RGU Journal of Social Science and Research, Vol. 1, Issue. 4 (2025)
(Special Issue on Sustainability and Social Entrepreneurship)
e-ISSN: 3049-3366
DOI: 10.3254/rgujssr.v1i3.84

A Bibliometric Study of Sustainability Education and Awareness during 2014-2024

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ARTICLE INFO

Keyword:
Sustainability Education, Bibliometric Analysis, Co-citation,citation, Bibliography Coupling

ABSTRACT

Based on data collected from the Dimensions database and analysed through VOSViewer, this bibliometric study explores the development of sustainability education and awareness research through the time window of 2014 to 2024. It seeks to summarise the main authors, journals, institutions, and emerging research trends within the extremely broad and rapid response from academia to the global sustainability challenges embodied in the 2030 Agenda and the United Nations Sustainable Development Goals (SDGs). This study applies co-citation, co-authorship and co-word analysis to provide a cognitive mapping of the intellectual structure of the research on sustainability education, identifying key contributors and the main lines of research, including environmental literacy, sustainable development, and education for sustainable development (ESD). The study also investigates the spatial distribution of research output, revealing top performers in sustainability education research by country and region. This bibliometric analysis contributes to global sustainability education by mapping the academic field toward sustainability education and exploring the collaborative networks that emerge from this process. The results help identify gaps in existing research and indicate pathways for future research, particularly with respect to social sustainability, interdisciplinary approaches, and sustainability education in higher?education curricula.

1. Introduction

Education occupies a central position in the response to the growing ecological crises of climate change, biodiversity collapse and depletion of natural resources that we now face, as it provides knowledge, values and skills for sustainable?development. According to UNESCO, Education for Sustainable Development (ESD)?is transformative in nature, and it is a process that empowers and enables people to develop the knowledge, skills, attitudes, and values to contribute to a sustainable and equitable future (United Nations Educational, Scientific and Cultural Organization, 1924). Introduction the last decade a significant interest from the scholarly community has centered on sustainability education and awareness due to a significant recognition that education systems and programs need to be?transformed towards a more sustainable focus in order to meet the complex and interdependent nature of global sustainability challenges. Yet the explosion of publications in recent years makes it difficult for researchers and policy-makers to synthesize evidence, spot emerging trends, and identify key?themes. Answering these questions is important from not only scientific but also practical points of view, and bibliometric analysis - mapping scientific literature using

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quantitative methods based on citations, co-authorships and publication patterns - provides a systematic solution to?this challenge [6,7]. In fact, mana recently bibliography used studies that are attached to higher education researching SDGs, the e areas of pursuit, second collections, large guides, institutes, and popular language in the field?(Dönmez, 2024; Kopp &Tafese, 2025).This study represents a new general theoretical framework and contextual approach to sustainability education and awareness research, focusing on 2014-2024, the period since the first comprehensive bibliometric analysis of the field was?published. Introduction this decade is crucial because it includes many prominent global events, namely the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015, featuring quality education (SDG 4) and?responsible consumption and production (SDG 12) as significant items within the global agenda, followed by the discovery of education and sustainable development (ESD) frameworks in educational institutions around the world (Aldawsari, Nemtallah& Abdellatif, 2025).It explores extensive publication volume, citation networks, co-authorship?clusters and keyword trends to give insights into how the international academic community have addressed sustainability within the context of education within the last two decades. Such initiatives have begun to?be evaluated experimentally and the findings highlight their importance and efficacy. Consider, for example, a 2025 survey of university?students in Egypt which found a strong positive association ($r = 0.848$, $p < .001$) while environmental education awareness (within the SDGs framework) and pro-environmental responsibility together account for almost 72% of variance in?responsible behavior (Aldawsari, Nemtallah& Abdellatif, 2025. In parallel,?a range of innovative pedagogical approaches - such as ICT-based interventions and virtual reality learning environments - have been designed to enhance environmental knowledge, agency and sustainable behaviors in students (Guerra Mota et al., 2024).However, scholars also highlight ongoing deficiencies and obstacles despite?these positive trends. Environmental education programs are?being conducted around the world but so little is known about the extent to which the programs catalyze long-term behavioral change and create systemic sustainability. Additionally, the intersection of environment,?economy, society, and ethics that characterizes the very essence of sustainability requires that research and curricula operate beyond boundaries defined by traditional disciplines (Tafese& Kopp, 2025).In this context, this bibliometric study provides a comprehensive overview of the research activity on the?topic of sustainability education and awareness, over a critical past decade. Its objective is to find key contributors (authors,?journals, institutions), leading research trends, spatial distribution, and future directions. These results are intended to serve entering students and educators, researchers,?and policymakers with the best development and venue to reinforce and direct future efforts in education for sustainability so that it continues to respond to changing global issues and build environmentally literate and socially responsible citizens.

Literature review:

The existing scholarship on sustainability education and awareness has?become quite extensive in recent years due in part to the increasing global interest in integrating sustainable development principles in education systems. Various bibliometric and systematic reviews have attempted to map these developments illustrating both maturing and diversification of the field (Dönmez, 2024; Bora,?M., & Barman, B 2017).One key strand?of literature reviews the wider context of sustainability education in higher education institutions (HEIs). For instance,(?. Meanwhile, Dönmez 2024) highlighted that the educational research trajectory has moved away from a narrow interpretation?of environmental education with a larger vision of sustainable education, indicating the contribution of education towards global sustainability objectives through a bibliometric analysis. Likewise, a study by (Tafese and Kopp 2025) surveyed research trends in higher education and ESD from 1990-2023 that also reported published works increased significantly from 2018 onwards - peaking approximately in 2022 - indicating an increasing

awareness of the contribution of higher education to SDGs, or sustainable development goals.Similarly, prominent journals, authors and countries leading the discourse can also be identified through bibliometric analyses [30]. To illustrate, systematic mapping studies have frequently found a common set of authors (e.g. Gericke, Leal?Filho, Kopnina) and countries (e.g. China, Spain, Germany) that are giant contributors in the higher education domain. In addition, works of sustainability performance of institutions, implementation of principles of sustainability in campus functionality/operations and curricula holds scholarly attention (Kopp &Tafese, 2025;Barman?Bikramaditya, M. Thematic reviews, which could provide another layer of complementary discussion to bibliometric studies, explore?conceptual clarity and educational outcomes. For instance, (Sánchez et al. A systematic literature review (SLR) by Shabaz &Yasir Hussain (2025)has been performed to review different definitions of "Sustainability Literacy (SL)" and "Environmental Literacy (EL)" throughout the studies, how they connect with ESD/EE (Environmental Education),?and what are their learning outcomes. The findings of the researchers demonstrate the ways in which SL and EL intersect with ESD and indicate a need for integrating principles of sustainability in curricula at all levels, focusing on critical and systems thinking, as well as interdisciplinary competencies. Against this backdrop?remain empirical research studies pointing out the strong possibility of sustainability education triggering awareness and behaviour. Recently, a cross-sectional survey among Egyptian?university students have reported a very strong positive correlation ($r = 0.848$, $p <. 001$), and accounted for 71.9% of the variance in environmental responsibility (Aldawsari, Nemt?allah& Abdellatif, 2025; Barman et al., 2025). This undermines the frequently mentioned "knowledge-action gap" and indicates that well-designed sustainability education can spur pro-environmental behaviourchange. At the same time, research continues to highlight the need for sound implementation plans. However, embedding sustainability into HEIs - be it in curricula, in campus operations, or in terms of institutional governance - has proven to be a vexed challenge. Given that most research continuously addresses sustainability from the environmental and economic domains, one review notes that the social dimension of sustainability has been neglected (Tafese& Kopp, 2025; Barman B. 2024). Likewise, scalable pedagogical techniques - experiential, project-based, community-oriented, transformative learning, etc. - are being touted as superior to traditional lecture-based approaches.

