Full paper

Sains Humanika

A Bibliometric Analysis of Sustainability in Future Education: Trends and Future Agenda

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Abstract

This paper aims to investigate the current trends and future sustainability agenda in future education using bibliometric analysis. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was used to select relevant documents for this bibliometric and content study. A quality assessment has been applied in this review; this review mainly focused on mapping the existing literature on sustainability and future education. The quality assessment started by only considering original research articles, excluding all conferences and proceedings articles. Moreover, the review narrowed the subject areas to social science, arts and humanities, and computer science. Finally, all articles were selected from 2011 to 2020; all research before 2011 was excluded from the search. An analysis was conducted into related publications and a bibliometric mapping, classifying major journals indexed by the Scopus database under its primary collection. With a focus on scientific publications, this paper examines types of publications, the quantity of publications, countries, most cited publications, and the most prolific authors. The current review presents a reference for further research and studies based on five main research areas: sustainability in education, future education; Education for Sustainable Development; sustainable learning process; and Sustainable development Goals. The primary conclusion that this review recommends is the high need for a change in the function and role of higher education institutions to investigate sustainability roles in education due to their prominent role in today's world.

Keywords: Future sustainability agenda, future education, sustainability education, bibliometric analysis.

Abstrak

Kertas kerja ini bertujuan untuk menyiasat trend semasa dan agenda kelestarian masa depan dalam pendidikan masa depan menggunakan analisis bibliometrik. Kertas kerja ini dibina berdasarkan rangka kerja Item Pelaporan Pilihan untuk Kajian Sistematik dan Meta-Analyses (PRISMA) untuk memilih dokumen yang berkaitan untuk kajian bibliometrik dan kandungan ini. Penilaian kualiti telah digunakan dalam semakan ini; tinjauan ini tertumpu terutamanya pada pemetaan literatur sedia ada mengenai kemampanan dan pendidikan masa depan. Penilaian kualiti bermula dengan hanya mempertimbangkan artikel penyelidikan asal, tidak termasuk semua artikel persidangan dan prosiding. Selain itu, semakan kemudiannya mengecilkan kepada bidang subjek kepada sains sosial, seni dan kemanusiaan, dan sains komputer. Akhirnya, semua artikel telah dipilih dari 2011 hingga 2020; semua penyelidikan sebelum 2011 dikecualikan daripada carian. Analisis telah dijalankan ke dalam penerbitan berkaitan dan pemetaan bibliometrik, mengklasifikasikan jurnal utama yang diindeks oleh pangkalan data Scopus di bawah koleksi utamanya. Dengan tumpuan pada penerbitan saintifik, kertas kerja ini mengkaji jenis penerbitan, bilangan penerbitan, negara, penerbitan yang paling banyak disebut dan pengarang yang paling produktif. Tinjauan semasa membentangkan rujukan untuk penyelidikan dan kajian lanjut berdasarkan lima bidang penyelidikan utama: kemampanan dalam pendidikan, pendidikan masa depan; Pendidikan untuk Pembangunan Mampan; proses pembelajaran lestari; dan Matlamat Pembangunan Mampan. Kesimpulan utama yang disyorkan oleh kajian ini ialah keperluan yang tinggi untuk perubahan dalam fungsi dan peranan institusi pengajian tinggi untuk menyiasat peranan kemampanan dalam pendidikan kerana peranan mereka yang menonjol dalam dunia hari ini.

Kata kunci: Agenda kelestarian masa depan, pendidikan masa depan, pendidikan kelestarian, analisis bibliometrik.

1.0 INTRODUCTION

Educators started to be concerned about the adverse impact of economic development on the environment and wasting resources during the 1990s raising the term 'environmental education' (Jickling & Wals, 2012). This concern presented the term 'education for sustainable development (Aikens, McKenzie & Vaughter, 2016; Combes, 2005; Jickling & Wals, 2012). Over the last two decades, policymakers worldwide have increasingly made an effort to raise attention and integrate education for the term Sustainable Development (SD). Education can achieve this purpose (Jickling & Wals, 2012). For instance, the United Nations (UN) launched the 'Education for Sustainable Development decade in 2004 (Combes, 2005). This project's main objectives were to incorporate the principles, practices, and values of SD into both informal and formal education. This has been rooted in believing that education is the only way to present SD for citizens in every society (Aikens, McKenzie & Vaughter, 2016; Salas-Zapata, Ríos-Osorio & Cardona-Arias, 2018). Upon completing the Education for Sustainable Development decade in 2015, the UN implemented 17 Sustainable Development Goals (SDGs), reflecting the

expansion of the international efforts to establish sustainable communities. These SDGs encoded these goals, ensuring that all kids receive a high-quality education, which encourages lifelong teaching and learning. Both policymakers and researchers have claimed that education for SD is the most basic SDG among the 17 SDGs created by the UN. To that end, education has proven to promote sustainable behaviors, attitudes, and values amongst future generations of the world's citizens to be the key to achieving all SDGs, including sustainability in future education. Sustainability in future education concerns not only secondary and primary education but is also important on all education levels, including higher education institutions. Higher education organizations have prepared schoolteachers with the attitudes, skills, and knowledge needed to be taught efficiently for general sustainability and future education sustainability (Chinedu, Wan-Mohamed & Ogbonnia, 2018). Thus, educational curricula taught in various university disciplines correspond to prepare university learners to integrate sustainable practices and attitudes into their lifestyles (Figueiró & Raufflet, 2015; Stephens et al., 2008). Accordingly, universities play a major role in acknowledging the consequences for sustainability in future education (Cortese, 2003; Martens, 2006). Such characteristics suggest that the field of education for SD is the key to achieving all 17 SDGs recommended by the UN (Figueiró & Raufflet, 2015; Lozano et al., 2013; Stephens et al., 2008).

