



In Search of Transformative Learning for Sustainable Development: Bibliometric Analysis of Recent Scientific Production

Mercedes Varela-Losada^{1*}, Uxío Pérez-Rodríguez¹, María A. Lorenzo-Rial¹ and Pedro Vega-Marcote²

¹ Faculty of Education and Sport Sciences, University of Vigo, Pontevedra, Spain, ² Faculty of Education Sciences, University of A Coruña, A Coruña, Spain

OPEN ACCESS

Edited by:

Mahmoud Maqableh,
The University of Jordan, Jordan

Reviewed by:

Gareth Joakim Davies,
The Open University, United Kingdom
Elisabete dos Santos Freire,
Universidade São Judas Tadeu, Brazil
Sónia Rolland Sobral,
Portugalense University, Portugal

*Correspondence:

Mercedes Varela-Losada
mercedesvarela@uvigo.es

Specialty section:

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

Received: 30 September 2021

Accepted: 13 April 2022

Published: 06 May 2022

Citation:

Varela-Losada M,
Pérez-Rodríguez U, Lorenzo-Rial MA
and Vega-Marcote P (2022) In Search
of Transformative Learning
for Sustainable Development:
Bibliometric Analysis of Recent
Scientific Production.
Front. Educ. 7:786560.
doi: 10.3389/educ.2022.786560

Transformative learning is a key element when it comes to making progress toward sustainable development. This goal requires an education that fosters the empowerment of people and the transformation of institutions, prepares for the necessary changes, facilitates resilience and encourages sustainable actions. The aim of this paper is to review the academic production on transformative learning in relation to the pursuit of sustainable development. To do so, a bibliometric analysis was conducted of the publications included in the Scopus databases for the 2003–2020 period, in order to explore its evolution, identify the main themes of which the field of knowledge is composed, and identify its main references and the network of collaborations between researchers and universities worldwide. During this period, scientific production has increased considerably, with a particular focus on adult education and competency development. At the same time, English-speaking dominance and the prevalence of Western origin has been observed. There is a need for more global, connected, and pluralistic research that is focused on diverse sociocultural contexts, research that factors in inequality and environmental justice and which calls into question the current socioeconomic model. A debate should also be started on which means of publication are the most appropriate for defending the quest for sustainability.

Keywords: bibliometric mapping, transformative learning, sustainability education, review, educational research

INTRODUCTION

The quest for development is the main challenge we must face today, as reflected in the consequences we are already experiencing as a result of climate change and the loss of sustainable biodiversity that has unfolded into a global pandemic (IPCC, 2019; Platto et al., 2021). This major environmental and humanitarian crisis comes at a great cost to ecosystems, the planet's resources, the climate and people (IPCC, 2022; Worldwatch Institute, 2017). In addition to this, there are inequalities between countries and between different social strata (Stiglitz, 2015).

The IPCC's sixth report already blames humans directly for severe global warming, warning of the need to take urgent action (IPCC, 2022). Thus, moving toward more sustainable societies involves a profound change in our lifestyles and in the socioeconomic model that drives them

(Jackson, 2016; Balsiger et al., 2017; Chomsky et al., 2020), which is already being encouraged by the United Nations through the 2030 Agenda for Sustainable Development (United Nations, 2015).

In this transition, education is a key element as an enabler in many areas related to the pursuit of sustainability (Vladimirova and Blanc, 2015), driving solutions to turn our destructive and divisive societies into ecologically resilient, socially just and economically viable ones (Burns, 2018). In a world increasingly dominated by neoliberal policies and consumerism, where inequalities and environmental damage are increasing (IPCC, 2022; Kopnina and Cherniak, 2016; UNDP, 2019), this ambitious goal requires an education that empowers people, who must strive to recover a notion of autonomous and critical citizenship, capable of making decisions that break with current patterns.

It seems natural, then, that education for sustainability has looked to transformative learning as a way to redirect approaches to learning, since, as Thomas (2009) highlights, there are strong connections between the two. In order to make the necessary transition, it is essential to begin by encouraging a major process of reflection which, as proposed by Mezirow (2003), the father of transformative pedagogy, encourages a change of the ways in which we interpret our experiences. This learning occurs when people critically examine their habitual expectations, review them, and act according to the new point of view (Cranton, 2016).

Within this framework, civic empowerment and the development of sustainable competencies require pedagogical approaches that focus on learning processes more so than on the accumulation of knowledge, in order to educate people with capacities for participation, adaptation, innovation, creativity, and resilience through skills such as critical and holistic thinking, problem solving, and teamwork (Thomas, 2009; UNESCO, 2015). Education that deals only with cognitive knowledge is not enough; the affective, attitudinal and actional component must also be considered, making it possible to bring to light unconsciously assumed patterns of action, values, and attitudes. This approach to learning must be based on a systemic and critical perspective on the prevailing socioeconomic models and current ways of living (Varela-Losada et al., 2016). People in complex situations must be encouraged to explore new ideas and approaches and to participate in sociopolitical processes, with the aim of progressively moving their communities toward sustainable development (Rieckmann, 2018).

It should not be forgotten, therefore, that while transformative learning is often presented as a form of individual change, transformation toward sustainable development clearly requires societal change (Balsiger et al., 2017). Some authors even go beyond human and social transformation and speak of the search for new, intimate, interconnected, and reciprocal relationships between humans and the living planet (Burns, 2018). Hence, change must start from collective and organizational learning, from reflection and the questioning of frames of reference, paying particular attention to the social and political context in order to break with unsustainable practices and institutions anchored by power (Boström et al., 2018).

The quest for sustainability must, essentially, be based on the transformation of people's values, beliefs and behaviors,

which is why research in social sciences and in education are key factors (UNESCO, 2013). Thus, it is necessary to study how education can promote sustainable development, especially through transformative learning.

Research on Transformative Learning Within the Context of Sustainable Development

Interest in the pursuit of sustainability in education has been growing in recent years, as has the publication of multiple reviews of the literature. Some of them are focused on education regarding specific environmental problems, such as conservation education (Ardoin et al., 2020) or climate change education (Monroe et al., 2019). However, studies with a more general focus on education for sustainable development have also been published (Gusmão Caiado et al., 2018; Martins et al., 2019), from a higher education context (Wu and Shen, 2016) or from lower levels of education (Ardoin et al., 2018).

Similarly, interesting reviews of the literature have emerged that make significant contributions to the field of transformative learning for sustainability (TLS). Thus, the recent review by Chen and Liu (2020) focused on systematically analyzing the studies that used the concept of action competence as the instructional approach. Their findings highlight the importance of working with authentic contexts on interdisciplinary topics and point out how the reviewed studies indicate that action-oriented pedagogy and transformative pedagogy cultivate students who

TABLE 1 | Summary of the main information of the dataset analyzed.

Description	Results
Timespan	2003:2020
Sources (journals, books, etc.)	57
Documents	129
Average years from publication	5.36
Average citations per documents	26.71
Average citations per year per doc	3.175
References	7,706
Document types	
Article	124
Review	5
Document contents	
Keywords plus (ID)	202
Authors' keywords (DE)	405
Authors	
Authors	305
Author appearances	343
Authors of single-authored documents	34
Authors of multi-authored documents	271
Authors collaboration	
Single-authored documents	38
Documents per author	0.423
Authors per document	2.36
Co-authors per documents	2.66
Collaboration index	2.98

are active participants, enhance their ability to deliberate on causes and effects and build their visions in order to find strategies to solve problems. Additionally, the purpose of the review by Boström et al. (2018) was to contribute a theoretical approach to understanding the conditions and constraints of social change toward sustainable development. To this end, they conducted a critical review of the literature in the field of sustainable development learning from a transformative learning approach, integrating three additional dimensions: institutional structures, social practices, and conflict perspectives. In addition, Rodríguez-Aboytes and Barth (2020) researched how it has been conceptualized and operationalized in education for sustainable development and collected evidence on how to support transformative learning. This important review highlights how social learning, the role of experience, and the development of sustainability competences are inherent to transformative learning.

In this context, bibliometric studies also make significant contributions, as they provide insight into the state of a field of knowledge and the production patterns of countries and institutions, recognizing their strengths and supporting decisions that help overcome possible biases and limitations (Maz-Machado et al., 2020). Thus, analyses have been carried out

from a bibliometric point of view to find out more about research in education for sustainability (Hallinger and Chatpinyakoo, 2019; Prieto-Jiménez et al., 2021) and environmental education (Yanniris and Huang, 2018; Lopera-Perez et al., 2021).

Even so, it is necessary to continue to promote research that seeks sustainable development, especially by furthering the role of the social sciences and education (Boström et al., 2018). This is the framework for this research, which conducts a bibliometric analysis of publications since the beginning of the century in the area of TLS, in order to explore this field and supplement the literature reviews already carried out. This analysis will be used to determine its evolution, identify the main themes that articulate the field of knowledge, and recognize its main references and the network of collaborations between researchers and universities worldwide.