Nevertheless, gaps and challenges remain. Prior literature has noted the need for more varied geographic representation - beyond the West and beyond the developed world - to reflect global views (Dönmez, 2024). We also find the need for more robust empirical studies measuring long-term behavioural, societal impacts and increased attention to social sustainability, equity and inclusion - dimensions which lie at the heart of sustainability goals. All in all, recent publications highlight a dual trend: (1) an expansion and deepening of scholarly attention to sustainability education across a diversity of disciplines and institutions and (2) a shift away from theory and concept to empirical evidence of education helping to build awareness and responsibility. Yet, future research needs to explore less-explored dimensions, especially social sustainability and perspectives from the global south, as well as more longitudinal and?impact-oriented studies.

Methodology:

For this specification of sustainability education and awareness for the decade 2014?to 2024, we initially derived data using the metrics database, Dimensions, the recent and most holistic bibliographic database of articles, conference proceedings and other types of scholarly output across a range of disciplines. Dimensions was selected based on its completeness and depth of coverage of research articles, citation data, and indexing of journals, books, and patents. This study period was between 2014 to 2024, which was a period of considerable global change in sustainability research, policy and practice following the introduction of the United Nations Sustainable

Development Goals (SDGs) in 2015, which has positioned education for sustainability firmly at the forefront of global agendas. This study is based on a wide-ranging set of documents to cover the research landscape, while focusing on peer-reviewed journals,?conference proceedings and book chapters relevant to the field. Retrieved documents.

Data Processing:

VOSviewer is a software tool for creating and visualizing bibliometric networks, with which the raw data imported from the Dimensions database was?extracted .Overthe co-citation, co-authorship, and keyword co-occurrence analysis, we used?the VOSviewer software package . The data processing was?carried out in the following steps:

Step 1: Data Importation running a query on the Dimensions database we?imported the data into VOSviewer. This included data on citation,?year of publication, authorship, keywords and journal titles.

In this stage, the records are removed for duplicates and irrelevant records (such as records not belong to research items or documents other than records?to be selected). The inclusion?criteria were based on articles and papers published in peer-reviewed journals only.

Keyword and Author Analysis: VOSviewer?was implemented to spot leading authors, journals, and keywords. The results of this tool included networks of keywords that co-occurs with each other frequently in titles, abstracts, and keywords?of selected publications. We have then scrutinized these keyword networks for research themes,?trends, and the evolution of topics in sustainability education and awareness.

Co-citation and Co-authorship Analysis:In order to determine which works, authors, and journals are most frequently cited?together (and hence would appear as co-citations), we performed co-citation analysis to find influential works and contributors in the field. Likewise, co-authorship?analysis revealed collaborative patterns, highlighting the network of sustainability education research groups and institutions working in tandem.

Out?of these, VOSviewer created network maps based on co-citation, co-authorship, and keyword co-occurrence for mapping and visualization. The maps represented the correlations between authors, institutions,?countries, and research topics. The resulting visualizations helped us discover research clusters, potential champion authors, and top journals of?the field.

Analytical Methods:

Citation Analysis : To assess the impact of the research, citation analysis was carried out to identify?the top authors, top cited papers, and top journals by frequency. Citation count of a specific paper or author is very indicative of the impact?within the field.

Co-citation Analysis: co-citation identifies pairs of documents, authors?or journals that appear together in the bibliography of a third work and therefore shows thematic or intellectual similarity or association. The paper maps the intellectual structure of the field using meta-analysis based on co-citation analysis?and identifies the research clusters and major works in the area.

Co-authorship Analysis: This analysis identified?the collaborative structure of the research community in relation to sustainability education. The research study highlighted the dominant research institutions and countries engaged in the most collaborative?research in this area through analysis of co-authorship linkages.

Keyword Co-occurrence Analysis: This analysis was used for identifying?the core research area and advances on sustainability education and awareness. We were also?able to plot the advent of new topics, changing foci in research, and the interconnectedness of disciplines in sustainability education through the frequency of co-occurrence of specific keywords in publications.

Limitations

Although Dimensions and VOSviewer are comprehensive, the study understands the limitations of performing a bibliometric analysis as part?of a study. These include:The dependence on indexed publications which may miss some grey literature?(i.e., reports, conference papers not in

Dimensions).

This creates a situation in which earlier publications may dominate the citations, thus introducing the risk of citation bias since high-cited works may block the?path for newly emerging research. The difficulty in maintaining term consistency across keyword analyses since authors may use different terms to reference the same construct.

Objectives:

1. To Identify Key Authors, Journals, and Institutions
2. To Analyze Emerging Research Trends and Themes
3. To Explore the Geographical Distribution of Research
4. To Understand Collaboration Patterns

Data analysis:

Co-authorship and author:

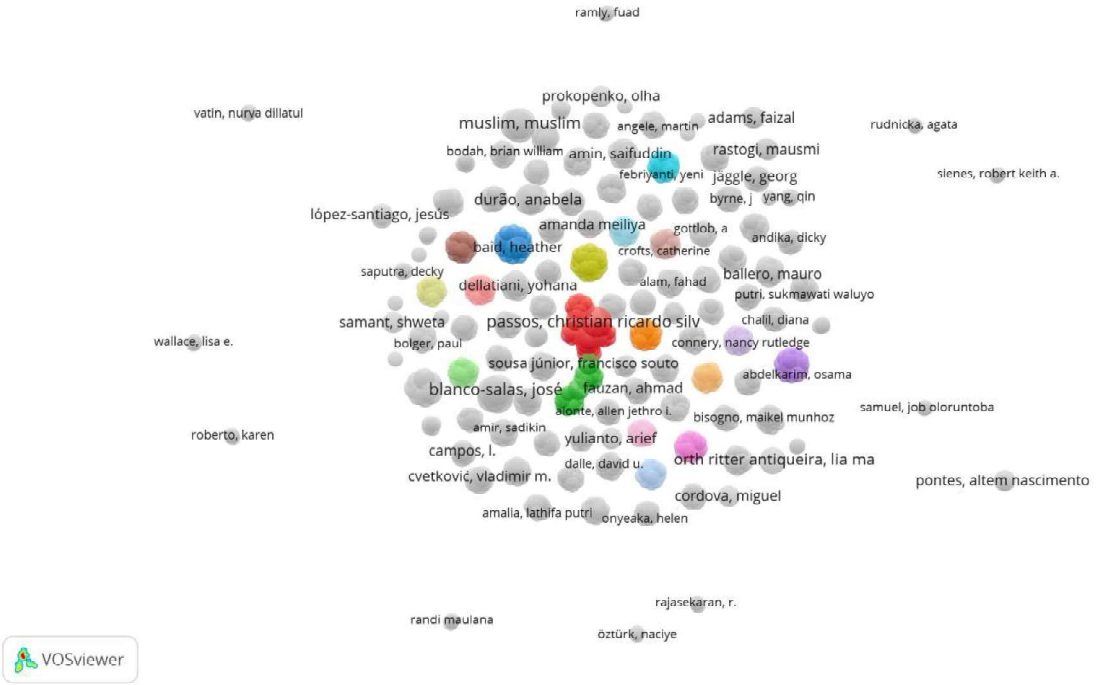


Figure 1 : A visualization of a co-authorship network (each node (circle) is an author; edges (lines) between nodes mean the nodes are co-authors) Authors who write?together regularly are situated next to one another, and the size of the nodes indicates author centrality or the degree of contribution to the network. The color coding groups authors into clusters, so if you have a cluster with a?similar color, it means they all co-authored together. It shows the links between authors who published together on papers, some of highlighted ones are Christian Ricardo Silv for Heather Baid, Mauro Ballero, for example, and the community is split into clusters, indicating the different sub areas of this intellectual community.