In this context, previous research clarified that SD in higher education is the new educational principle that “allows individuals to accurately reflect over future, global, and multicultural, oriented perceptions, regarding their obligation of behavior and decision-making” (Adomßent et al., 2014, p. 2). Such a new education is participative, reflective, and an open-minded process that examines a sustainable future possibility. Consequently, researchers have indicated that higher education for SD is not just a syllabus; it is a kind of transformational education that aims for a social transformation (Boström et al., 2018; Sipos, Battisti & Grimm, 2008). In addition, a review by Veiga Ávila et al. (2018) examined literature relating to the education for SD and sustainability in all educational institutions; therefore, it analyzed 5000 publications and research papers from 2005-to 2014 using the Web of Science (WOS) database. Similar to our review, Veiga Ávila et al. (2018) utilized a bibliometric approach; thus, they have identified wide-ranging objectives such as health, environmental issues, agriculture, energy, management, and education. They have reported that most of the authors of their reviewed publications were based in Canada, Australia, China, the UK, and the USA. They claimed that their review aimed to define the key most prolific authors, most productive journals, and the most cited publications.

Consequently, this review quantitatively analyses the status and future agenda of future education and education for sustainability (FEES) bibliometrics analysis of publications published between 2010 and 2020 to comprehensively examine the research landscape, particularly FEES. The analysis of bibliometrics is a statistical method for quantifying and assessing the number of rising trends in a particular field of study. (Abuhassna et al., 2022a; Abuhassna et al., 2022b; Hao et al., 2018; Chen et al., 2018a, Chen et al., 2019). Bibliometrics analysis has been widely used to evaluate the academic outputs of various study disciplines, such as in Chen et al. (2018b) and Abuhassna et al. (2022a). They were primarily designed to assess educational study disciplines. Song et al. (2019), by identifying the top journals and key contributors examined the intellectual structure, trends, and status of online learning settings dialogue study, as well as illustrating the scientific associations, using 3914 publications gathered from the Web of Science. Similarly, Chen et al. (2020) quantitatively examined research papers in the journal Computers and Education in terms of scientific collaborations, author profiles, and research topics.

This review, in particular, has now evolved into a fascinating research field with numerous studies as a result, thematic structure of such a study area must be investigated using an accurate machine learning method capable of randomly examining large amounts of documented literature data.

The current research is then conducted to provide insights into what has been involved as well as educational trends for a sustainable future. This is accomplished by analysing relevant prominence patterns and broadening research areas. Furthermore, the implications and insights associated with future studies conducted by our analyses are intended to assist researchers in making decisions about the types of research to focus on in the fields.

The purpose of this study is to use bibliometrics to analyse FEES publications indexed in Scopus. The purpose of this study is to use bibliometrics to analyse FEES publications that are indexed in Scopus. We were able to see how research interests in online learning have changed over time thanks to this analysis. Furthermore, this study visualised and investigated previously unstudied scientific collaborations among top contributors in education for a sustainable future (Chen et al., 2018b; Abuhassna et al., 2022b). We planned to only answer the following research questions:

RQ1 What is the year-by-year distribution of FEES publications over the last decade?
RQ2 What are the most relevant journals and authors in future education and education for sustainability?
RQ3 What are the most productive countries in terms of future education and education for sustainability?
RQ4 What have been the primary research keywords in the last decade concerning future education and education for sustainability?

2.0 MATERIALS AND METHODS

This paper has been structured using Moher et al. (2015)'s Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to extract relevant documents in education for a sustainable future to fill a gap in the literature. The current review seeks to determine the profile of research papers for education for a sustainable future over the last decade. To accomplish this goal, a bibliometric was used in the analysis. Furthermore, bibliometric analysis follows studies on a specific subject, revealing the conclusions reached by analysing these by different characteristics (MartParreo, MéndezIbáez, & AlonsoArroyo, 2016).

To reach high-quality research papers, relevant publications from the Scopus database were incorporated into the study, excluding any conferences or proceedings; this exclusion was made to focus on full published articles. This scan took place on August 17, 2021. The keyword, summary, and title options have all been searched for keyword phrases. Following the search procedure, two criteria were used for selection: first, papers were written in English; second, open access articles were included in the study; this exclusion was "Future and education," "sustainability for education," and "sustainable education" were used as keywords and phrases that evoked them. Scopus was used in this review to find journals on education for a sustainable future. It includes intelligent tools for visualising, analysing, and tracking

research outputs in fields such as humanities, technology, and science (Tober, 2011; Agapiou & Lysandrou, 2015). Furthermore, to ensure the relative importance of the analysed publications to education for a sustainable future, we performed manual screening to exclude irrelevant publications according to the criteria shown in Table 1.

Table 1 The inclusion and the exclusion criteria for data screening

Inclusion criteria	Sustainability for education Publications from 2011-2020 (this is because educational sustainability is still a new concept)
Exclusion criteria	Conference papers, proceedings papers, nonindexed publications. To avoid any irrelevant publications.

A total of 2626 documents have been found in the initial search in the Scopus database for the bibliometric analysis. Moreover, after manually screening to exclude irrelevant publications per the criteria, a total of 316 papers have been extracted from the Scopus database. After analyzing the abstracts of all documents, a quality assessment was carried out; the quality assessment was applied through the following. First, this review mainly focused on mapping the existing literature on sustainability and future education. Secondly, this review is based only on original research articles, excluding all conferences and proceedings articles. Thirdly, the review then narrowed the subject areas to social science, arts and humanities, and computer science. All articles were selected from 2011 to 2020, and all research before 2011 was excluded from the search. And thus, 112 articles are left for the analysis of this review. Table 1 shows the exclusion and inclusion criteria. Figure 1 depicts the analytic research framework in addition.

