Bibliometric Analysis of Sustainable Leadership Using Visual Mapping Technique

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Abstract

Sustainable leadership is a necessity to achieve the goals of sustainable development, such as addressing complex global issues, preserving environmental and social balance, ensuring the well-being of future generations, and promoting innovation. Sustainable leadership in education is important to contribute to sustainable development goals by equipping future generations with environmental, social, and economic responsibilities and integrating sustainability principles into the education system. This study aims to determine the current state of research containing the term "sustainable leadership" by conducting a bibliometric analysis using the Web of Science (WoS) database. The VOSviewer software is employed to visually represent the data obtained from the WoS database. According to the comprehensive bibliometric analysis results, research related to the theme of "sustainable leadership" began to emerge in 2002, with a total of 390 publications identified in the period from 2002 to 2023. The majority of these publications are in the form of articles, reflecting the interest and curiosity within academic circles in this field. However, considering the lower presence of other document types such as conference papers, book chapters, and review articles, there appears to be a growing need for these types of sources. The bibliometric analysis reveals that research on sustainable leadership is predominantly published in the form of articles, with a significant increase observed, particularly in publications from 2019. The VOSviewer analysis of the "sustainable leadership" field categorizes the most commonly used terms into three clusters: "sustainability", "sustainable leadership", and "leadership". In terms of the distribution of articles in the field of sustainable leadership by citing countries, the countries with the highest number of citations are Thailand, South Africa, the United States, and China, respectively. The findings of the analysis are believed to contribute as a resource for future research and benefit researchers in exploring potential topics related to the theme of sustainable leadership in the near future. Additionally, it is noted that there is limited research on sustainable leadership in Turkey, and recommendations are provided for its further development.

Keywords: Sustainable leadership, Sustainability, Leadership, Bibliometric analysis, VOSviewer

Introduction

In an era characterized by unprecedented global challenges, such as climate change, resource depletion, and societal disparities, the notion of sustainability has emerged as a foundational doctrine. It guides not only organizations but also communities and individuals in their actions (Rockström et al., 2009). This critical juncture necessitates individuals possessing profound insights into the intricate interplay among ecological, social, and economic dynamics. These individuals, commonly referred to as sustainable leaders, assume a central role in instigating transformative changes directed toward harmonizing current imperatives with the expectations of forthcoming generations (Liao, 2022).

Sustainable leadership transcends the confines of traditional managerial competencies, embodying a paradigm that encompasses the capacity to embrace the comprehensive well-being of ecosystems and societies, surpassing immediate gains (Kantabutra, 2012). Sustainable leaders are tasked with responsibilities that span beyond strategic planning, encompassing the cultivation of ethical values, stakeholder engagement, and the promotion of innovative initiatives conducive to positive change (Hallinger and Suriyankietkaew, 2018). Sustainable leadership represents an approach geared towards steering organizations to operate with consideration for both short-term objectives and enduring sustainability goals (Avery and Bergsteiner, 2011). Its significance extends

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beyond the economic realm, encompassing environmental, social, and societal domains. Sustainable leadership endeavors to strike a balance between environmental, social, and economic responsibilities while taking into account the needs of future generations (Bansal, 2005). Educational organizations, being open systems, are subject to the influence of shifting environmental and societal conditions. Furthermore, instances of sustainable leadership can serve as a source of inspiration for students, faculty, and other stakeholders, encouraging the display of positive behaviors and values (Hargreaves and Fink, 2004). Additionally, it can equip organizations with the ability to adapt to future challenges, foster innovation, and bolster employee commitment (Çayak, 2021). Furthermore, the sustainable leadership approach can assume a pivotal role in risk management, enhancing organizations' capacity to proactively identify potential issues (Liu and Heizmann, 2018). Consequently, this leadership approach holds the potential to fortify sustainability within an organizational culture and engender a more profound alignment of internal stakeholders with these values. In light of this, the exigency for educational organizations to be led by individuals possessing sustainable leadership acumen becomes increasingly salient, as they must navigate the complex terrain of both environmental and societal shifts.

In the realm of education, sustainable leadership represents a strategic paradigm of growing significance within contemporary educational systems (Hargreaves and Fink, 2004). This pioneering leadership approach extends its purview beyond immediate educational objectives, instead prioritizing the comprehensive development of future generations' capacities and awareness. Sustainable leaders do not merely endeavor to enhance the current accomplishments of educational institutions; they are committed to the cultivation of students as individuals equipped with ethical values, environmental stewardship, and social consciousness. These leaders are catalysts for the cultivation of innovative and sustainable practices across a broad spectrum of domains, ranging from pedagogical methods to institutional governance. Sustainable leaders within educational organizations can be characterized as individuals whose sustainable practices continue to exert a lasting influence, even when they assume leadership roles in different educational institutions. Consequently, despite the frequent turnover of leadership within educational institutions, organizations led by sustainable leaders tend to manifest reduced levels of emotional strain, turnover intentions, and cynicism (Hargreaves & Fink, 2004). In line with these studies, Moreira et al. (2022) have found that sustainable leadership enhances employees' perceptions of organizational support, places value on their competency development, and mitigates their intentions to leave their positions Çayak and Çetin (2018) have demonstrated that the sustainable leadership behaviors of school principals can predict high levels of organizational commitment and job satisfaction among teachers. Dalati et al. (2017) have ascertained that sustainable leadership can enhance employees' levels of organizational trust.