Co-authorship with organization:

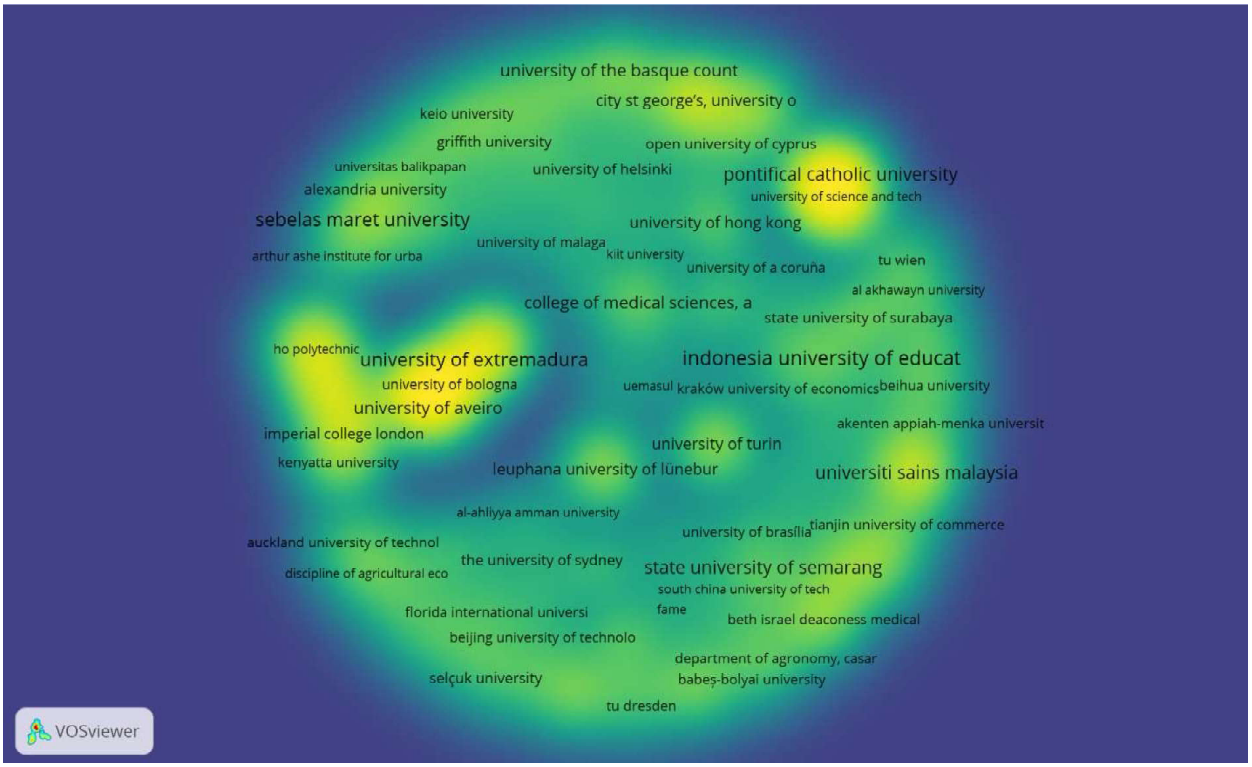


Figure 2: Co-authorship network?of different universities/institutions in the field Two organizations in the network are co-authors if a specific set of criteria are met (e.g., "double affiliation" criteria); nodes are located based on the frequency and strength of co-authorships in the network, and the co-authorships are represented by edges; the size of the nodes is relative to the organizations and the number of publications published by each node. Green to yellow reflects the density of connections, with the hottest areas indicating the highest concentration of collaborations. Located in one of the high-density regions, institutions such as University of Extremadura, Pontifical Catholic University and University of Aveiro clearly associate themselves through close collaborative work. Through co-authored research, the network also illustrates a global nature of academic collaboration, showing how institutions from various world regions-including Asia, Europe, and the Americas-are connected.

Co-authorship with country :

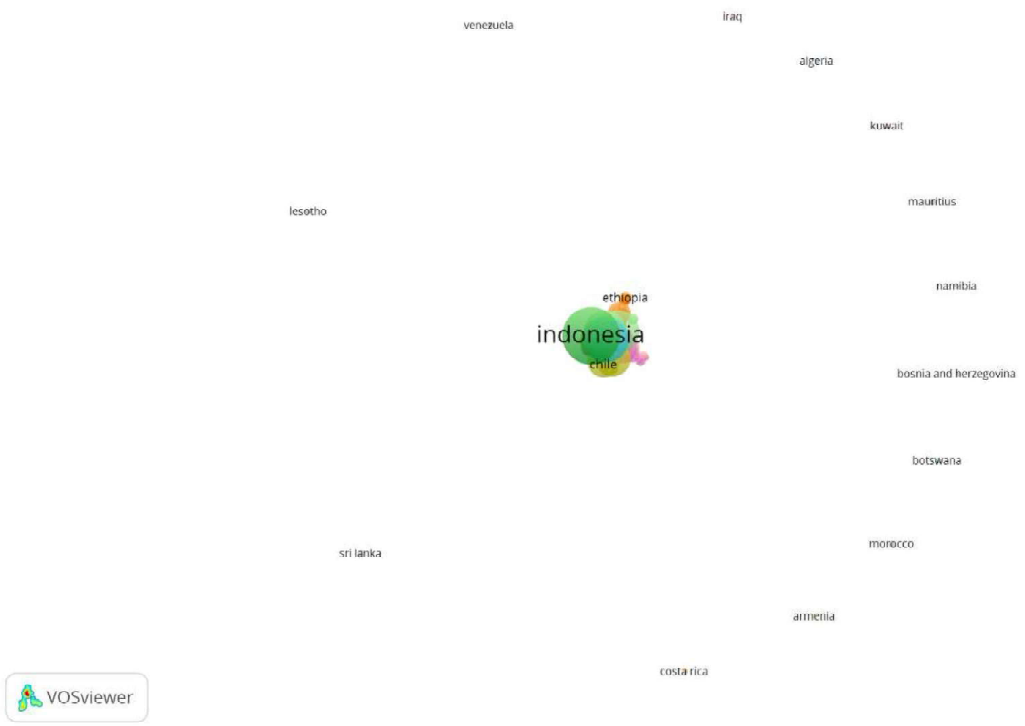


Figure 3 is a map of the country collaboration network, and node size and position indicate each country's collaboration intensity with other countries. The countries are grouped according to the rate of participation in co-authorship networks. Indonesia, for example, is in the center with other countries like?Ethiopia, Chile, and Sri Lanka, indicating the country collaborates closely with them. Here, nodes are colored and sized by co-authorship ties, with nodes inflated for stronger or more frequent academic co-authorship ties (brighter, larger nodes). The map shows the international nature of research partnerships, listing countries heavily involved in co-authored academic papers.