MATERIALS AND METHODS

In order to characterize the scientific literature on TLS, the metadata of the selected publications were analyzed and the bibliometric maps were constructed. This process was carried out in two phases:

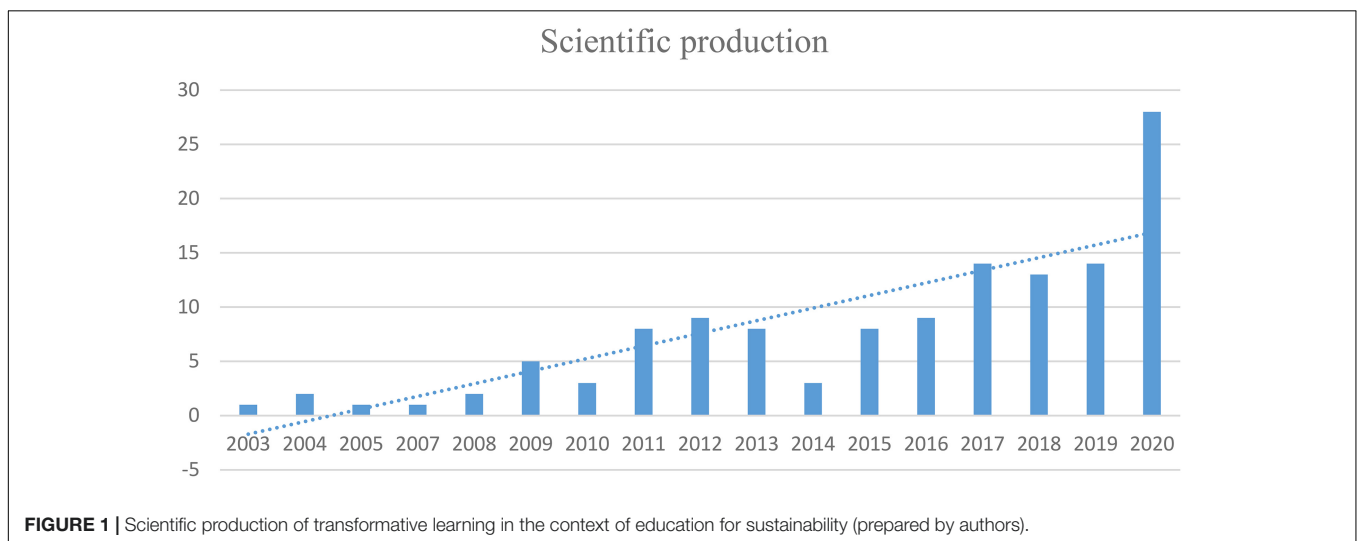


TABLE 2 | Most relevant sources and most local cited sources (prepared by authors).

Most relevant sources	No. of articles	Most local cited sources	No. of citations
Sustainability	16	Environmental Education Research	280
Journal of Transformative Education	11	International Journal of Sustainability in Higher Education	177
Environmental Education Research	10	Adult Education Quarterly	166
International Journal of Sustainability in Higher Education	10	Journal of Cleaner Production	142
Sustainability Science	7	Journal of Transformative Education	107
Adult Education Quarterly	5	Sustainability	63
Australian Journal of Environmental Education	5	Futures	53
Journal of Teacher Education for Sustainability	5		
International Review of Education	3		
Journal of Environmental Planning and Management	3		
Local Environment	3		

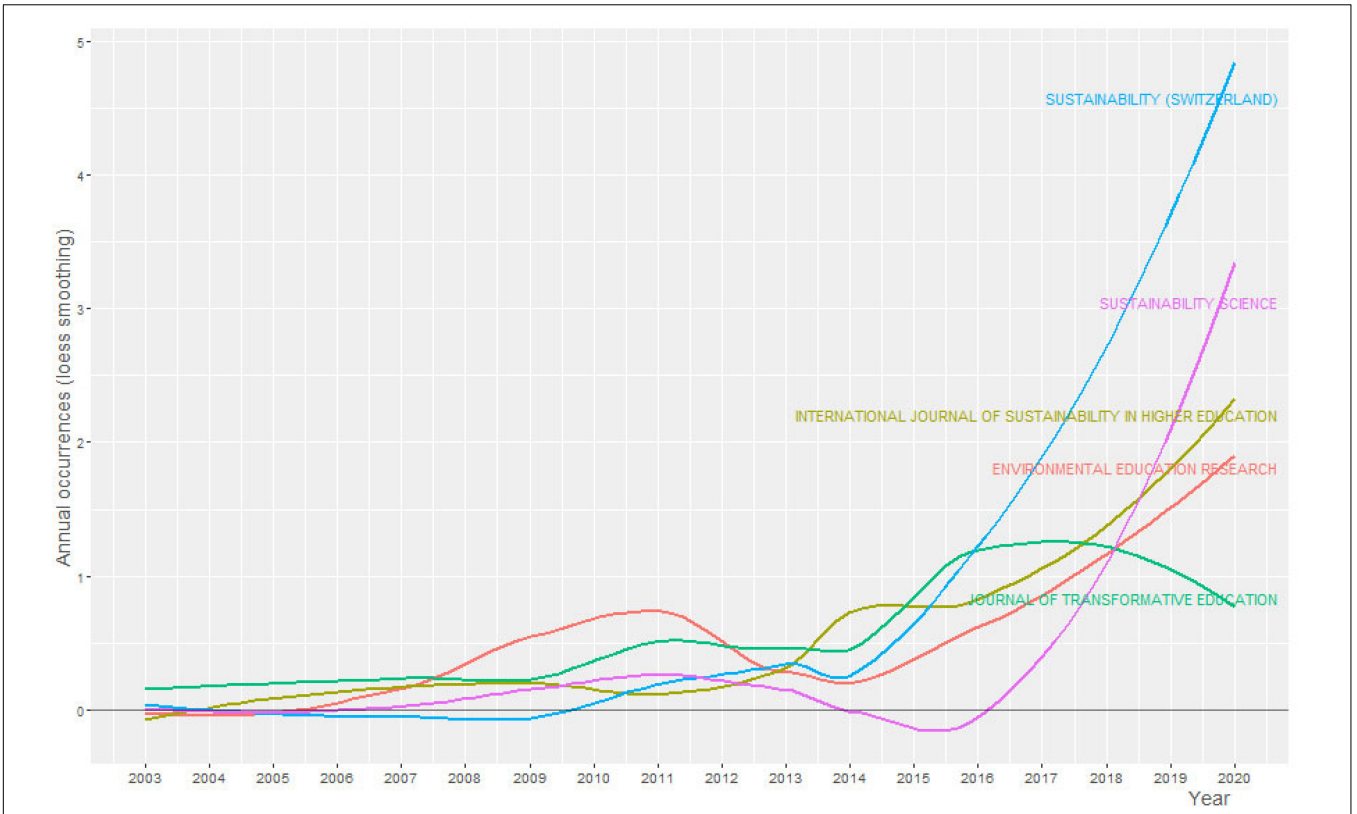


FIGURE 2 | Sources growth (prepared by authors).

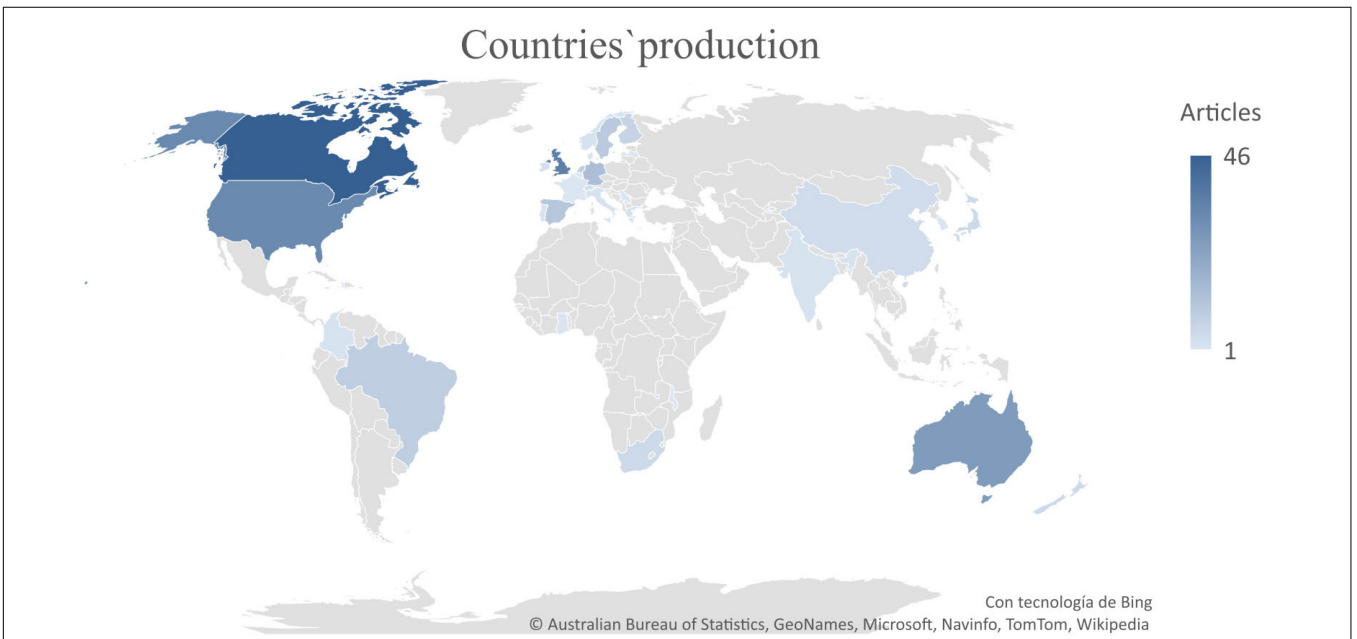


FIGURE 3 | Production by country (prepared by authors).