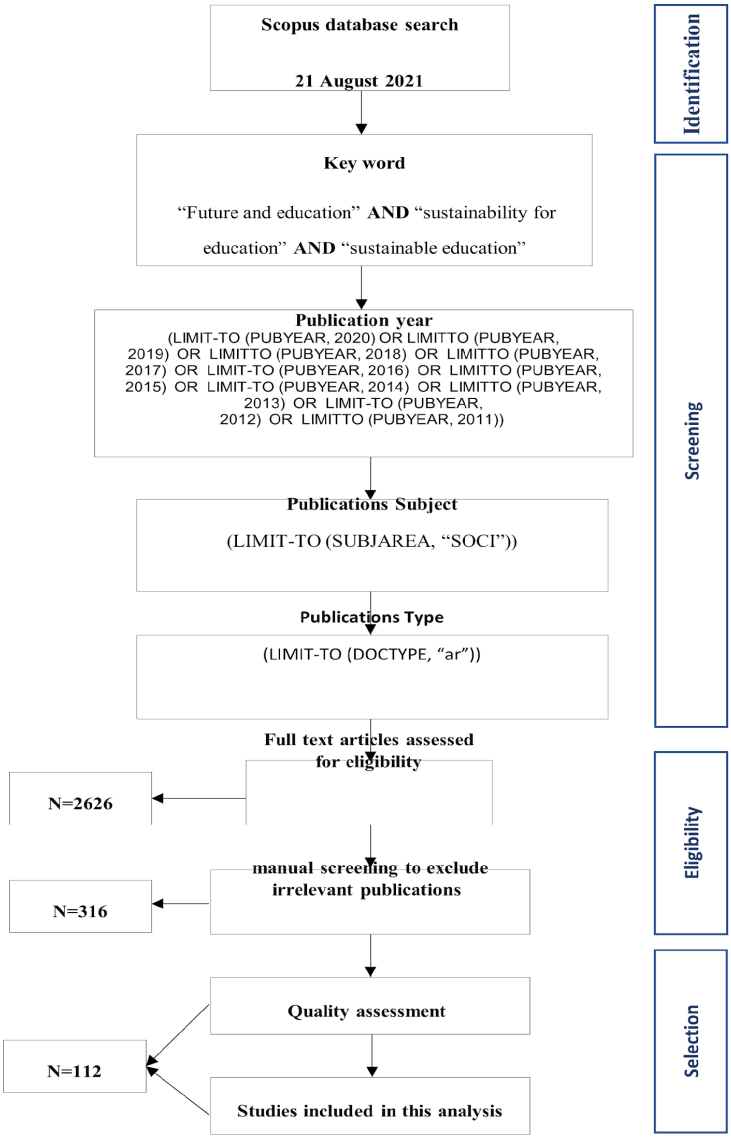

Figure 1 The analytic framework of the study

The Bibliometric Analysis

A bibliometric analysis technique was used in this review. The goal of this bibliometric analysis was to highlight a few results categories: first, the relationship between the authors, the most cited authors, the keywords used and their relationship, the publication cooperation between countries, the countries that did the most studies on the subject, the journals that published the most studies on the subject, the most cited journals, the most published journals, the most commonly used keywords, the journals that were jointly published, and the journals that were jointly published. VOSViewer software was used in this analysis. VOSViewer is a popular software for visualising bibliometric networks (Artsn, 2020). This software was used to demonstrate network visualisation in the analysis.

3.0 FINDINGS

The current review analysis exposes the studies' profile for FEES for the last decade. Results for the studies addressed in this context were given in parallel with the research questions.

RQ1: What is the year-by-year distribution of FEES publications over the last decade?

The first discovery addressed by the content analysis is the year of publication of the articles over the last decade. Beginning with an examination of the yearly distribution of FEES publications, it is worth noting that FEES research has received a dramatic increase in interest from scholars, indicating a promising growth trend.

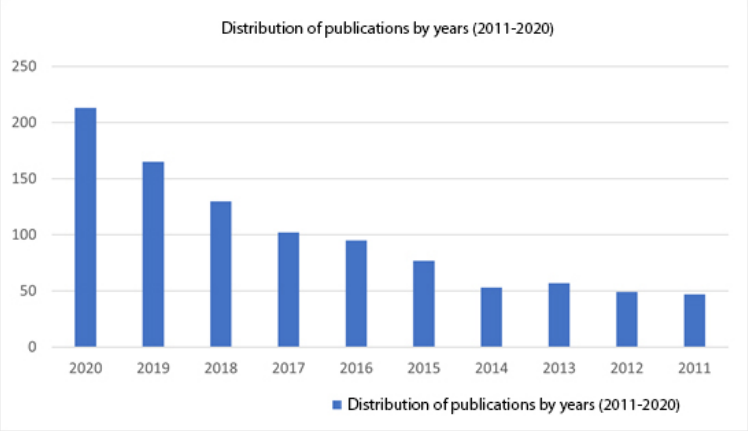

Figure 2 Distribution of publications by years (2011-2020)

Figure 2 depicts the distribution of publications by year; it has been noted that the articles were mostly published within the last few years; in the year 2020, a total of 213 publications about FEES were released in the year 2019, a total of 165 publications about FEES research area were published, followed by a total of 180 publications in the year 2018. Figure 2 depicts how the other publications were distributed over the next few years.

RQ2: What are the most relevant journals and authors in future education and education for sustainability?

As shown in table 2, The criteria for analysing the most cited journals were "Total Publication" "Total Citation" "Cite Score of the journal" "The most cited article" "Times cited," and "Publisher."