Citation with document :

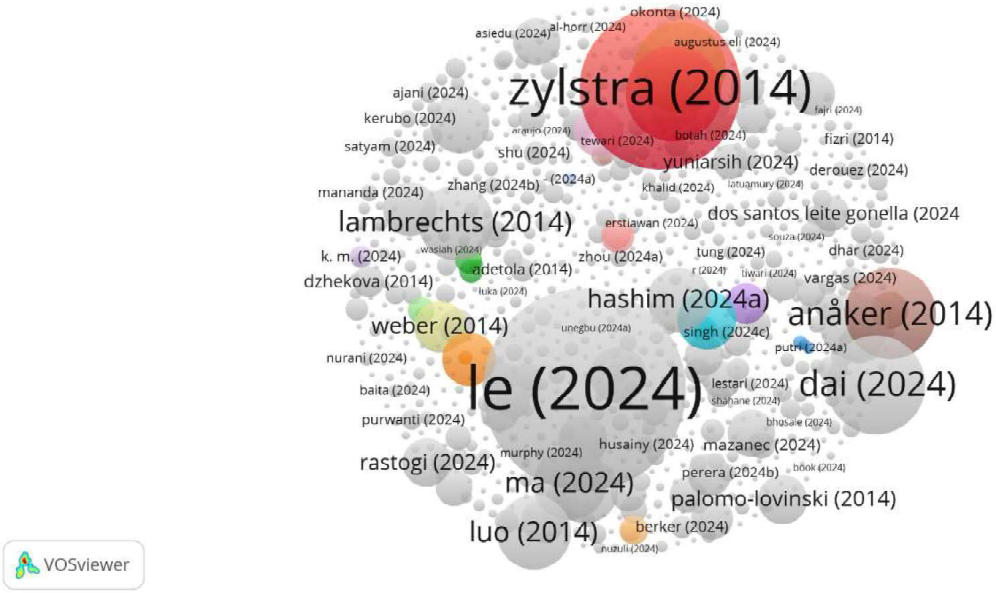


Figure 4 is a visualization of a citation network indicating the relationships and linkages between authors and their published documents; each node represents an author and their node is sized by the number of citations received by their work. Now surround nodes colored by publication year (i.e. 2014 & 2024) and positioned based on citation patterns. The bigger and red nodes (Zylstra, 2014) are highly cited authors or documents, and smaller and light grey nodes are less-cited works. Edges between the nodes represent the links between authors based on their shared citations. Nodes that have similar citation patterns or that co-author papers should be more closely linked to each other in the network. The following map indicates the most impactful and cited bodies within that discipline, enabling us to see major papers and how they're connected to each other through citation?in the academic community.

Citation with source:

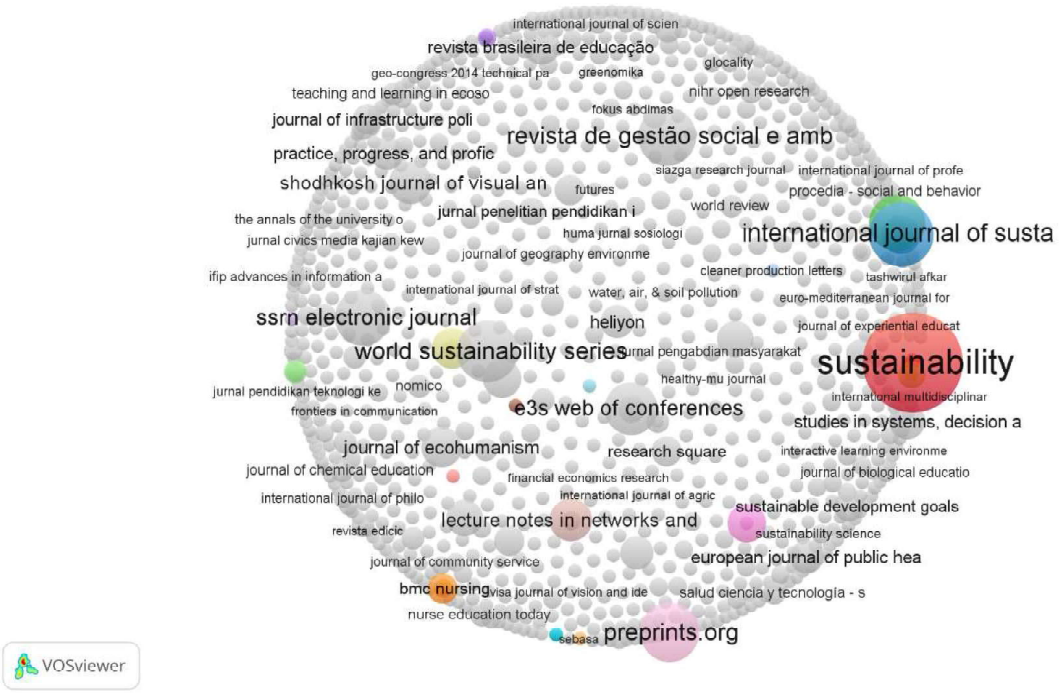


Figure 5,?Citation network of alternative sources of Academic Journals - Sustainability. The nodes represent individual journals and publications and the size of each node denotes the count of citations or the impact ofthe journal in the corresponding networks. Journals with larger node sizes and closer proximity to the centre of the visual such as Sustainability and International Journal of Sustainability, have higher citation frequencies. The coloursmay separate broad categories of programming (sustainability vs environmental sciences vs social happiness, etc.) The edges between the nodes here are citation links between those journals; the thicker the edge, the more one journal cites the other, generating a rich web of interlocking academic articles. This visualisation shows important nodes of research in sustainability and their high-level citation and scholarly relationships.

citation with author



Citation network visualization: Relationships between authors in citation network (figure 6) Here each node represents an author, and each node size in the graph corresponds to the volume or impact of an author's work, measured in citations. Different clusters of authors are?grouped together by color and the edges between them show which authors cite each other, indicating strong citation links. For example, AfiahNunuy Nur, Fauzan Ahmad, Julie M. Davis found a significant and representative node size as authors in this network. By seeing the graph, emphasizing on representative authors of academia by citational networks and a sources of their citation, as where the nodes are located in correlation with their contribution to the literature of the field of RCS and QLC, and on their citation count.

Citation withorganisation:

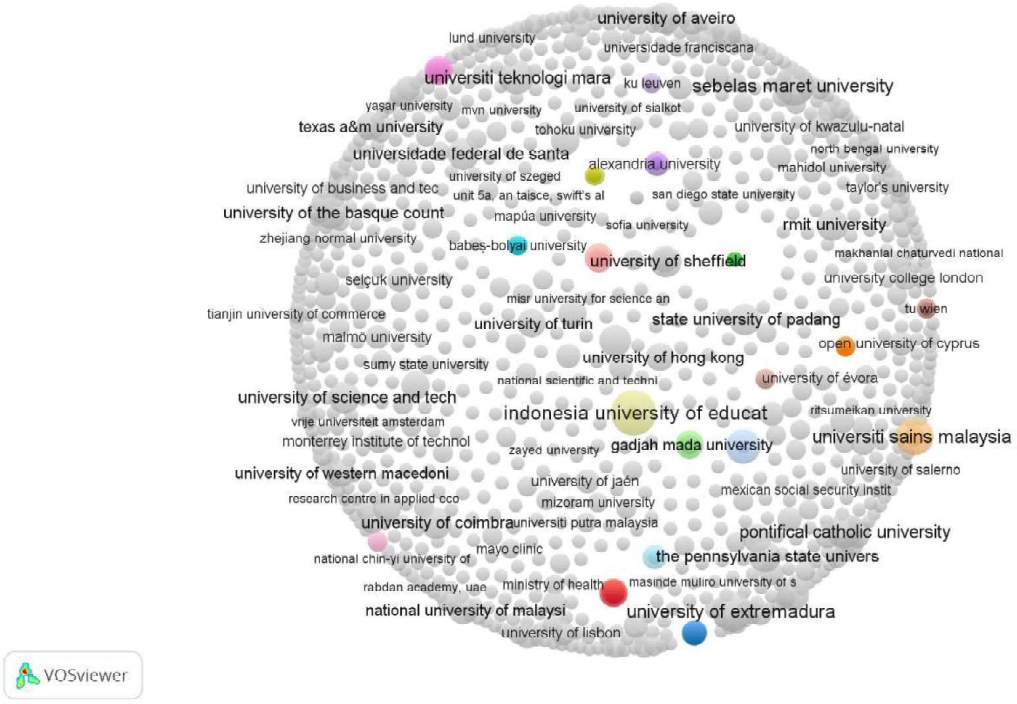


Figure 7: Citation Network of Academic Organizations or Institutions [7. Note how large the each of the nodes represent the citationof the institution in the network, where the greater the frequency the larger the node. These center institutions are represented with a relatively large node,such as UniversitiTeknologi Mara, University of Extremadura, and University Sains Malaysia, which indicates a high citation of these institutions in the network. The edgesbetween the nodes represent citation links that illustrate the collaborations or citations that occur between these institutions. The color coding might differentiate between narrow subsets of institutions, and the?centrality of the nodes show how similar the institutions are based on the similarity of their citation patterns. This infographic visualises the scholarship across the globe and how universities are interlinking one another through citations.