Search and Selection of Articles

Data were extracted through the Scopus database. This database provides extensive coverage of the broad variety of scientific journals that exist in the field (Mongeon and Paul-Hus, 2016). It has, therefore, been used in the literature as a source of bibliometric data for a large-scale analysis of research evaluations and research landscape studies (Baas et al., 2020; Kipper et al., 2020; Gao et al., 2021; Sobral, 2021). Furthermore, bibliometric research on databases confirms its value in citation tracking and citation analysis (Chadegani et al., 2013). Thus, this database was searched by selecting only *articles and reviews* in the social science arena. The following keywords were used as a search string: TITLE-BS-KEY “transformative learning” AND sustainability OR “sustainable development.” These keywords were selected because they should help identify articles with a significant focus on the topic of interest. As a time frame, articles published from 2003 to 2020 were selected (eliminating those with early access), taking as a starting reference the publication of Mezirow, which marked a milestone in the dissemination of transformative learning (Mezirow, 2003). The first selection was then refined by reading abstracts to select those related to the topic of interest. This resulted in a final sample of 129 documents, the main information on which is provided in **Table 1**.

Analysis and Bibliometric Mapping

The metadata characterizing the selected documents (titles, authors, affiliation, country of origin, keywords, references, and citations) were extracted through the Scopus platform. The R-package bibliometrix v. 4.0.3, which performs scientific mapping for large research streams, was used to analyze these metadata and their connections (Aria and Cuccurullo, 2017). In order to facilitate the compressibility of the information obtained, tables and graphs were created and processed using Microsoft Excel. R-package bibliometrix was also used to obtain, by means of co-occurrence analysis, the citation and keyword maps and the thematic evolution figures. VOSviewer v. 1.6.15 was also used to obtain the cartographies showing the cooperation networks and the maps of relationships between keywords, by means of cluster analysis.

RESULTS

Evolution of the Research on Transformative Learning for Sustainability

The scientific literature in this area of research has evolved significantly over the period studied, as can be seen in **Figure 1**. Interest in transformative learning in the context of education for sustainability has grown steadily over the last 2 decades, with a major increase in the year 2020, which has doubled the scientific output compared to previous years.

Main Sources

When focusing on the main sources of publication in this research area (see **Table 2**), of note are an interdisciplinary

journal (*Sustainability*) and a specialized journal in the research topic at hand (*Journal of Transformative Education*). Next are two journals focused on environmental education and education for sustainability (*Environmental Education Research* and *International Journal of Sustainability in Higher Education*). Looking at the same table, it is clear that these two sources are the ones that provide the most references to papers on transformative education for sustainability.

As can be seen in **Figure 2**, the exponential growth of interest in TLS in recent years in two interdisciplinary journals, *Sustainability* and *Sustainability Science*, is remarkable.

The Context of Scientific Production

Looking at **Figure 3**, it stands out that the countries with the highest scientific production on TLS are four English-speaking countries: Canada (with 46 articles), United Kingdom (35), United States (32), and Australia (26). Just after them are Germany (14), followed by Spain (11), Sweden (10), and Brazil (9).

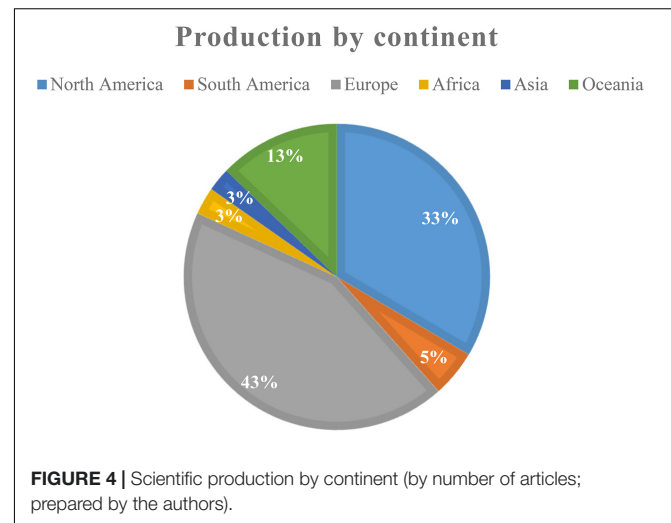


TABLE 3 | Main affiliations of published research.

Affiliations	Articles
University of Manitoba (Canada)	11
University of Saskatchewan (Canada)	7
Wageningen University (Netherlands)	7
University of Plymouth (United Kingdom)	6
Leuphana University of Luneburg (Germany)	5
California Polytechnic State University (United States)	4
RMIT University (Australia)	4
University of Helsinki (Finland)	4
Arizona State University (United States)	3
Athabasca University (Canada)	3
Deakin University (Australia)	3
Griffith University (Australia)	3
Örebro University (Sweden)	3
The Kings University (United Kingdom)	3

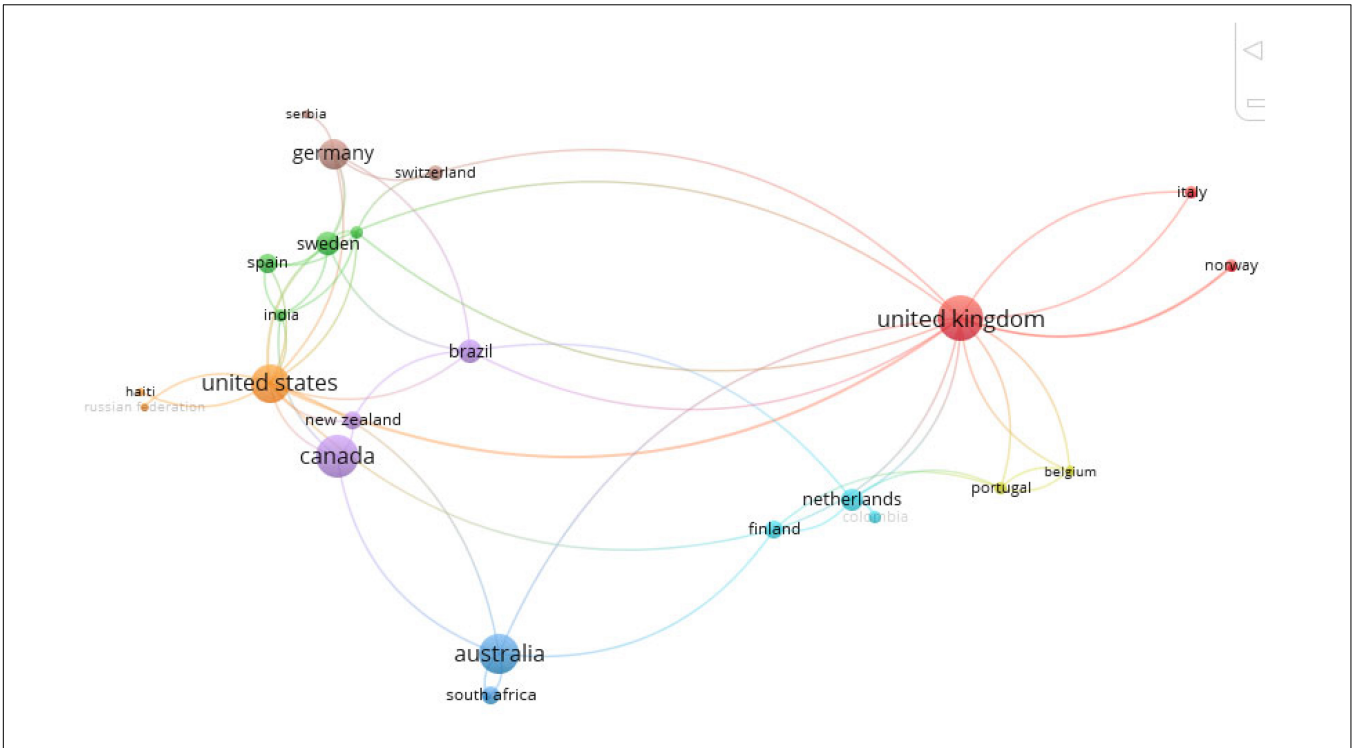


FIGURE 5 | Collaboration network (only the countries that show some collaboration in the publication of a document appear in the image; prepared by authors).