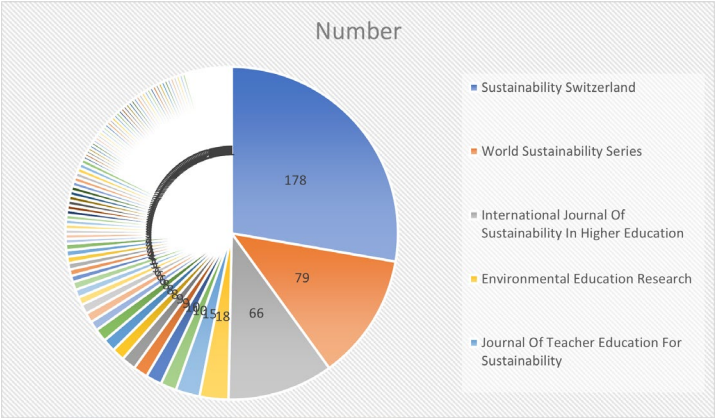

Figure 3 Distribution of publications by years (2011-2020)

Table 2 The top 10 highly productive journals in the years (2011-2020)

Journal	TP	TC	Cite Score (2020)	The most cited article (Reference)	Times cited	Publisher
Multidisciplinary Digital Publishing Institute (MDPI)	10,672	720	3.9	Exploring the critical challenges and factors influencing the E-learning system usage during the COVID-19 pandemic	65	Multidisciplinary Digital Publishing Institute (MDPI)
World Sustainability Series	170	170	0.9	Towards a Learning System for University Campuses as Living Labs for Sustainability	9	Springer Nature
International Journal of Sustainability in Higher Education	88	86	4.1	Are the sustainable development goals implemented in the Portuguese higher education formative offer?	8	Emerald
Environmental Education Research	116	131	5.2	From action to intra-action? Agency, identity and 'goals' in a relational approach to climate change education	7	Taylor & Francis
Journal of Teacher Education for Sustainability	22	1	3.0	Environmental Education Competency: Enhancing the Work of Teachers	1	Walter de Gruyter
International Journal of Engineering Education	160	71	2.1	Engineering students' conceptions of collaboration, group-based strategy use, and perceptions of assessment in PBL: A case study in Qatar	7	Dublin Institute of Technology Tempus Publications
International Journal of Management Education	47	36	5.1	Entrepreneurship education: Time for a change in research direction?	5	Elsevier
Sustainability Science	120	227	8.5	Mapping citizen science contributions to the UN sustainable development goals	9	Springer Nature
Australian Journal of Environmental Education	27	4	1.6	Education for sustainable development in the senior Earth and Environmental Science syllabus in Queensland, Australia	1	Cambridge University Press
Journal of Chemical Education	695	564	3.4	Attempts, successes, and failures of distance learning in the time of covid-19	5	American Chemical Society

TP= Total Publications, TC= Total Citation

Table 2 shows that the most productive journal about FEES was "Multidisciplinary Digital Publishing Institute (MDPI)" with a total number of publications of 10, 72, and 720, followed by "World Sustainability Series" with a total number of publications of 170, and a total citation of 170, as well as "International Journal of Sustainability in Higher Education" with a total number of publications of 88, and a total citation of 86. Furthermore, the distributions of the most productive FEES journals are shown in Table 2. RQ2 investigated the most prolific authors in future education and education for sustainability research areas, on the other hand. In the content analysis conducted for prolific authors in future education and education for sustainability research.

Table 3 List of the 15 most prolific authors

	Author	Author ID	Year of 1st publication	TP	h-index	TC	Current affiliation	Country
1	Barth, Matthias	36090790100	2007	36	14	1264	Leuphana Universität Lüneburg, Luneburg, Germany	Germany
2	Vilches, Amparo	8551760700	1999	19	9	288	Universitat de València, Valencia, Spain	Spain
3	Filho, Walter Leal	57210792153	2012	259	22	1813	Hochschule für Angewandte Wissenschaften Hamburg, Hamburg, Germany	Germany
4	Fischer, Daniel	36091174000	2010	35	13	728	Arizona State University, Tempe, United States	United States
5	Glover, Alison	37116835900	2011	6	4	59	University of South Wales, Pontypridd, United Kingdom	United Kingdom
6	Kopnina, Helen	11541014500	1990	114	22	1635	The Hague University of Applied Sciences, The Hague, Netherlands	Netherlands
7	Maragakis, Antonios	55961248700	2013	9	6	1	Faculteit Bouwkunde van de TU Delft, Delft, Netherlands	Netherlands

8	Peters, Robert W.	7401442431	1992	140	31	5663	Baltimore VA Medical Center, Baltimore, United States	United States
9	Rieckmann, Marco	22136076000	2007	31	13	1151	Universität Vechta, Vechta, Germany	Germany
10	Sharma, M. P.	24426735600	1979	152	39	6452	Department of Hydro and Renewable Energy, Roorkee, India	India
11	Winslett, Matthew	36054925300	2009	13	1	4	The University of Alabama at Birmingham, Birmingham, United States	United States
12	Albareda-Tiana, Sílvia	57191052083	2015	10	6	154	Universitat Internacional de Catalunya, Barcelona, Spain	Spain
13	Anholon, Rosley	56910252000	2015	77	14	582	Universidade Estadual de Campinas, Campinas, Brazil	Brazil
14	Archambault, Leanna M.	6701718473	2003	30	12	645	Arizona State University, Tempe, United States	United States
15	Boyd, Diane K.	7202871078	1985	18	11	578	Montana Department of Fish, Wildlife and Parks, Helena, United States	United States

TP= Total Publications, TC= Total Citation

Table 3 lists the 15 most prolific authors in the fields of future education and education for sustainability research. Furthermore, the most prolific author was "Barth, Matthias" with a total of 36 publications, an h-index of 14, and a total of 1264 citations, and the author is from Germany. This was followed by "Vilches, Amparo," a Spanish author with 19 publications, an h-index of 9, and 288 citations. Following that is "Filho, Walter Leal," who has a total of 259 publications, an h-index of 22, and a total of 1813 citations. The author is from Germany. Furthermore, the top three H-index rankings remained the same as ranked by publishing count. Moreover

RQ3: What are the most productive countries in terms of future education and education for sustainability?