Citationwith country

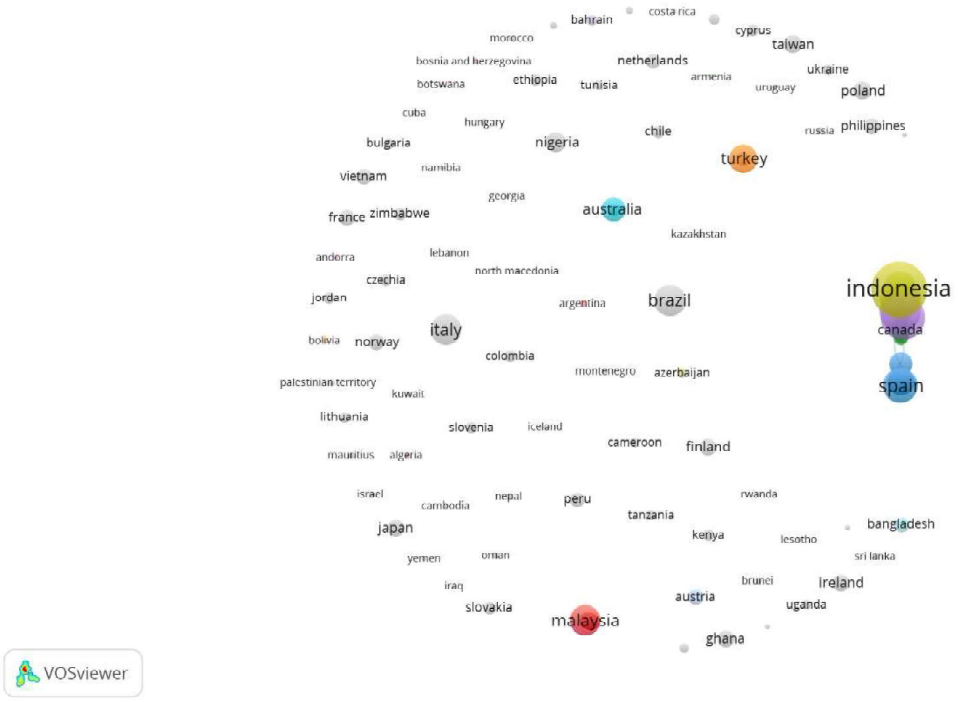


Figure 8 Citation network map Source: MapThese data are up to October 2023The nodes represent the countries, and their size indicates the number of citations/influence the country has in the network. Closer positioning of nodes implies stronger academic collaborative and citation ties?Walker et al., 2007, 2008. For instance, Indonesia, Spain and Australia are big nodes - that is, the citation activity from these countries is more pronounced. The countries are probably seen on geographical regions or citation-wise, such as Malaysia in the South, Brazil in West, and Turkey at the middle, grouped in clades. The lines between the countries are citation links, reflecting the academic exchange between nations. Working on this visualisation that focuses on the flow of research globally and how countries cite each other in scholarly literature.

Bibliography coupling with document :

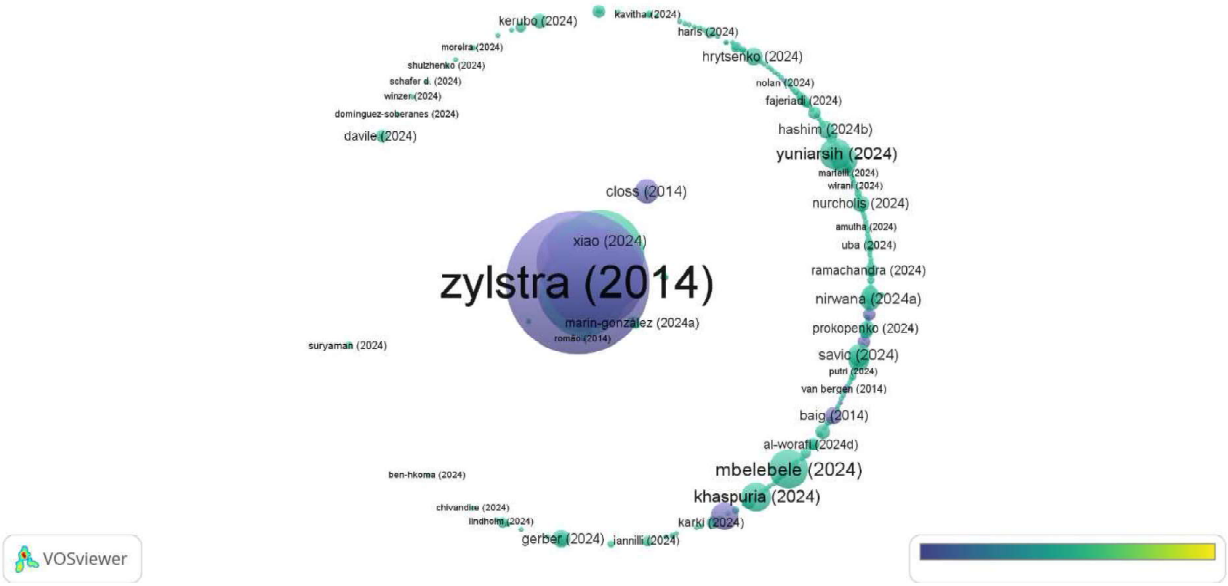


Figure 9 is an example of a bibliography coupling network where each node is a document (author year), and the size?of the node represents the degree of references or citations of the document. The undirected lines connecting nodes indicate bibliography coupling, when two documents cite the same reference. Figure 1 - Zylstra (2014) As A Central Node In The 2014 Idea Network It has out edges to surrounding documents, shown as Xiao (2024), Kerubo (2024), and Hytsenko (2024), which share references with Zylstra (2014). This colour gradient displays the degree of coupling, with warmer colours showing a stronger bibliographic coupling. This map depicts a clustering of related documents in which?the relationship between publications is based on their common citations, and identifies the most crucial work in the academic circle.