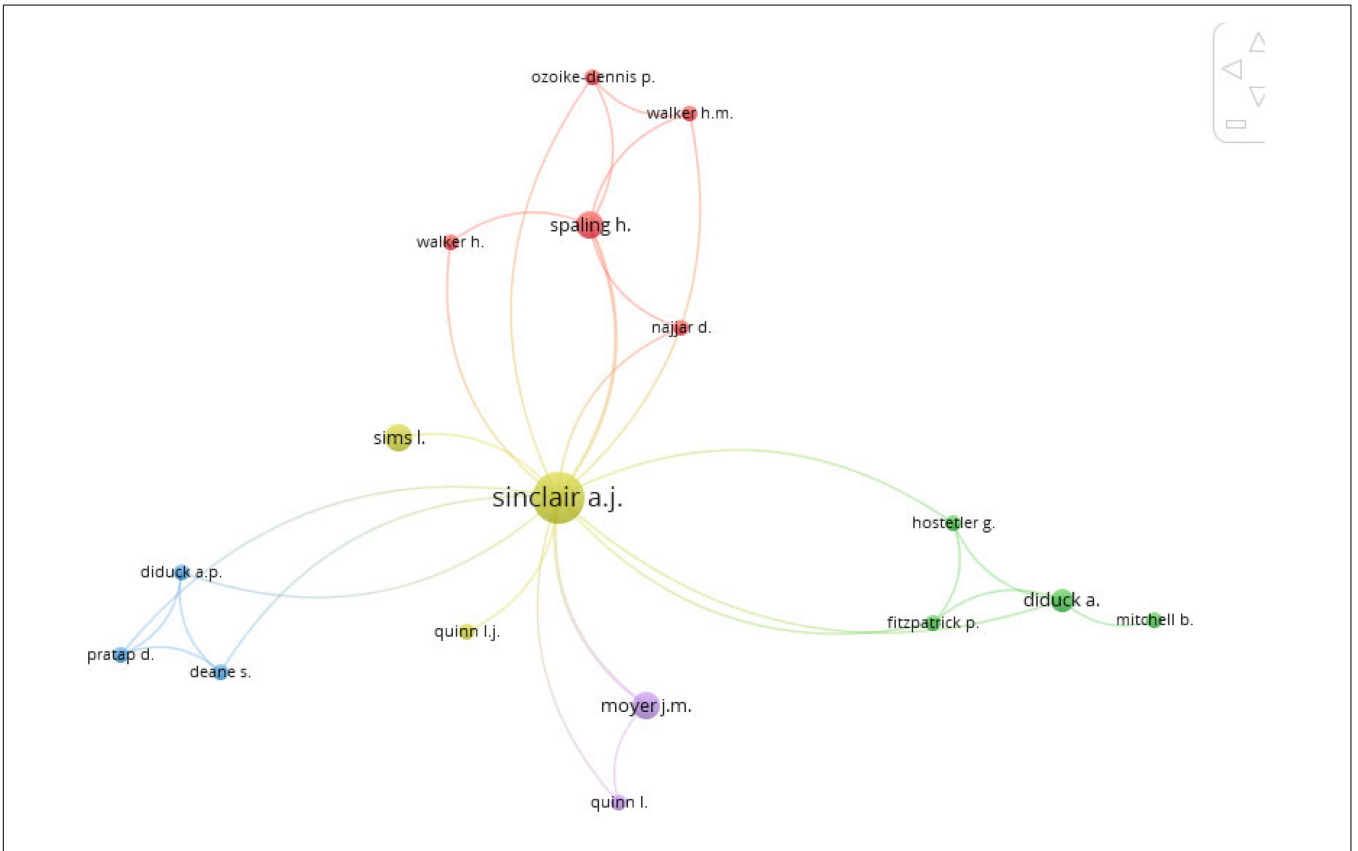


FIGURE 6 | Co-authorship network (only authors who collaborate in the publication of a document are shown in the image; prepared by authors).

Figure 4 also highlights the scientific production originating in the northern regions of the planet. Europe and North America account for more than 75% of the articles published in Scopus on the topic of interest.

It is also interesting to note the main universities that are researching transformative learning in the context of sustainable development (see **Table 3**). These include two Canadian universities (Manitoba and Saskatchewan), one from the Netherlands (Wageningen), and one from England (Plymouth). Once again, there is a lack of universities from countries classified by the United Nations as developing countries (United Nations, 2020).

Collaboration Network

Starting from the geographical context and looking at the map of collaborations in **Figure 5**, it stands out that the main nodes of cooperation are, again, in the four most productive English-speaking countries (United States, Australia, Canada, United Kingdom), although Germany, Brazil, and Sweden figure prominently.

Figure 6 also shows the co-authorship network (with at least one published paper), which shows a rather small number of collaborations. In the central hub, the role of A. J. Sinclair is notable.

Main References

The papers with the greatest impact can be seen in **Table 4**. Of note is the number of papers focusing on the study of TLS at the university level (Moore, 2005; Ferrer-Balas et al., 2008; Cotton et al., 2009; Thomas, 2009; Blake et al., 2013; Howlett et al., 2016). Another important point of interest is the creation of a framework for developing key sustainability competences (Wiek et al., 2011; Giangrande et al., 2019). Additionally, public participation in resource management is also a relevant issue (Diduck and Mitchell, 2003; Sims and Sinclair, 2008; Diduck et al., 2012, 2013). It is worth noting that two of the most frequently cited papers focus on transformative learning in relation to tourism (Coghlan and Gooch, 2011; Pritchard et al., 2011).

In **Figure 7**, on the most prolific authors, highlights the role of A. J. Sinclair, who has published ten articles in the period under review, sharing authorship with researchers of great impact such as Diduck and Sims, some of them with wide dissemination. In fact, he appears as a central hub in **Figure 6**, which shows the co-authorship network. Also relevant is the position of S. Sterling, who has published five articles in this period, one of which is on the list of papers with the greatest impact.

It is also interesting to see which are the most-cited authors locally (in the article selection itself). Here, J. Mezirow—the main promoter of transformative pedagogy—clearly stands out with more than 200 citations, as does S. Sterling, with 129. A. J. Wals, with 106, also plays an important role. Although the latter author does not appear on the list of documents in this selection of articles, he is one of the main references on social learning and higher education in the framework of sustainability.

TABLE 4 | Most-cited documents related to transformative learning for sustainability (TLS).

References	TC	TC per Year
Wiek et al., 2011	825	75
Pritchard et al., 2011	254	23.0909
Ferrer-Balas et al., 2008	191	13.6429
Thomas, 2009	166	12.7692
Sterling, 2010	152	12.6667
Moore, 2005	144	8.4706
Coghlan and Gooch, 2011	101	9.1818
Lange, 2004	95	5.2778
Cotton et al., 2009	94	7.2308
Brundiers and Wiek, 2011	87	7.9091
Diduck et al., 2012	60	6
Diduck and Mitchell, 2003	55	2.8947
Howlett et al., 2016	54	9
Diduck et al., 2013	49	5.4444
Percy-Smith and Burns, 2013	43	4.7778
Bell, 2016	41	6.8333
Sims and Sinclair, 2008	39	2.7857
Boström et al., 2018	36	9
Giangrande et al., 2019	35	11.6667
Blake et al., 2013	35	3.8889

Main Themes

Taking the keywords as a reference when analyzing the themes around TLS, different categories can be formed (see **Table 5**). There is a category closely related to the learning approach, where general terms such as transformative learning appear, but also more specific ones, such as critical reflection, social learning, and holistic education. There is also a category containing education-related terms such as Education for Sustainable Development or Higher Education. Additionally, there is a separate category related to sustainable development handling or policy, where terms such as sustainable development and public participation are placed. Lastly, there is a small, separate category containing keywords related to research, such as study abroad or action research.

Taking the keywords plus (keywords added by the databases automatically generated from the titles of the articles cited) as a reference, no significant new terms seem to be included, except in the category of sustainable development handling/policy, where more descriptive words such as local participation or community resource management do appear.

Figure 8 shows the keyword network, yields a similar depiction of the field of study. Thus, a main cluster can be observed with the most important elements that characterize transformative learning, such as transdisciplinarity, critical reflection, and social learning, and another fundamental cluster focused on sustainability, linked to terms such as environmental justice and social change.

In **Figure 9**, on the evolution of the trend topics in the last decade, the keywords related to research (action research, study abroad) were initially highlighted to then give relevance to topics related to adult education, such as public