The conceptual framework of sustainable leadership within educational organizations holds considerable interest and significance. It not only pertains to the contribution of the education sector to sustainability but also serves as a guiding force in the evolution of leadership practices (Hallinger and Suriyankietkaew, 2018). In this context, the execution of a bibliometric analysis of sustainable leadership within educational organizations represents a noteworthy research undertaking. Bibliometric analysis offers a systematic and quantitative examination of articles, publication trends, and key authors within academic literature (Van Eck and Waltman, 2020). The conduct of such analysis assumes importance in comprehending the potential contributions of sustainable leadership within educational organizations to both the domains of education and leadership. Moreover, it aids in the identification of prevailing trends within this area of study. Such analyses provide insights into the current state of the literature and its evolutionary trajectory over time and, consequently, point towards avenues for future research. Furthermore, bibliometric analysis can facilitate the elucidation of interdisciplinary collaborations and interaction networks, offering a multidisciplinary perspective on the subject. Bibliometric analysis holds paramount importance within the realm of educational science, offering a systematic and quantitative means to assess scholarly output and trends in this field. Through the analysis of academic publications, citation patterns, and author networks, bibliometrics provides invaluable insights into the dissemination of knowledge, the impact of research, and the identification of seminal works This methodological approach enables researchers and educational policymakers to discern the most influential authors, journals, and research themes, thereby informing decisions regarding resource allocation, curriculum development, and the identification of emerging research directions (Mingers & Leydesdorff, 2015). Moreover, bibliometric analysis serves as a tool for benchmarking the research productivity of educational institutions, facilitating international comparisons, and fostering collaboration among researchers in this multidisciplinary field (Van Eck & Waltman, 2010). Thus, bibliometrics not only enhances the transparency and accountability of educational research but also contributes to its continuous evolution by illuminating the dynamics of knowledge creation and dissemination.

Method

In this research endeavor, the thematic discourse surrounding "sustainable leadership" has been scrutinized within the timeframe spanning from 2002 to 2023. The objective of this investigation has been to delineate prevailing research trends in this domain through the application of bibliometric analysis techniques to the pertinent scholarly literature. The acquired dataset has been subjected to tabulation and visual mapping methods for visualization. Bibliometrics, a methodological tool of significance, serves a multifaceted role in academia. It aids in the identification of authoritative sources in scientific publications, facilitates the assessment of recent developments and alterations in the scholarly landscape, contributes to the establishment of an academic foundation, and permits the evaluation of research outcomes (Visser and Courtice, 2011). Furthermore, it offers a means of objectively evaluating the work of scientists while quantifying scientific quality and productivity (Leal Filho et al., 2020). Within this context, bibliometric analyses assume a prominent position as quantitative methodologies that depict institutions, nations, research institutes, journals, publishers, universities, authors, and the intricate networks of citations and relationships. These analyses provide valuable academic guidance about the subject under examination (Erer et al., 2023).

Contemporary bibliometric analyses can be executed using a variety of databases, complementing traditional methods. Databases such as Web of Science (WoS), Scopus, Google Scholar, PubMed, and MEDLINE are among the most commonly favored sources for conducting bibliometric inquiries (Chen, 2017; Kahraman, 2022). For this study, the WoS database was employed. WoS enjoys recognition as a pioneering academic literature database within the social sciences and encompasses the proceedings of international conferences, symposia, seminars, workshops, and congresses (Martinez et al., 2015). Notably, this database possesses a distinguished impact factor and provides fundamental metadata, including abstracts, references, citation statistics, author affiliations, institutional origins, countries of origin, and journal impact factors (Donthu et al., 2021).

As this study has been designed as a bibliometric analysis, it does not fall under the classification of research requiring ethical approval. Consequently, in the initial stage of the investigation, on May 28, 2023, the search query "sustainable leadership" was employed in the WoS database using the formulation ALL= ("sustainable leadership"). Although adjustments were made to encompass all years within the database, the analysis encompassed scientific publications between the years 2002 and 2023 due to the presence of "sustainable leadership" research within the database since 2002. In the subsequent phase, the VOSviewer software was harnessed to generate visual representations of the acquired dataset. VOSviewer is a recognized software tool employed for creating, visualizing, and exploring network-based maps founded on diverse datasets (Van Eck and Waltman, 2020). In this context, this study first conducted assessments based on data extracted from the WoS database. Subsequently, publications about sustainable leadership underwent analysis utilizing the VOSviewer software, encompassing aspects such as publication types, temporal distribution, research domains, leading countries of activity, text-based mapping, keyword analysis, co-authorship networks, citation patterns, and co-citation patterns. The ensuing findings are expounded upon below.