As shown in table 4 and figure 3, the analysis criteria for the most productive countries in future education and education for sustainability research were "country," "Total Publications," and "most productive academic institution."

Table 4 List of the 15 most prolific authors

Rank	Country	TP	Most productive academic institution	Rank	Country	TP	Most productive academic institution
1	United States	177	Duquesne University, Pittsburgh, PA, USA	**9**	China	29	Shanghai Jiao Tong University (SJTU)
2	United Kingdom	128	Organisational Sustainability	**10**	Italy	29	University of Brescia
3	Australia	115	Royal Melbourne Institute of Technology (RMIT University)	**11**	Finland	26	University of Helsinki
4	Spain	100	Universidad Camilo José Cela, c/Castillo de Alarcón	**12**	Netherlands	25	Delft University of Technology
5	Germany	67	Leuphana University of Lüneburg	**13**	Norway	23	Oslo University
6	Canada	44	Dalhousie University	**14**	India	22	World Academy of Art and Science
7	Brazil	40	Cidade Universitária	**15**	Malaysia	21	University teknologi Malaysia
8	Sweden	35	University of Gävle				

TP= Total Publications

The top 15 productive countries in future education and education for sustainability research are shown in Table 4 and Figure 4, as well as the topic distributions of the most productive countries/regions and establishments.

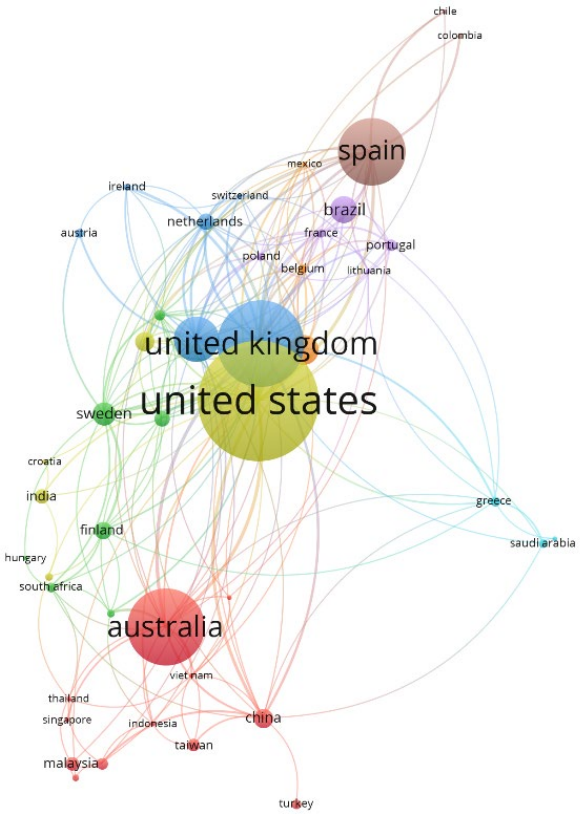

Figure 4 Distribution of publications by years (2011-2020)

In terms of the country, the majority All of the countries/regions listed showed consistent interest in all aspects of online learning research. Different countries/regions, on the other hand, were interested in specific trends. The most effective country was "USA" which produced 177 publications at Duquesne University in Pittsburgh. It is followed by "The United Kingdom," which has an unlimited number of publications (128 in total) within the Organizational Sustainability. Then comes "Australia," with a total of 115 publications within the Royal Melbourne Institute of Technology (RMIT University). In summary, it was discovered that only 16% of the authors of the publication were from developed economies. Through relatively little study among developing countries, research capacity in 'sustainability in future education' is poorly disseminated globally. Table 4 and Figure 4 show data from other prolific, productive countries in the FEES research area.

RQ4: What have been the primary research keywords in the last decade concerning future education and education for sustainability?

The content analysis made for the Top used keywords in future education and education for the sustainability research area, as shown in table 5 and figure 5.

Table 5 Top keywords by the minimum five occurrences

Keyword	Occurrences/Frequency	Total Link Strength
sustainability	100	185
sustainability education	19	57
Higher education for sustainability	20	44
Sustainable activities	13	39
Sustainable learning process	18	37
Sustainable development goals	16	24
Sustainable design	11	26
Sustainable design	8	27
Sustainable design rubric	8	27
Sustainable development goals (SDGs)	8	26
Sustainable development issues	8	25
Sustainability science education	8	20
Sustainability assessment	6	21
Sustainability literacy	5	21
Education for sustainable leadership	5	15
Sustainability Entrepreneurship	5	11
Participatory approach	5	8

Table 5 summarises the most frequent keywords with at least 5 occurrences, with "sustainability" having the highest keyword occurrence. It is followed by "sustainability education," "sustainability higher education," and "sustainable activities." Table 5 and Figure 5 also show the most frequently used keywords.