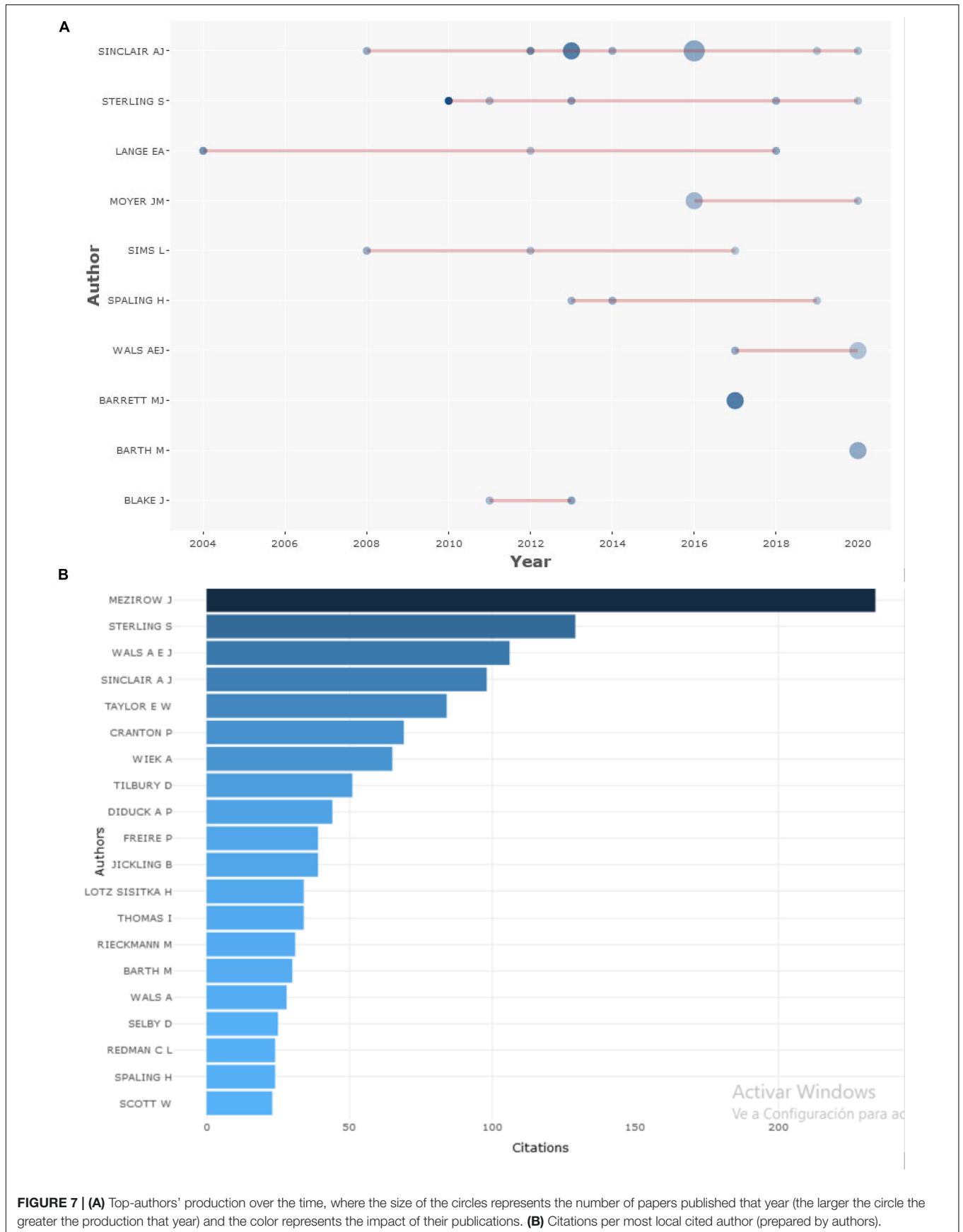


TABLE 5 | Main themes (Authors' keywords in gray and keywords plus in yellow).

Learning approach	Sustainable development handling/policy		Education		Research		
Transformative learning	76	Sustainable development	39	Education for sustainable development	40	Action research	3
Critical reflection	6	Kenya	5	Higher education	12	Learning outcomes	3
Social learning	5	Social change	4	Education	6	Study abroad	3
Transformative learning theory	5	Canada	3	Environmental education	6	Threshold concepts	3
Transformative pedagogy	5	Public participation	3	Learning	3	Academic research	3
Holistic education	3	Sustainable development	49	Teacher education	3	Action research	3
Transdisciplinarity	3	Local participation	6	Learning	35	Conceptual framework	3
Transgressive learning	3	Kenya	4	Education	11	Theoretical study	3
Participatory approach	7	Canada	3	Teaching	6		
Decision making	3	Climate change	3	Higher education	5		
		Community resource management	3	Student	4		
		Environmental management	3	Educational development	3		
		Social change	3	Environmental education	3		
		United Nations	3	Knowledge	3		

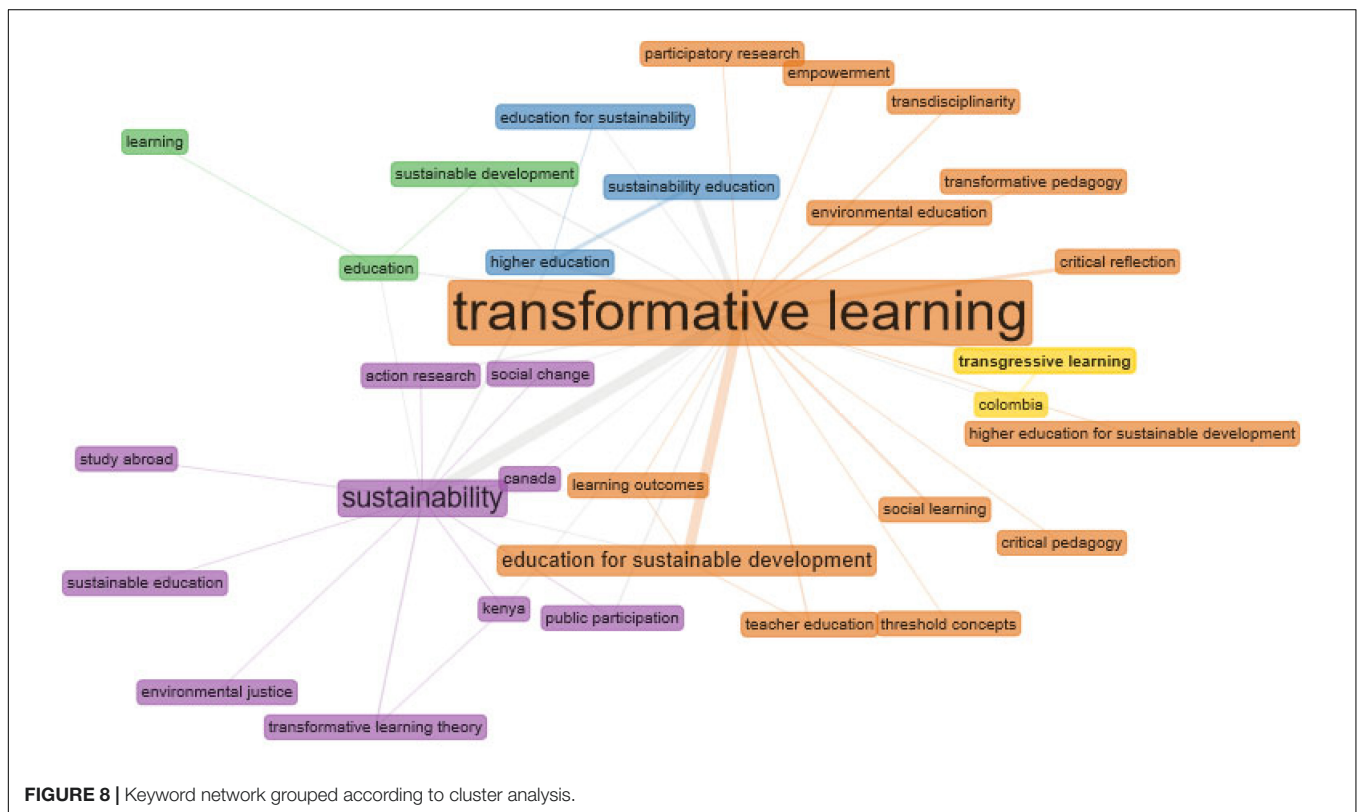


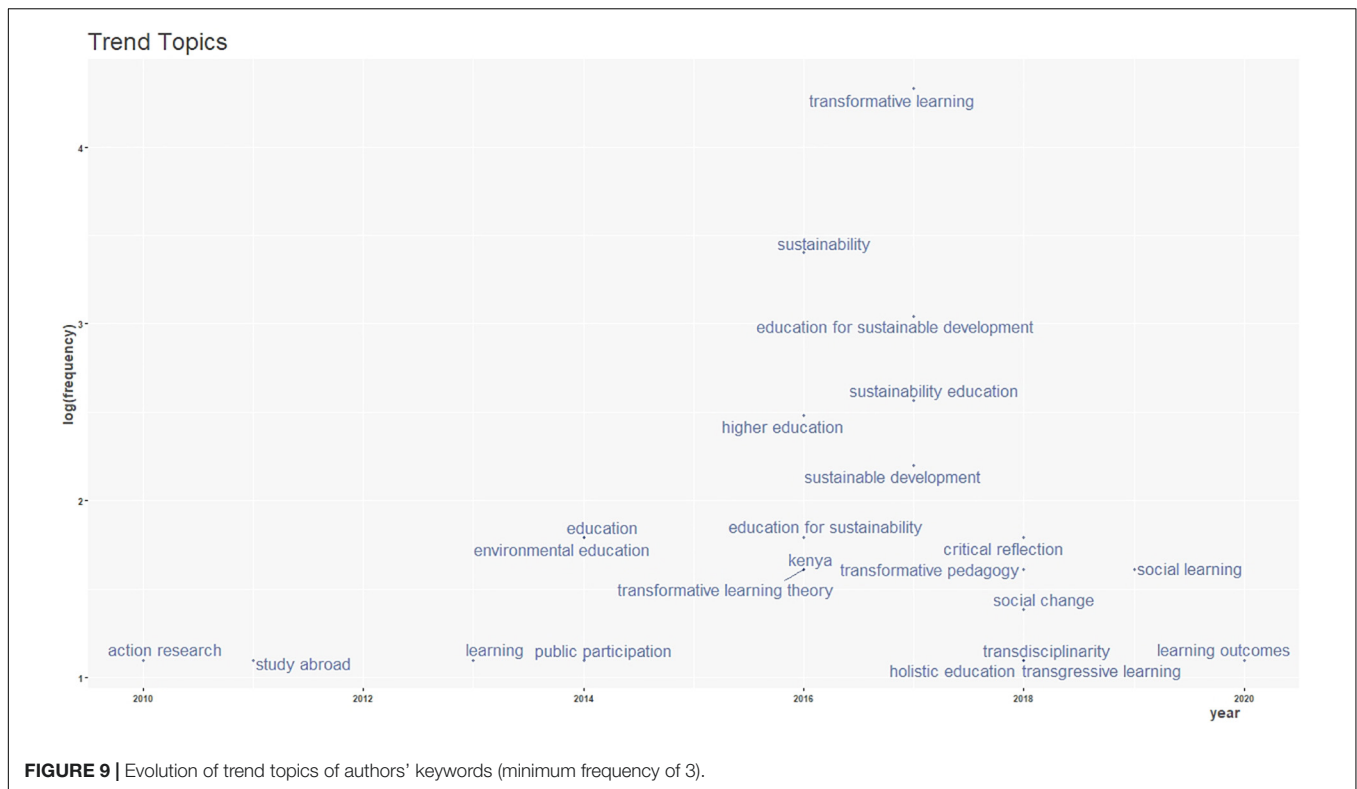
FIGURE 8 | Keyword network grouped according to cluster analysis.

participation and higher education. In the last section, where there is already a considerable increase in scientific production (see **Figure 1**), there is a greater variety of terms, such as social change, transgressive learning, holistic education, and transdisciplinarity, all related to innovative educational trends in transformative learning.