Bibliography coupling with source

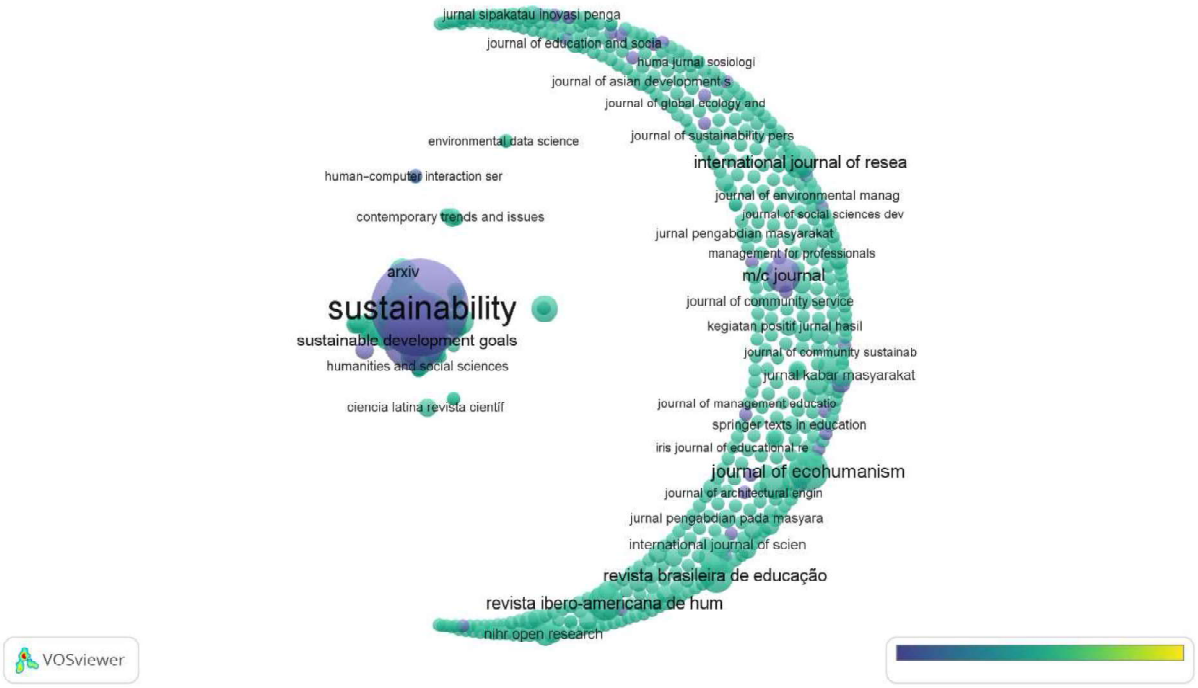


Figure10 Glossed based on academic sources, a bibliography coupling network where each node represents a journal (or publication), and the size of the node is the magnitude or frequency of its presence in the network. The edges that connect these nodes are bibliography coupling, which is the citation or references shared by that journal. Both Sustainability and Sustainable Development Goals are clearly visible as important central nodes, indicating that they are highly influential?nodes within this network. Encompassing them is a set of morespecialised journals - Journal of Ecohumanism, Journal of Community Service, and International Journal of Research - which are tightly clustered by virtue of their co-citations. The color gradient represents coupling strength, where warmer colours signify a stronger citation relationship. This figure facilitates identification of which sustainability and related field journals are connected by shared references, illuminating the academic sources that support and respond to sustainability discourse.

Bibliography coupling with author:

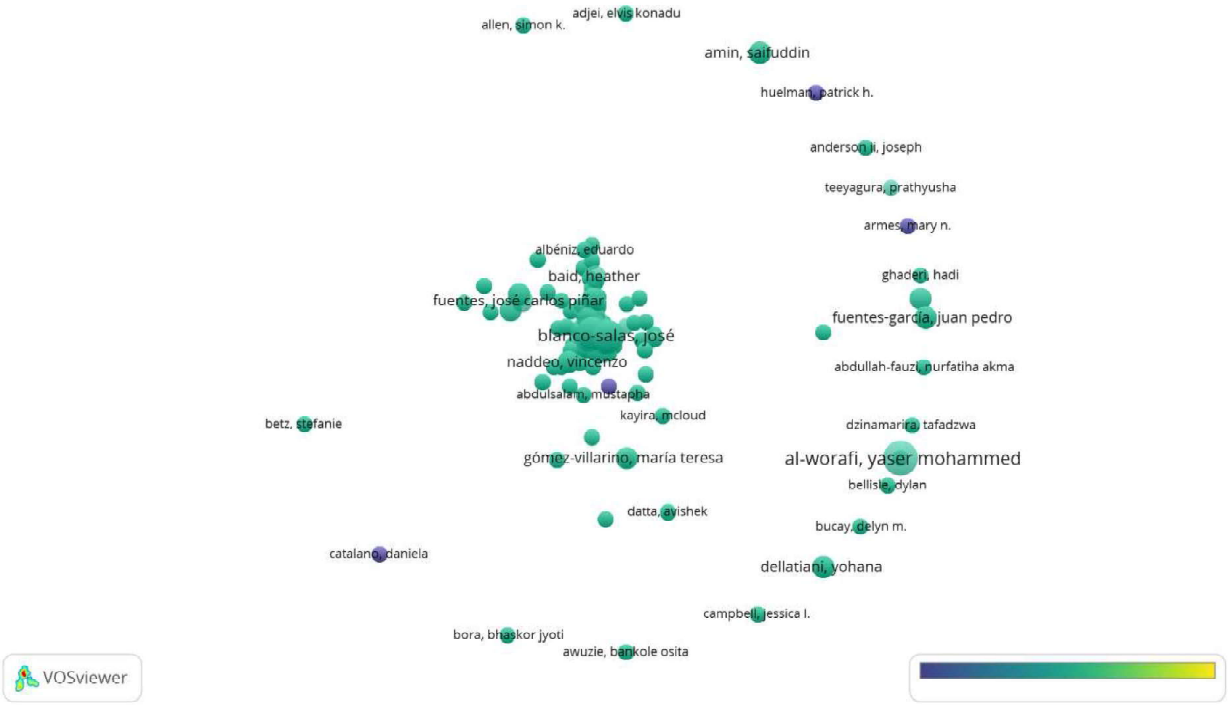


Figure 11 presents an author-based bibliography coupling network, where researchers are represented as nodes and the edges among nodes represent the citations and/or references between their writing. Authors that often cite each other or commonly reference are clustered together, and the distance in the network indicates academic relationships. For instance, authors such as Heather Baid, José Blanco-Salas and Vincenzo Naddeo are tightly linked which indicates that they have many references in common or work in the same field of investigation. Darker shades denote stronger coupling between the fitting bands. It allowed us to use the visualization such as the one I just retrieving, where the main nodes are authors, connected each other by sharing academic resources (this represents the academic collaboration), example are the others authors which articles are cited by the one that can be seen as the main node, Voronoi nodes help focus on key people within particular areas of research based on their citation patterns, and for this part are OK.

Bibliography coupling with organization:

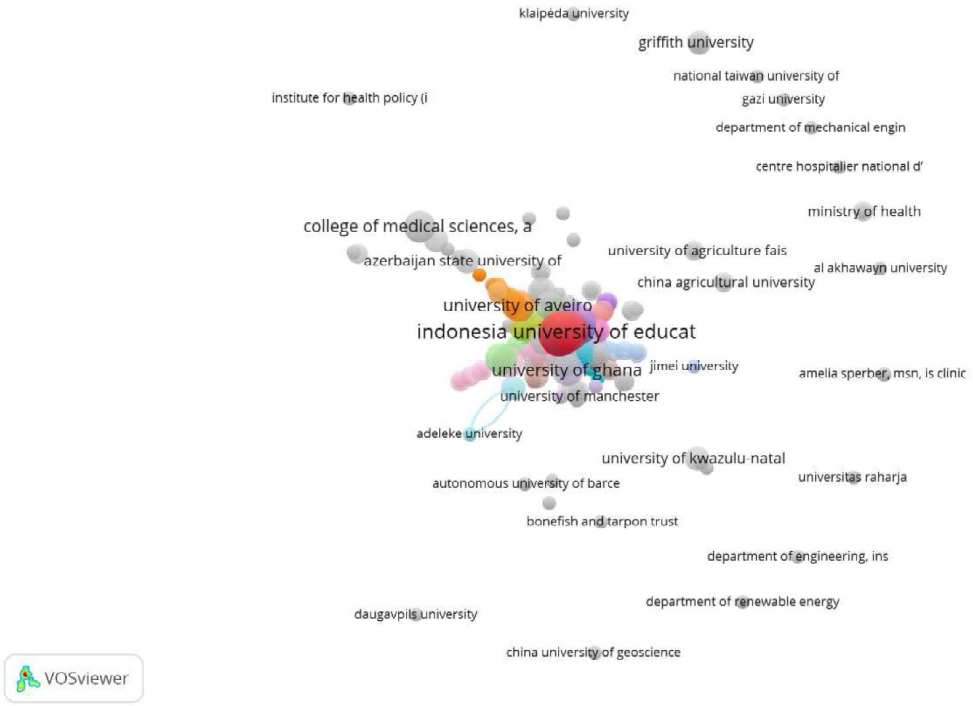
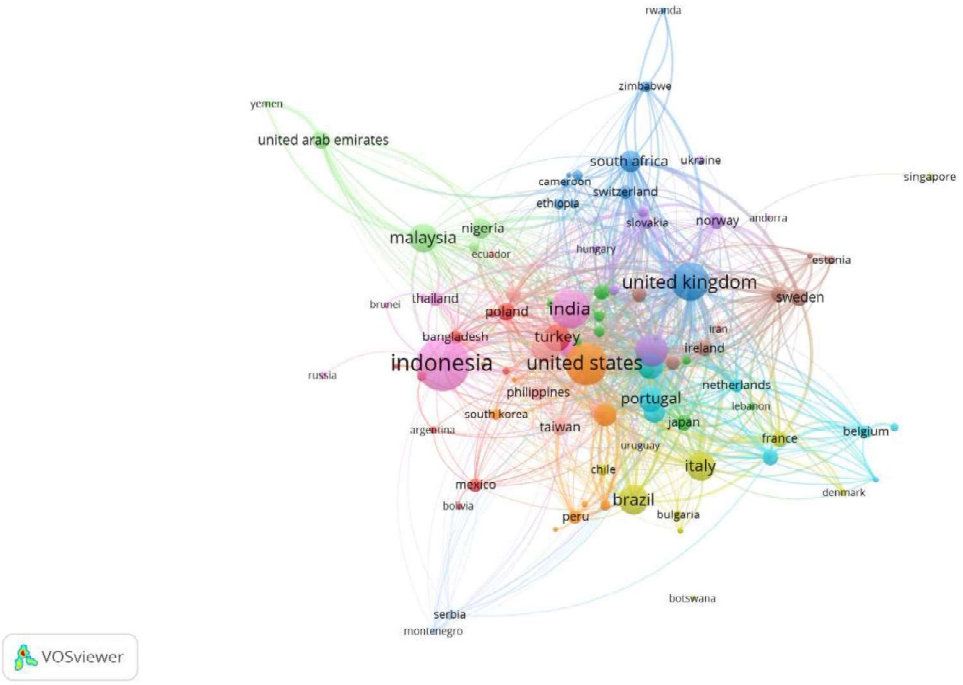


Figure 12: Bibliographic coupling network of academic organisations, nodes represent university/research institution. The edges between the nodes can be read as citations, in the sense that these organizations cite similar papers or work in related research areas. For example Indonesia University of Educat and University of Ghana are shown close to one another, implying a great deal of citation sharing. The colours probably reflect different clusters or classes of institutions, and each colour is likely to represent a unique academic discipline or collaboration network. The nodes in size and position show how influential or central to the network the institutions are, with larger nodes representing the bigger or more frequently cited institutions. This is a visualization of different academic institutions and how they relate to one another through similar citations, thus indicating collaborative patterns in the research environment.

Bibliography coupling with country:



Country-level data can also be plotted - Figure13 shows a bibliography coupling network with a country as a node and an edge representing a country that papers co-cited or collaborated on. Figure 13 depicts the network of countries based on the global citation network of their academic publications, which hosts well connected nodes majorly in the center node level like India, Indonesia, United States, and United Kingdom. The clusters of color represent countries that recognize each other in the academic literature relatively often. The nodes size reflects the importance of these countries in terms of citation network and the edges reflect the citation (collaboration) strength. Through this image, you can get an overview of the world academia and the interconnectedness of research and citations between countries.

co-citation with cited reference

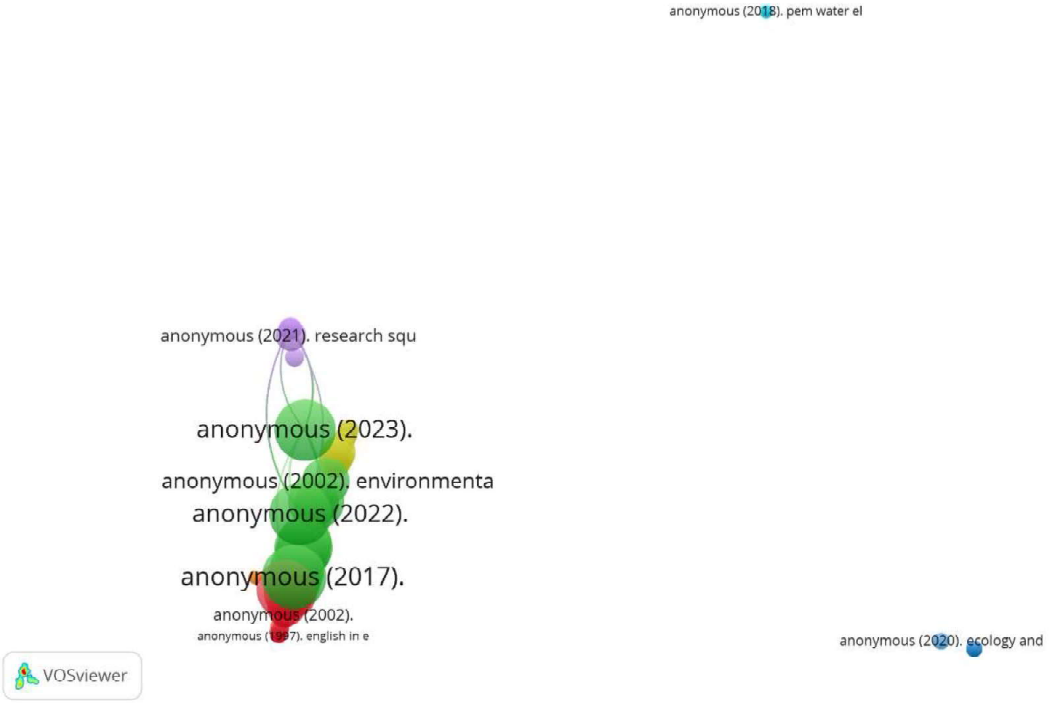


Figure 14Co-citation network, with nodes corresponding to a cited reference, and links between them representing the fact that the two references are co-cited in academic works. Such a node arrangement indicates comparative relations of the nodes for having same or similar citation structure. For instance, Anonymous (2023); Anonymous (2022); Anonymous (2021) refer to works written with anonymity in such a way that they are offset, demonstrating they are cited together in accordance with participation in conducting simultaneous research. Assuming the colour coding is to identify different clusters of references grouped by contextual relevance, i.e, themes or areas of research. The area of the nodes could be proportional to the number of citations of these references. This visualisation uncovers the relationship of cited works based on their appearances in scholarly citations — showing how often works appear together and highlighting the most influential ones together providing an overview of the academic discourse around particular topics or areas of research.