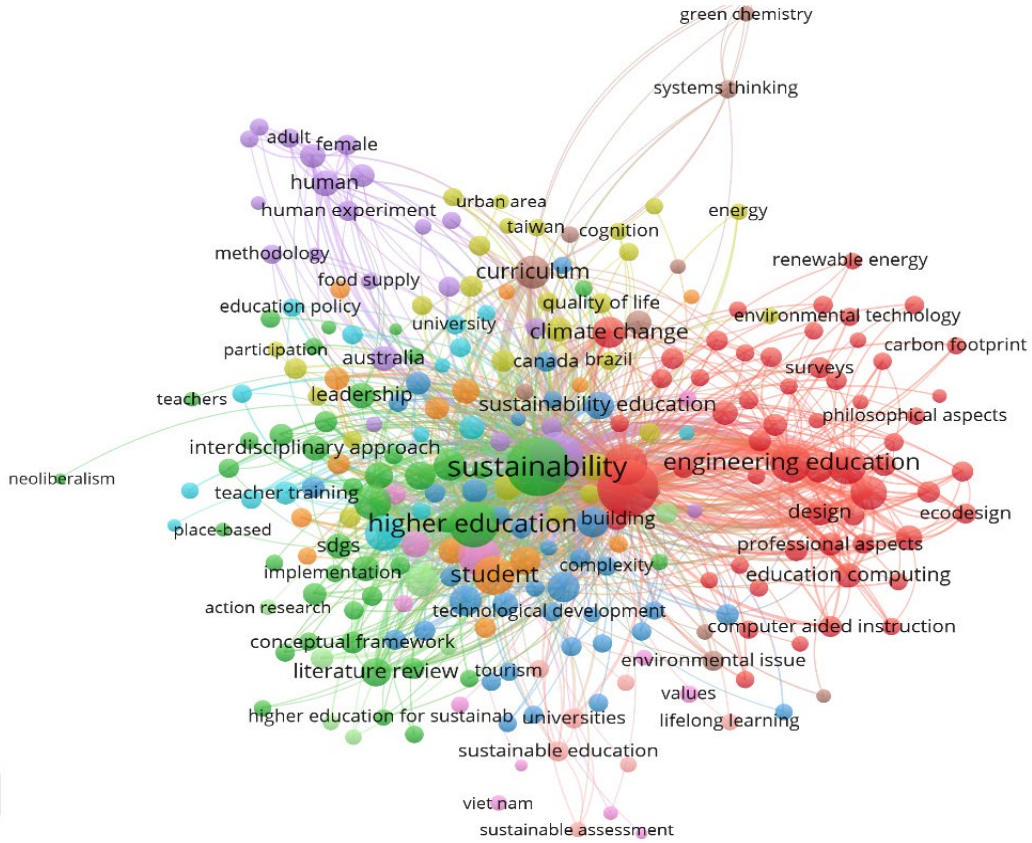

Figure 5 The most productive journals in future education and education for sustainability

■4.0 DISCUSSION

The present review aims to map a knowledge base to investigate the current trends and future agenda of sustainability in future education using bibliometric and content analysis through bibliometric analysis of 2626 found in the initial search in the Scopus database for the bibliometric analysis. After manually screening to exclude irrelevant publications per the criteria, a total of 316 papers were extracted from the Scopus database. We conducted a quality assessment after analyzing documents abstracts where 112 articles were left to examine in this paper between 2011 and 2020. A bibliometric mapping focuses on illustrating knowledge construction tendencies instead of synthesizing research results. Consequently, the review ensured the necessity for research reviews that look at the study's results concerning the current trends and future sustainability agenda in future education.

This review has not reviewed all publications related to sustainability in future education. This review used only the Scopus database since the Scopus database has a large body of publications. Yet, it is impossible to determine to what extent these review findings will represent other databases, such as the WoS database. Thus, this bibliometric focused on 'sustainability in future education.' Therefore, identifying a total of 2626 Scopus-indexed publications published between 2011-2020 presents a guideline for further research in 'sustainability in future education.' Moreover, the analysis of the Scopus database has shown accelerated growth in 'sustainability in future education' publications over the last decade. This trend has been in line with Veiga Ávila et al. (2018) results; their investigation was not limited to 'sustainability in future education' and concentrated on the timeline of 2005-2014.

This conclusion should be explored in a forthcoming study that examines literature in this specific research area. Another remarkable feature of this review is focusing on a small group of western and developed economic societies. More accurately, it was discovered that only 16% of the publication's authors were developed economy societies. Accordingly, such results indicate that perspectives and solutions of sustainability as a term may not be expected to be promptly transferable (Raffe & Semple, 2011; Hallinger, 2020). Such findings indicate a need for 'sustainability in future education 'research based on a wider socioeconomic, cultural, and institutional settings (Hallinger, 2020). Additionally, researchers claimed that the consequences of 'unsustainable development' will be felt more severely in the developing world (Sachs, 2015). Thus, there is a need to integrate sustainability with education and focus more on future education as a source for sustainable development. Developing societies' resource scarcity often leads to a survivor mentality that makes policymakers contradict society's future. Additionally, once the consequences of unsustainable growth occur in growing communities, fewer resources are accessible to avoid the impact of such a phenomenon. This review has concluded that the 'sustainability in future education' publications are published in a widely scattered, over a productive number of journals. Those journals were mainly specializing in social education, development, and the environment The current review's findings were consistent with those reported by Veiga vila et al (2018).

According to the data, the most productive journal in the field of FEES was "Multidisciplinary Digital Publishing Institute (MDPI)" with 10,672 total publications and 720 total citations, followed by "World Sustainability Series" with 170 total publications and 170 total citations, and "International Journal of Sustainability in Higher Education" with 88 total publications and 86 total citations (See table 2).