DISCUSSION

Transformative learning has become an element of growing interest in the quest for sustainability, as reflected in the data

obtained by this research. The number of articles published on this topic has been increasing over the last two decades, and this increase seems to enrich the aspects addressed (see **Figure 9**). It is particularly important to highlight as a strength last year's production (2020) when 28 articles were published, double the number of articles of the previous year, perhaps driven by recent publications of international organizations that put special emphasis on the importance of this type of learning (United Nations, 2015; Leicht et al., 2018). This growth follows the upward trend in the scientific literature on education for sustainable development (Hallinger, 2020; Prieto-Jiménez et al., 2021), which can be related to the great concern that



problems such as climate change are causing in society and the international political sphere. The data obtained also seem to show how this increase in publications contributes to the richness of the field of knowledge (see **Figure 9**).

Other authors, however, are concerned about this increase in scientific production, which seems to be occurring in the different fields of knowledge driven by open access publications. Mahon and Henry wonder about the usefulness of research in the humanities field, which is increasingly unwieldy, where much is written and little is read, and point to the instrumentalist and mercantilist tendencies that pervade the research activity (Mahon and Henry, 2021). Macfarlane (2021) also talks about the rise of neoliberal values and the advance of competitiveness in academia. In the field of sustainability, Shephard et al. (2021) discuss how the current demands of researchers, quality indicators, and the review and publication processes for articles often clash with the values that should advance sustainable development. Moreover, Rodríguez-Aboytes and Barth (2020), now in the field at hand, warn of the superficial use of transformative learning theory in many studies.

In this regard, it is interesting to note the exponential growth in the number of articles on transformative learning in the journal *Sustainability*, which has made it the main source on the topic of study (see **Table 2** and **Figure 2**). This is an open access Swiss interdisciplinary journal of environmental, cultural, economic, and social sustainability of human beings, with an impact index of 3.251 (IF in JCR, 2020), which reflects the quality and interest of many of the articles published, and its main advantage is that it can be read by anyone with internet access. These types of

open access journals are publishing a large number of articles but often require payment for each of these publications. It is, therefore, necessary to consider the difficulty for researchers with few resources to publish.

In the current context, the journals that contribute the most articles to this study are the aforementioned *Sustainability* and *The Journal of Transformative Education*, a specialist journal on the subject. However, it is also worth noting that the most-cited publication in our selection is *Environmental Education Research*, a traditional reference in environmental education. It is followed by the *International Journal of Sustainability in Higher Education* and *Adult Education Quarterly* (see **Table 2**). These two journals focus on post-school education, which reflects the importance of adult education in the pursuit of sustainability (Balsiger et al., 2017).

Another important element in the critical analysis of the data obtained is the origin of the selected publications. The four main countries producing the selected literature are four English-speaking countries, in line with the data provided by some studies that warn of the over-representation of English-language journals to the detriment of other languages (Mongeon and Paul-Hus, 2016). Once again, English-speaking researchers are privileged over other contexts. In fact, some studies show, for example, that the vast majority of Ibero-American researchers publish in English, rather than in their own language, Spanish or Portuguese (Badillo, 2021). This same document highlights the fact that this situation has relevant consequences for the vitality of languages, reducing the linguistic diversity of the scientific and academic world and diminishing

access to knowledge. This aspect is particularly important when it comes to advancing sustainability, which requires a transition at all levels and from most of the world's socio-cultural environments.

There is a clear prevalence of Europe and North America and their universities in the publications analyzed (with 75% of the articles published on the topic of study), evidencing the dominance of the West and its cultural hegemony in the ESD discourse (Barth and Rieckmann, 2016). Furthermore, few cross-country collaborative networks were found, and these are dominated by the same regions. Some of the reasons for this dominance are the lack of public funding for social science research in general (and on global environmental change in particular in the southern hemisphere and in emerging economies), as well as the lack of interest in these topics at national research funding agencies, and the lack of interest and motivation of traditional social scientists (Caillods, 2013).

This imbalance has significant consequences for the way in which TLS is researched, notably in relation to the diversity of scientific production and dissemination of knowledge, and, of course, in the way this knowledge can be applied in each context, which seems to compromise the significant need to address socio-environmental problems in a contextual way, requiring interventions based on the sociocultural characteristics of each region. This must be done at the macro, meso, and micro levels, as much of the behavior related to sustainability issues occurs at a crossroads of material infrastructures (e.g., what transport systems are available to me), social norms (how I should move around) and practical knowledge (how I use energy) (Shove et al., 2012; Boström et al., 2018).

As for authors working in the field, the data show that 305 people have published articles in the selection made for this paper, most of them in collaboration with other authors (see **Table 1**), with an average of two to three authors per paper. This seems to suggest that a good number of researchers are interested in TLS. Sinclair and Sterling, in particular, stand out among them. Nevertheless, the data also appear to indicate a need to continue creating collaborative networks where researchers from countries far from the West become more relevant and improving North-South networks, in order to favor more global, pluralistic, and intercultural research (Reid and Scott, 2013; Shephard et al., 2021; Tight, 2021).

When analyzing the papers with the greatest impact and the keywords used to describe the articles, three main TLS research trends emerge: (i) education for sustainability, especially in higher education, (ii) policies that drive sustainability, with a strong focus on public participation in resource management, and (iii) the learning approaches needed to develop transformative learning, with a particular focus on competence development. These trends seem to reflect an urgent need to tackle environmental problems, which requires changes in current decision-makers, without waiting for new generations. One need only think of the climate emergency, which requires a drastic reduction in greenhouse gas emissions by 2030 (IPCC, 2020). And these changes must be based on an education that empowers people, so that they are able to break with current

patterns and seek new ways of dealing with everyday situations, both on a personal and a professional level. Thus, in the evolution of the trend topics, innovation in research seems to focus on TLS's defining characteristics: social and transgressive learning, critical reflection, and transdisciplinarity. An excellent way to delve deeper into these aspects would be to read some recently published review articles of great interest (Rodríguez-Aboytes and Barth, 2020; Wolff and Ehrström, 2020).

The analysis of the field also shows some significant gaps. TLS research does not appear to be particularly interested in issues related to inequity and environmental justice, which characterize socio-environmental problems, as well as gender studies that include in the debate the effect of patriarchy or the lack of valuing care for people and the environment. As Boström et al. (2018) point out, TLS must address issues of inertia, power and inequality at the societal and individual level. More publications focusing on these aspects are, therefore needed.

And, of course, it is also essential to continue encouraging research that promotes the questioning of the current socioeconomic model and that brings us closer to alternative positions. In the search for sustainability, it seems increasingly necessary to introduce approaches such as degrowth from a truly transformative perspective.

CONCLUSION

The urgent need to address the socio-environmental crisis involves a radical and rapid transition toward more conscious and just development models. Hence, the importance of transformative education, especially in relation to adult learning, as it is adults who are making today's decisions. This is reflected in the main TLS research trends, with a particular focus on university education and public participation in resource management. Also essential is research on what TLS should look like, where skill development is a key element in addressing socio-environmental issues.

Thus, research on TLS, despite being a relatively new field, has been growing in recent years, providing fundamental elements for change and driven by a good number of researchers. But there are still many challenges, debates, and gaps that need to be addressed, as the evidence shows. The issue of increasing scientific output that is occurring in all fields must be considered. In TLS research, the quality of publications must be prioritized over the quantity thereof, so that the term is not used superficially, as some authors complain (Rodríguez-Aboytes and Barth, 2020). The transformative approach must permeate the practice of education for sustainability, but research must be based on quality approaches to transformative learning, including the re-examination of current systems and patterns, with a social justice and gender perspective, in a way that supports and underpins the necessary change that need to take place in schools and among teachers.

In addition, researchers should be encouraged to reflect on what the most relevant resources are for defending the quest for sustainability. Open access, fee-paying journals are publishing a large number of articles and reaching a wide audience. But

it is important to consider whether this business model is the most appropriate one for TLS, particularly considering the difficulty unfunded researchers, such as researchers from developing countries or junior researchers, face in publishing their research. Should journals with this business model become a benchmark for transformative learning in the pursuit of sustainable development? Are we taking this field of study toward the utilitarian and neoliberal framework that some critics relate to sustainability (Huckle and Wals, 2015)? This is an interesting debate that needs to be considered, and which requires further study.