co-citation with cited sources

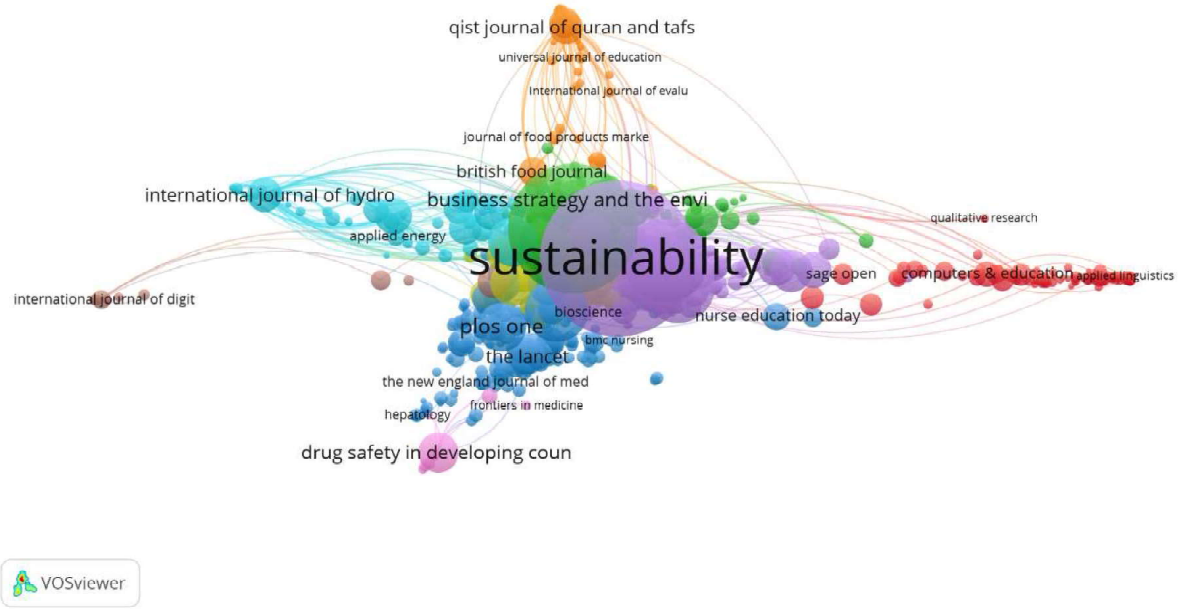


Fig 15 depicts a co-citation graph with nodes for every cited source (e.g. a journal) and edges between nodes where they are known to be co-cited together. Sustainability is clearly the central node, meaning that it is frequently co-cited with journals from a variety of fields. Other groups are PLOS One and International Journal of Hydro and Drug Safety in Developing Countries, all clustered by discipline around it. Color coding the journals by clusters: green and blue — sustainability and environmental journals; purple — business and social sciences; and red — education and linguistics. The links illustrated above suggest that citations of academic works on sustainability are nearly as likely to cite other academic works on sustainability as they are to cite research from a multitude of fields, establishing an interdisciplinary nature of the topic. This visualization shows the subjects of academic research and how each subject is interconnected based on shared citations of their respective literature.

co-citation with cited author:

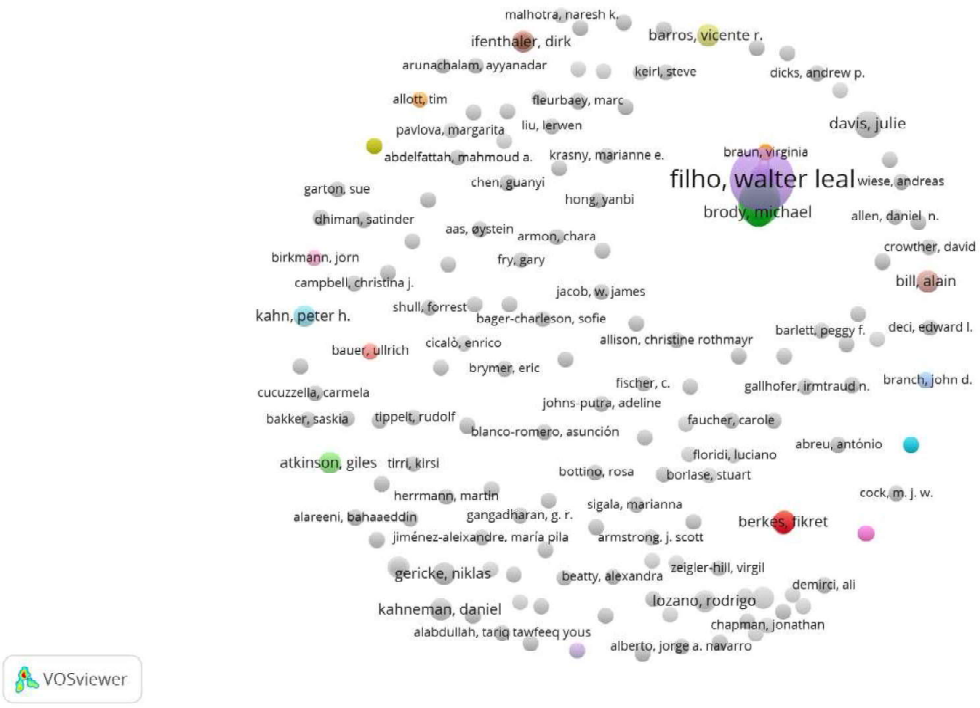


Figure 16 is a co-citation network based on authors where the nodes are the cited authors and the edges denote they are frequently cited together in academic papers. The location and aggregation of the nodes uncover clusters of authors that are frequently cited together in academic papers. Nodes marked in dark blue indicate strong centrality of both nodes, such as Walter Leal Filho and Michael Brody, suggesting those authors are the most frequently appearing authors that get co-cited together in the network. The colours probably correspond to different research themes or disciplines, where authors are clustered according to related citations. A bigger node signals a more prominent authors (e.g., cited more in this field of academia, e.g., Peter H. Kahn and Giles Atkinson). It serves to indicate some of the major authors in the area, their scholarly impact and the connectivity of their work in so far as overlapping references.

Findings:

The above analyses offered a microcosmic perspective of academic research networks based on co-citation and bibliography coupling at authors, journals, organizations and country-level. Revealed via co-citation networks, citation ties of authors grouped by strong citation ties found co-citation networks under environmental sustainability and environmental research demand more attention to influential authors (such as Walter Leal Filho and Michael Brody) who seem disconnected by hardly any citation ties to others (as Peter H. Kahn and Giles Atkinson) but still influential. This is even more apparent in the clusters of journals relatable to the expressed academic themes, like the journals Sustainability, PLOS One, and International Journal of Hydro clustering together based on prevalent topics of sustainability and environmental science. Country-level bibliographic coupling also demonstrates global academic collaboration, with countries that frequently co-author and cite each other forming central nodes in a diamond shaped country-level coupling network (India, Indonesia and United States in this case). Furthering this

interdisciplinarity assumption, the landscape of journal and author networks reveal to which academic fields nations, such as Brazil, Turkey, and Malaysia, also contribute." The interdependence underscores the collaborative nature of global research, emphasizing the importance of common references in influencing academic discourse across disciplines and regions.

Conclusion:

Starting with the bibliometric analysis of sustainability education and awareness (SE&A) for the past decade (2014-2024), this paper highlights the increasing interdependence and interdisciplinary in the research of sustainability education and awareness. The prominent co-citation analysis and bibliographic coupling also indicate authors, journals, and institutions with a significant number of academic collaborations across various disciplines as well as the fast-growing popular research fields of the two key categories, like sustainability, sustainable development goals and environmental education,emerge as a few of the key topics that have received significant research attention. This provides evidence for popular journals (e.g. Sustainability, PLOS One, International Journal of Hydro); and authors (e.g. Walter Leal Filho, Michael Brody). Additionally, nations such as India, Indonesia, and the USA have taken an important part in redrafting the worldwide academic discourse, giving high priority to environmental awareness and education. The findings of this study illustrate the importance of sustainability education in shaping research agendas at the global level, enabling international collaboration, and disseminating environmental awareness in academic and policy debates.

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