■5.0 IMPLICATIONS AND FUTURE AGENDA

This review results recommend a few implications. First, while this analysis focused only on English publications that may have one-sided this image, such results suggested that the research capacity in 'sustainability in future education' is poorly disseminated worldwide, through relatively little study among developing countries (see Figure 3). Such findings are presented in the last bibliometric review in administration education (Hallinger, 2020). However, increasing the density of 'sustainability in future education' beyond conventional centers of academic studies must represent an immediate priority. More precisely, this implies a need for research funding and formal programs designed to stimulate 'sustainability in future education' research areas among developing countries. On the other hand, there has been a consistent pattern of growth in the 'sustainability in future education' research area in the last decade among authors from developed countries such as (the United States, United Kingdom, Australia, Spain, Germany, Canada, Brazil, Sweden, China, Italy, Finland, Netherlands, Norway), as well as developing countries such as India and Malaysia. As a result, this is a positive sign for responding to universal efforts to increase interest, support empirical research, and expand capacity in 'sustainability in future education' among authors from developed countries.

Next, this review delimitation to higher education for sustainable development has brought conclusions that extend and complement those that have already been mentioned in research (Veiga Ávila et al., 2018). Results were an analytically verified list of authors, documents, and critical journals that shaped this research area. Such analyses have practical usefulness for academics who work within this research area. For instance, the primary documents and scholars referred to this analysis as new classifications in higher education for sustainable development. These classifications are sustainability in education, future education; Education for Sustainable Development; sustainable learning process; and sustainable development goals. Moreover, knowing these classifications might help shorten the time required to speed on primary conceptual empirical and finding themes. Identifying the emerging intellectual construction of 'higher education for sustainable development' researcher underlines several key areas which may become for further examination by employing critical synthesis review methods, thematic, and traditional narrative.

For future agenda in 'higher education for sustainable development,' results regarding the research methodologies that prevail in 'higher education for sustainable development' knowledgebase represent potential cause and a limitation for concern. Prescriptive reports and qualitative studies are in a position that offers helpful explanatory understandings of a variety of significant issues. Nevertheless, such results indicate a necessity to integrate a more advanced study design capable of contextualizing and documenting learning practices in a cross-disciplinary, rapidly changing research field.

Sustainability researchers should consider tools used in future studies (Kerkhoff, 2017; List, 2006). These appear well suited to studying 'higher education for sustainable development challenges. Lastly, this analysis results strengthen the increasing acknowledgment the education system plays a crucial role in worldwide efforts to attain the UN's SDGs. This is evident in the growth path of 'higher education for sustainable development research, its cross-disciplinary structure, the width of journals that characterize 'higher education for sustainable development' content, journals quality, and researchers in the field that have been prolific in this research area. Altogether, those trends cohere into an image of an evolving cross-disciplinary field of scholarship with the potential to impact practice and policy in coming years.

■6.0 CONCLUSION

This review provided a knowledge base for investigating the current trends and future agenda of sustainability in future education through bibliometric and content analysis. This review found an increase in the number of publications on 'sustainability in future education' over the last decade. This review made a contribution by highlighting the distribution of FEES publications by year over the last decade, the most relevant journals and authors in future education and education for sustainability, the most prolific countries in future education and education for sustainability, and the primary research keywords in future education and education for sustainability over the last decade. The primary recommendation of this review is that higher education institutions' functions and roles be changed to investigate sustainability roles.

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References

Jickling, B., & Wals, A. E. (2012). Debating education for sustainable development 20 years after Rio: A conversation between Bob Jickling and Arjen Wals. *Journal of Education for Sustainable Development*, *6*(1), 49-57.

Combes, B. P. (2005). The United Nations decade of education for sustainable development (2005–2014): Learning to live together sustainably. *Applied Environmental Education and Communication*, *4*(3), 215-219.