The quest for diversity in the field should also encourage publishers to publish in different languages. In addition, quality and rigor should be prioritized over quantity. Interdisciplinary and networked research is needed, involving diverse sociocultural contexts, especially from the southern hemisphere and developing countries. Research funding agencies must also take these aspects into account.

Bibliometric analyses such as this one can help people understand the field of study, detect gaps, and facilitate new ideas for research. But their design has several limitations. The results obtained are limited by the search conducted. The search parameters and the database used mark the articles selected and may result in some relevant publications being left out of reach. Therefore, future research should include more databases. It should be kept in mind that the impact discussed in this article corresponds to the term used in the academic field. Analyzing the real coverage (non-academic audience) of the publications would require another type of broader study. The analysis is also affected by the criteria and mappings chosen. For this reason, it is important to remember that although this research can serve as a reference, it is exploratory in nature and must be complemented with exhaustive literature reviews that help provide an in-depth understanding of the conclusions reached and the strengths and weaknesses identified in the results of the analysis conducted.

In short, education alone cannot achieve sustainable development, but it is one of the fundamental instruments for

its progress. In order to tackle the socio-environmental problems in which we are immersed, it is essential to seek fundamental changes in the field of education. Hence the relevance of this type of analysis, which highlights the importance of researching new transformative approaches to develop the capacity to deal with the complexity and uncertainty of today's world, encouraging citizens to actively participate in the development of sustainable communities.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

MV-L and PV-M: conceptualization. MV-L and UP-R: methodology. MV-L, PV-M, ML-R, and UP-R: formal analysis and writing—original draft preparation. ML-R and UP-R: writing—review and editing. MV-L and UP-R: supervision and funding acquisition. All authors have read and agreed to the published version of the manuscript.

FUNDING

This research was funded by FEDER/Ministry of Science, Innovation and Universities – State Investigation Agency (Spain)/ESPIGA Project (“Scientific thinking and scientific practices in the post-truth era: Promoting epistemic performances in school, aiming to critical and empowered citizenship”, Grant No. PGC2018-096581-B-C22) and the University of Vigo (“Addressing the sustainable development goals: contributions from the different curricular areas” project).

REFERENCES

- Ardoin, N. M., Bowers, A. W., and Gaillard, E. (2020). Environmental education outcomes for conservation: a systematic review. *Biol. Conserv.* 241:108224. doi: 10.1016/j.biocon.2019.108224
- Ardoin, N. M., Bowers, A. W., Roth, N. W., and Holthuis, N. (2018). Environmental education and K-12 student outcomes: a review and analysis of research. *J. Environ. Educ.* 49, 1–17. doi: 10.1080/00958964.2017.1366155
- Aria, M., and Cuccurullo, C. (2017). bibliometrix: an R-tool for comprehensive science mapping analysis. *J. Informetr.* 11, 959–975. doi: 10.1016/j.joi.2017.08.007
- Baas, J., Schen, M., Plume, A., Côté, G., and Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quant. Sci. Stud.* 1, 377–386. doi: 10.1162/qss_a_00019
- Badillo, A. (2021). *El portugués y el español en la ciencia: apuntes para un conocimiento diverso y accesible*. Madrid: Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura/Real Instituto El Cano.
- Balsiger, J., Förster, R., Mader, C., Nagel, U., Sironi, H., Wilhelm, S., et al. (2017). Transformative Learning and Education for Sustainable Development. *GAIA - Ecol. Perspect. Sci. Soc.* 26, 357–359. doi: 10.14512/gaia.26.4.15
- Barth, M., and Rieckmann, M. (2016). “State of the art in research on higher education for sustainable development,” in *Routledge Handbook of Higher Education for Sustainable Development*, eds M. Barth, G. Michelsen, M. Rieckmann, and I. Thomas (Milton Park: Routledge), 100–113.
- Bell, D. V. (2016). Twenty first century education: transformative education for sustainability and responsible citizenship. *J. Teach. Educ. Sustain.* 18, 48–56. doi: 10.1515/jtes-2016-0004
- Blake, J., Sterling, S., and Goodson, I. (2013). Transformative Learning for a Sustainable Future: an Exploration of Pedagogies for Change at an Alternative College. *Sustainability* 5, 5347–5372. doi: 10.3390/su5125347
- Boström, M., Andersson, E., Berg, M., Gustafsson, K., Gustavsson, E., Hysing, E., et al. (2018). Conditions for Transformative Learning for Sustainable Development: A Theoretical Review and Approach. *Sustainability* 10:4479. doi: 10.3390/su10124479
- Brundiers, K., and Wiek, A. (2011). Educating students in real-world sustainability research: vision and implementation. *Innov. High. Educ.* 36, 107–124. doi: 10.1007/s10755-010-9161-9
- Burns, H. (2018). Thematic Analysis: Transformative Sustainability Education. *J. Transform. Educ.* 16, 277–279. doi: 10.1177/1541344618796996

