84]. Cultural values, institutional policies, and financial resources cohere to create a “different context” for addressing sustainability challenges in developing societies [84–86].

Cross-national experience gleaned from developed societies is of course relevant. However, the need to contextualize policies and practices highlights an urgent need for greater diversification of the ESD knowledge base. Indeed, the kinds of curriculum and instructional approaches adopted in Western societies do not always find a similar uptake in developing societies. Teacher and student attitudes towards novel approaches to teaching and learning differ across cultures [87].

We also found that the ESD knowledge base appears overly weighted towards prescriptive commentaries and descriptive research. While we are not advocates for “blind empiricism”, a mature knowledge base requires a critical mass of research that examines problems empirically, tests the utility of prescriptions, and validates theories. Thus, we conclude that the next generation of ESD literature needs more empirical research that describes and analyzes ESD implementation in diverse contexts. Although continuing conceptual critiques of developments in ESD are warranted, the field urgently needs research that offers insights into patterns of curricular and instructional practice and their efficacy in achieving the goals of ESD. This will require a critical mass of qualitative, mixed methods, and more sophisticated quantitative studies using a wider variety of research designs.

Based on a combination of productivity, citation and co-citation analyses, the review identified Arjen Wals, Bob Jickling, Daniella Tilbury, Helen Kopnina, Stephen Sterling, William Scott, and Johann Öhman as the most influential scholars in the emergent ESD literature. Author co-citation analysis further identified John Dewey’s scholarship on democratic and experiential education as foundation stones in the ESD literature. Quite correctly, in 2011 Armstrong posited that ESD is the next chapter in the evolution of progressive education launched by Dewey a century ago [88].

Document citation analyses documented the roots of ESD in environmental education, as well as its gradual expansion into related fields of public health, science, geography, special education, and early childhood education. These analyses further identified seminal papers in this field. These included the Brundtland Report [10] as well as conceptual papers authored by Jickling and Wals [33], Jensen and Schnack [70], and Bonnett [73].

Our final analyses sought to illuminate the “intellectual structure” of the ESD knowledge base [29,37]. We found that the ESD knowledge base is comprised of three schools of thought of varying size and impact. The largest and most influential school is comprised of a constellation of scholars who have focused on defining and critiquing Education for Sustainable Development. Other schools of thought have focused on Developing a Sustainability Mindset and Teaching and Learning for Sustainable Development. These schools of thought, self-organized by the contributing scholars, were identified inductively through author co-citation analysis. These empirically derived findings complement trends reported in previous reviews of the ESD literature that used traditional methods of research synthesis [2,11,15,62,89].

5.3. Conclusions

In conclusion, this review offers several recommendations. The “geographical imbalance” documented in this literature argues for measures that both stimulate and prioritize ESD research from developing societies. Measures designed to stimulate research on ESD in developing societies could, for example, take the form of research grants programs launched by foundations (e.g., Ford Foundation, Asia Foundation) and international organizations (e.g., OECD, World Bank, UNESCO). Capacity-building strategies aimed at scholars in developing societies could include post-doctoral fellowships as well as the formation of research centers and networks that explicitly prioritize and support scholarships and capacity development among scholars in developing societies. Journals may also wish to more actively capture and highlight research on ESD in developing societies through special issues. These practical steps represent stepping stones towards a more diverse global knowledge base in ESD.

A second implication follows from the lack of a critical mass of empirical research in the ESD knowledge base. Although conceptual and commentary papers form an essential portion of any “mature” knowledge base, at some point, both policymakers and practitioners also need guidance on “what works”; when, how, and under what conditions. This must be addressed in the coming years. Otherwise, this field will be in danger of being dismissed as an academic wonderland of critique and prescription divorced from practice in schools.

Third, findings arising from citation analyses offer useful information for scholars working in this emerging field. For example, the author and document citation analyses could be used to generate an initial “reading list” for new scholars. This would reduce the start-up time required for scholars entering this field of education research. Similarly, the schools of thought identified through author co-citation analysis highlight the influential conceptual streams of inquiry that have emerged in this field of sustainability scholarship.

Finally, as noted earlier, this review was limited to the English language literature on ESD. As such, it offers an incomplete picture of global ESD scholarship. This review should, therefore, be complemented by future efforts to capture and disseminate findings reported in literature published in other languages.

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