Aikens, K., McKenzie, M., & Vaughter, P. (2016). Environmental and sustainability education policy research: A systematic review of methodological and thematic trends. *Environmental Education Research*, *22*(3), 333-359.
Salas-Zapata, W. A., Ríos-Osorio, L. A., & Cardona-Arias, J. A. (2018). Knowledge, Attitudes and Practices of Sustainability: Systematic Review 1990-2016. *Journal of Teacher Education for Sustainability*, *20*(1), 46-63.
Chinedu, C. C., Wan-Mohamed, W. A., & Ogbonnia, A. A. (2018). A systematic review on education for sustainable development: Enhancing TVE teacher training programme. *Journal of Technical Education and Training*, *10*(1).
Figueiró, P. S., & Raufflet, E. (2015). Sustainability in higher education: a systematic review with focus on management education. *Journal of cleaner production*, *106*, 22-33.
Kagawa, F. (2007). Dissonance in students' perceptions of sustainable development and sustainability: Implications for curriculum change. *International journal of sustainability in higher education*. 8(3)
Lozano, R., Lozano, F. J., Mulder, K., Huisingh, D., & Waas, T. (2013). Advancing higher education for sustainable development: international insights and critical reflections. *Journal of Cleaner Production*, *48*, 3-9.
Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning?. *Futures*, *44*(2), 127-135.
Stephens, J. C., Hernandez, M. E., Román, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International journal of sustainability in higher education*. 9(3)
Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for higher education*, *31*(3), 15-22.
Martens, P. (2006). Sustainability: science or fiction?. *Sustainability: Science, practice and policy*, *2*(1), 36-41.
Adomßent, M., Fischer, D., Godemann, J., Herzig, C., Otte, I., Rieckmann, M., & Timm, J. (2014). Emerging areas in research on higher education for sustainable development–management education, sustainable consumption and perspectives from Central and Eastern Europe. *Journal of cleaner production*, *62*, 1-7.
Boström, M., Andersson, E., Berg, M., Gustafsson, K., Gustavsson, E., Hysing, E., ... & Öhman, J. (2018). Conditions for transformative learning for sustainable development: A theoretical review and approach. *Sustainability*, *10*(12), 4479.
Sipos, Y., Battisti, B., & Grimm, K. (2008). Achieving transformative sustainability learning: engaging head, hands and heart. *International journal of sustainability in higher education*. 9(1)
Veiga Ávila, L., Rossato Facco, A. L., Bento, M. H. D. S., Arigony, M. M., Obregon, S. L., & Trevisan, M. (2018). Sustainability and education for sustainability: An analysis of publications from the last decade. *Environmental Quality Management*, *27*(3), 107-118.
Abuhassna, H., Awae, F., Bayoumi, K., Alzitawi, D., Alsharif, A., & Noraffandy, Y. (2022a). Understanding Online Learning Readiness among University Students: A Bibliometric Analysis. International Journal of Interactive Mobile Technologies (iJIM), 16(13), 81–94. https://doi.org/10.3991/ijim.v16i13.30605
Abuhassna, H., Van, N., Noraffandy Y., Zakaria, H., Awae, F., Al Zitawi, D. & Bayoumi, K. (2022b). Strategies for Successful Blended Learning—A Bibliometric Analysis and Reviews. International Journal of Interactive Mobile Technologies (iJIM), 16(13), 66–80. https://doi.org/10.3991/ijim.v16i13.30739
Hao, T., Chen, X., Li, G., & Yan, J. (2018). A bibliometric analysis of text mining in medical research. *Soft Computing*, *22*(23), 7875-7892.
Chen, X., Hao, J., Chen, J., Hua, S., & Hao, T. (2018a). A bibliometric analysis of the research status of the technology enhanced language learning. In *International symposium on emerging technologies for education* , 169-179. Springer, Cham.
Chen, X., Yu, G., Cheng, G., & Hao, T. (2019). Research topics, author profiles, and collaboration networks in the top-ranked journal on educational technology over the past 40 years: a bibliometric analysis. *Journal of Computers in Education*, *6*(4), 563-585.
Chen, X., Xie, H., Wang, F. L., Liu, Z., Xu, J., & Hao, T. (2018b). A bibliometric analysis of natural language processing in medical research. *BMC medical informatics and decision making*, *18*(1), 1-14.
Alsharif, A. H., Salleh, N. Z. M., Baharun, R., Alsharif, Y. H., & Abuhassna, H. (2021). A Bibliometric Analysis of Neuromarketing: Current Status, Development and Future Directions. *International Journal of Academic Research in Accounting, Finance and Management Business Sciences*, *11*(3), 828-847.
Song, Y., Chen, X., Hao, T., Liu, Z., & Lan, Z. (2019). Exploring two decades of research on classroom dialogue by using bibliometric analysis. *Computers & Education*, *137*, 12-31.
Chen, X., Zou, D., Cheng, G., & Xie, H. (2020). Detecting latent topics and trends in educational technologies over four decades using structural topic modeling: A retrospective of all volumes of Computers & Education. *Computers & Education*, *151*, 103855.
Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ... & Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*, *4*(1), 1-9.
Martí-Parreño, J., Méndez-Ibáñez, E., & Alonso-Arroyo, A. (2016). The use of gamification in education: a bibliometric and text mining analysis. *Journal of computer assisted learning*, *32*(6), 663-676.
Tober, M. (2011). PubMed, ScienceDirect, Scopus or Google Scholar–Which is the best search engine for an effective literature research in laser medicine?. *Medical Laser Application*, *26*(3), 139-144.
Agapiou, A., & Lysandrou, V. (2015). Remote sensing archaeology: Tracking and mapping evolution in European scientific literature from 1999 to 2015. *Journal of Archaeological Science: Reports*, *4*, 192-200.
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. *Educational Management Administration & Leadership*, *48*(2), 209-230.
Hallinger, P., & Kovačević, J. (2019). A bibliometric review of research on educational administration: Science mapping the literature, 1960 to 2018. *Review of Educational Research*, *89*(3), 335-369.
Raffe, D., & Semple, S. (2011). *Policy borrowing or policy learning?: How (not) to improve education systems*. Edinburgh: Centre for Educational Sociology.
White, H. D., & McCain, K. W. (1998). Visualizing a discipline: An author co-citation analysis of information science, 1972–1995. *Journal of the American society for information science*, *49*(4), 327-355.
Hallinger, P. (2010). Making education reform happen: is there an 'Asian'way?. *School leadership and management*, *30*(5), 401-418.
Sachs, J. D. (2015). The age of sustainable development. In *The Age of Sustainable Development*. Columbia University Press.
Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability science*, *6*(2), 203-218.
Barth, M., Godemann, J., Rieckmann, M., & Stoltenberg, U. (2007). Developing key competencies for sustainable development in higher education. *International Journal of sustainability in higher education*. 8(4)
Shephard, K. (2008). Higher education for sustainability: seeking affective learning outcomes. *International journal of sustainability in Higher Education*. 9(1)
Brundiers, K., Wiek, A., & Redman, C. L. (2010). Real-world learning opportunities in sustainability: from classroom into the real world. *International Journal of Sustainability in Higher Education*. 11(4)
Thomas, I. (2004). Sustainability in tertiary curricula: what is stopping it happening?. *International Journal of Sustainability in Higher Education*. 5(1)
Barth, M., Adomßent, M., Fischer, D., Richter, S., & Rieckmann, M. (2014). Learning to change universities from within: a service-learning perspective on promoting sustainable consumption in higher education. *Journal of Cleaner production*, *62*, 72-81.
List, D. (2006). Action research cycles for multiple futures perspectives. *Futures*, *38*(6), 673-684.
Kerkhoff, S. N. (2017). Designing global futures: A mixed methods study to develop and validate the teaching for global readiness scale. *Teaching and Teacher Education*, *65*, 91-106.