- Caillois, F. (2013). "Divisorias regionales de la capacidad de investigación del cambio ambiental global," in *Informe mundial sobre Ciencias Sociales 2013. Cambios ambientales*. (Paris: UNESCO).
- Chadegani, A. A., Salehi, H., Yunus, M., Farhadi, H., Fooladi, M., Farhadi, M., et al. (2013). A comparison between two main academic literature collections: web of Science and Scopus databases. *Asian Soc. Sci.* 9, 18–26.
- Chen, S. Y., and Liu, S. Y. (2020). Developing students' action competence for a sustainable future: a review of educational research. *Sustainability* 12:1374. doi: 10.3390/su12041374
- Chomsky, N., Pollin, R., and Polychroniou, C. J. (2020). *Climate Crisis and the Global Green New Deal: The Political Economy of Saving the Planet*. London: Verso Books.
- Coghlan, A., and Gooch, M. (2011). Applying a transformative learning framework to volunteer tourism. *J. Sustain. Tour.* 19, 713–728. doi: 10.1080/09669582.2010.542246
- Cotton, D., Bailey, I., Warren, M., and Bissell, S. (2009). Revolutions and second-best solutions: education for sustainable development in higher education. *Stud. High. Educ.* 34, 719–733. doi: 10.1080/03075070802641552
- Cranton, P. (2016). *Understanding and Promoting Transformative Learning: A Guide to Theory and Practice*. Sterling, VA: Stylus Publishing.
- Diduck, A., and Mitchell, B. (2003). Learning, Public Involvement and Environmental Assessment: A Canadian Case Study. *J. Environ. Assess. Policy Manag.* 5, 339–364. doi: 10.1142/S1464333203001401
- Diduck, A., Sinclair, A. J., Hostetler, G., and Fitzpatrick, P. (2012). Transformative learning theory, public involvement, and natural resource and environmental management. *J. Environ. Plan. Manag.* 55, 1311–1330. doi: 10.1080/09640568.2011.645718
- Diduck, A. P., Pratap, D., Sinclair, A. J., and Deane, S. (2013). Perceptions of impacts, public participation, and learning in the planning, assessment and mitigation of two hydroelectric projects in Uttarakhand. *India. Land Use Policy* 33, 170–182. doi: 10.1016/j.landusepol.2013.01.001
- Ferrer-Balas, D., Adachi, J., Banas, S., Davidson, C. I., Hoshikoshi, A., Mishra, A., et al. (2008). An international comparative analysis of sustainability transformation across seven universities. *Int. J. Sustain. High. Educ.* 9, 295–316. doi: 10.1108/14676370810885907
- Gao, S., Meng, F., Gu, Z., Liu, Z., and Farrukh, M. (2021). Mapping and clustering analysis on environmental, social and governance field a bibliometric analysis using Scopus. *Sustainability* 13:7304. doi: 10.3390/su13137304
- Giangrande, N., White, R. M., East, M., Jackson, R., Clarke, T., Saloff Coste, M., et al. (2019). A Competency Framework to Assess and Activate Education for Sustainable Development: addressing the UN Sustainable Development Goals 4.7 Challenge. *Sustainability* 11:2832. doi: 10.3390/su11102832
- Gusmão Caiado, R. G., Leal Filho, W., Quelhas, O. L. G., Luiz, de Mattos Nascimento, D., and Ávila, L. V. (2018). A literature-based review on potentials and constraints in the implementation of the sustainable development goals. *J. Clean. Prod.* 198, 1276–1288. doi: 10.1016/j.jclepro.2018.07.102
- Hallinger, P. (2020). Science mapping the knowledge base on educational leadership and management from the emerging regions of Asia, Africa and Latin America, 1965–2018. *Educ. Manag. Adm. Leadersh.* 48, 209–230. doi: 10.1177/1741143218822772
- Hallinger, P., and Chatpinyakoo, C. (2019). A Bibliometric Review of Research on Higher Education for Sustainable Development, 1998–2018. *Sustainability* 11:2401. doi: 10.3390/su11082401
- Howlett, C., Ferreira, J.-A., and Blomfield, J. (2016). Teaching sustainable development in higher education: Building critical, reflective thinkers through an interdisciplinary approach. *Int. J. Sustain. High. Educ.* 17, 305–321. doi: 10.1108/IJSHE-07-2014-0102
- Huckle, J., and Wals, A. E. (2015). The UN decade of education for sustainable development: business as usual in the end. *Environ. Educ. Res.* 21, 491–505. doi: 10.1080/13504622.2015.1011084
- IPCC (2019). *Climate change and land*. Geneva: IPCC.
- IPCC (2020). *Global Warming of 1.5 °C*. Available online at: <https://www.ipcc.ch/sr15/> (accessed May 5, 2021).
- IPCC (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. IPCC. Available online at: <https://www.ipcc.ch/report/ar6/wg2/> (accessed April 21, 2022).
- Jackson, T. (2016). *Prosperity without growth: foundations for the economy of tomorrow*. New York, NY: Taylor and Francis.
- Kipper, L. M., Furstenau, L. B., Hoppe, D., Frozza, R., and Iepsen, S. (2020). Scopus scientific mapping production in industry 4.0 (2011–2018): a bibliometric analysis. *Int. J. Prod. Res.* 58, 1605–1627. doi: 10.1080/00207543.2019.1671625
- Kopnina, H., and Cherniak, B. (2016). Neoliberalism and justice in education for sustainable development: a call for inclusive pluralism. *Environ. Educ. Res.* 22, 827–841. doi: 10.1080/13504622.2016.1149550
- Lange, E. A. (2004). Transformative and restorative learning: a vital dialectic for sustainable societies. *Adult Educ. Q.* 54, 121–139. doi: 10.1177/0741713603260276
- Leicht, A., Heiss, J., and Byun, W. J. (eds) (2018). *Issues and Trends in Education for Sustainable Development*. Paris: UNESCO.
- Lopera-Perez, M., Maz-Machado, A., Madrid, M. J., and Cuida, A. (2021). Bibliometric analysis of the international scientific production on environmental education. *J. Balt. Sci. Educ.* 20:428. doi: 10.33225/jbse/21.20.428
- Macfarlane, B. (2021). The neoliberal academic: illustrating shifting academic norms in an age of hyper-performativity. *Educ. Philos. Theory* 53, 459–468. doi: 10.1080/00131857.2019.1684262
- Mahon, A., and Henry, S. (2021). But who are all these journal articles for? Writing, reading and our unhandsome condition. *Camb. J. Educ.* 0, 1–13. doi: 10.1080/0305764X.2021.1933903
- Martins, V. W. B., Rampasso, I. S., Anholon, R., Quelhas, O. L. G., and Leal Filho, W. (2019). Knowledge management in the context of sustainability: literature review and opportunities for future research. *J. Clean. Prod.* 229, 489–500. doi: 10.1016/j.jclepro.2019.04.354
- Maz-Machado, A., Muñoz-Nungo, B., Gutiérrez-Rubio, D., and León-Mantero, C. (2020). Patterns of Authorship and Scientific Collaboration in Education: the Production of Colombia in ESCI. *Libr. Philos. Pract. E-J.* 2020:4278.
- Mezirow, J. (2003). Transformative Learning as Discourse. *J. Transform. Educ.* 1, 58–63. doi: 10.1177/1541344603252172
- Mongeon, P., and Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics* 106, 213–228. doi: 10.1007/s11192-015-1765-5
- Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., and Chaves, W. A. (2019). Identifying effective climate change education strategies: a systematic review of the research. *Environ. Educ. Res.* 25, 791–812. doi: 10.1080/13504622.2017.1360842
- Moore, J. (2005). Is Higher Education Ready for Transformative Learning?: a Question Explored in the Study of Sustainability. *J. Transform. Educ.* 3, 76–91. doi: 10.1177/1541344604270862
- Percy-Smith, B., and Burns, D. (2013). Exploring the role of children and young people as agents of change in sustainable community development. *Local Environ.* 18, 323–339. doi: 10.1080/13549839.2012.729565
- Platto, S., Zhou, J., Wang, Y., Wang, H., and Carafoli, E. (2021). Biodiversity loss and COVID-19 pandemic: the role of bats in the origin and the spreading of the disease. *Biochem. Biophys. Res. Commun.* 538, 2–13. doi: 10.1016/j.bbrc.2020.10.028
- Prieto-Jiménez, E., López-Catalán, L., López-Catalán, B., and Domínguez-Fernández, G. (2021). Sustainable Development Goals and Education: a Bibliometric Mapping Analysis. *Sustainability* 13:2126. doi: 10.3390/su13042126
- Pritchard, A., Morgan, N., and Ateljjevic, I. (2011). Hopeful tourism: a New Transformative Perspective. *Ann. Tour. Res.* 38, 941–963. doi: 10.1016/j.annals.2011.01.004
- Reid, A., and Scott, W. (2013). "Identifying Needs in Environmental Education Research," in *International Handbook of Research on Environmental Education*, eds R. B. Stevenson, M. Brody, J. Dillon, and A. E. J. Wals (New York, NY: Routledge), 518–528. doi: 10.4324/9780203813331-65
- Rieckmann, M. (2018). "Learning to transform the world: Key competencies in Education for Sustainable Development," in *Issues and trends in education for sustainable development*, eds A. Leicht, J. Heiss, and W. J. Byun (Paris: UNESCO), 39–59. doi: 10.1136/bmjgh-2021-007996
- Rodríguez-Aboytes, J. G., and Barth, M. (2020). Transformative learning in the field of sustainability: a systematic literature review (1999–2019). *Int. J. Sustain. High. Educ.* 21, 993–1013. doi: 10.1108/IJSHE-05-2019-0168
- Shephard, K., Thondhlana, G., Wolff, L.-A., Belluigi, D. Z., Rieckmann, M., and Vega-Marcote, P. (2021). On the Nature of Quality in the Contexts of Academic Publication and Sustainability. *Front. Educ.* 6:634473. doi: 10.3389/feduc.2021.634473

- Shove, E., Pantzar, M., and Watson, M. (2012). *The Dynamics of Social Practice: Everyday Life and How It Changes*. London: Sage.
- Sims, L., and Sinclair, A. J. (2008). Learning Through Participatory Resource Management Programs: case Studies From Costa Rica. *Adult Educ. Q.* 58, 151–168. doi: 10.1177/0741713607309802
- Sobral, S. R. (2021). Two Decades of Research in e-Learning: a Deep Bibliometric Analysis. *Int. J. Inf. Educ. Technol.* 11, 398–404. doi: 10.18178/ijiet.2021.11.9.1541
- Stiglitz, J. (2015). *The Great Divide*. London: Penguin UK.
- Sterling, S. (2010). Learning for resilience, or the resilient learner? Towards a necessary reconciliation in a paradigm of sustainable education. *Environ. Educ. Res.* 16, 511–528. doi: 10.1080/13504622.2010.505427
- Thomas, I. (2009). Critical Thinking, Transformative Learning, Sustainable Education, and Problem-Based Learning in Universities. *J. Transform. Educ.* 7, 245–264. doi: 10.1177/1541344610385753
- Tight, M. (2021). Globalization and internationalization as frameworks for higher education research. *Res. Pap. Educ.* 36, 52–74. doi: 10.1080/02671522.2019.1633560
- UNDP (2019). *Human Development Report 2019*. New York, NY: UNDP.
- UNESCO (2013). *Informe mundial sobre Ciencias Sociales 2013. Cambios ambientales globales*. Paris: UNESCO.
- UNESCO (2015). *Rethinking Education. Towards a global common good?*. Paris: UNESCO.
- United Nations (2015). *Transforming our world: the 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs*. Available online at: <https://sdgs.un.org/2030agenda> (accessed July 7, 2021).
- United Nations (2020). *World Economic Situation and Prospects as of mid-2020 | Department of Economic and Social Affairs*. Available online at: <https://www.un.org/development/desa/dpad/publication/world-economic-situation-and-prospects-as-of-mid-2020/> (accessed July 19, 2021)
- Varela-Losada, M., Vega-Marcote, P., Pérez-Rodríguez, U., and Álvarez-Lires, M. (2016). Going to action? A literature review on educational proposals in formal Environmental Education. *Environ. Educ. Res.* 22, 390–421. doi: 10.1080/13504622.2015.1101751
- Vladimirova, K., and Blanc, D. L. (2015). *How well are the links between education and other sustainable development goals covered in UN flagship reports? A contribution to the study of the science-policy interface on education in the UN system*. Available online at: <https://sustainabledevelopment.un.org/content/documents/2111education%20and%20sdgs.pdf> (accessed date October 2015).
- Wiek, A., Withycombe, L., and Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustain. Sci.* 6, 203–218. doi: 10.1007/s11625-011-0132-6
- Wolff, L.-A., and Ehrström, P. (2020). Social Sustainability and Transformation in Higher Educational Settings: A Utopia or Possibility? *Sustainability* 12:4176. doi: 10.3390/su12104176
- Worldwatch Institute (2017). *EarthEd (State of the World): Rethinking Education on a Changing Planet*. Washington, D.C: Island Press.
- Wu, Y.-C. J., and Shen, J.-P. (2016). Higher education for sustainable development: a systematic review. *Int. J. Sustain. High. Educ.* 17, 633–651. doi: 10.1108/IJSHE-01-2015-0004
- Yanniris, C., and Huang, Y. S. (2018). Bibliometric evidence point to loci of empirical knowledge production in environmental education. *Cogent Educ.* 5:1542961. doi: 10.1080/2331186X.2018.1542961
- Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
- Publisher's Note:** All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Varela-Losada, Pérez-Rodríguez, Lorenzo-Rial and Vega-Marcote. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.