Results and Discussion

As previously stated, on May 28, 2023, a systematic search was carried out within the Web of Science (WoS) database utilizing the query ALL=("sustainable leadership") to retrieve a comprehensive corpus of 390 scholarly works spanning the publication period from 2002 to 2023. The WoS platform furnishes comprehensive data about the dissemination of retrieved studies categorized by publication year, research domains, prominent authors contributing the highest volume of publications, and the citation indices in which these studies are indexed. The resultant compilation delineates the various publication types obtained through the WoS inquiry, accompanied by the corresponding numerical count for each category, as delineated in Table 1.

Table 1. The types of studies conducted on sustainable leadership

Document Type	Number of studies
Article	234
Proceeding paper	94
Review article	42
Book chapter	28
Book	1
Book review	9

As can be seen in Table 1, there are a total of 234 articles, 94 conference papers, 42 reviews, 28 book chapters, 1 book, and 9 book reviews scanned in WoS related to "sustainable leadership. Figure 1 presents a bar graph

depicting the chronological distribution of studies examined in the Web of Science (WoS) database. Notably, the first study on the subject matter emerged in 2002. This inaugural study, titled "No Easy Answers: Research and Innovation for the Forestry Sector," was conducted by J.D. Wright and subsequently published in the "Forestry Chronicles" journal. Except for the year 2003, every subsequent year featured at least one study addressing the subject matter. Although the number of studies related to the subject was relatively limited until 2010, the period spanning from 2011 to 2018 witnessed a consistent annual surge, with the number of studies surpassing 15. Significantly, in 2019, there was a remarkable upsurge in studies about the subject, culminating in a total of 86 publications within that year.
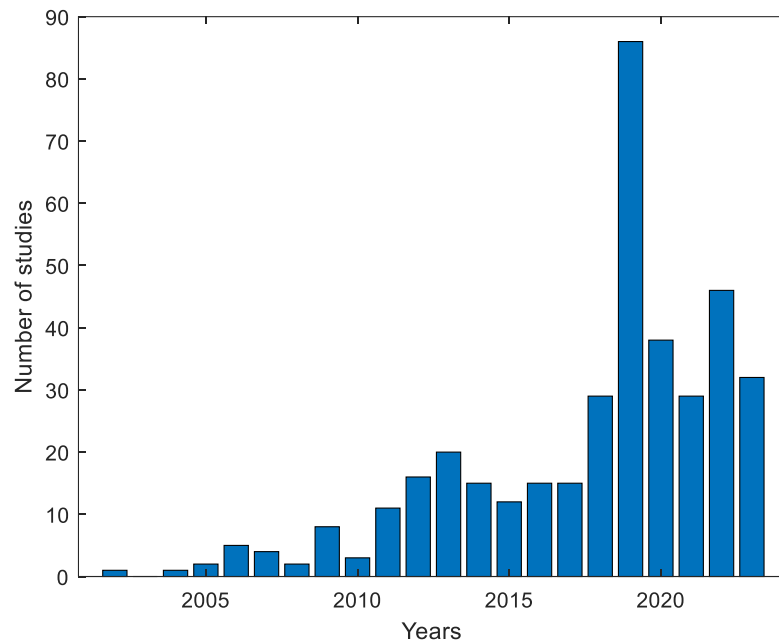

Figure 1. Distribution of studies on sustainable leadership by years

Subsequent years continued to yield a substantial volume of research, with 38, 29, 46, and 32 studies published, respectively. Table 2 complements this analysis by providing insights into the research fields associated with the studies scanned in WoS. The first column of Table 2 delineates the study types, while the second column enumerates the corresponding quantities for each category. It is important to note that Table 2 exclusively features the nine fields where the highest number of studies were conducted.

Table 2. The main research areas of study on sustainable leadership

Research categories	Number of studies
Green Sustainable Science Technologies	140
Management	134
Education Educational Research	130
Environmental Sciences	79
Environmental Studies	73
Business	45
Economics	10
Engineering	10
Multidisciplinary Psychology	12

As indicated in Table 2, the predominant research categories about the subject encompass, in descending order, "Green Sustainable Science and Technologies," "Management," and "Educational Research," accounting for 140, 134, and 130 studies, respectively. Additionally, there are a combined total of 79 and 73 studies associated with the domains of "Environmental Sciences" and "Environmental Studies". Furthermore, within the realms of "Business," "Economics," "Engineering," and "Multidisciplinary Psychology," the research landscape comprises 45, 10, 10, and 12 studies, respectively.

Table 3. Distribution of studies on sustainable leadership according to the WoS index

Citation Index Type	Number of studies

Social Science Citation Index	152
Emerging Resources Citation Index	99
Extended Science Citation Index	98
Conference Paper Citation Index (Social and Humanities)	83
Book Citation Index (Social and Humanities)	29
Conference Paper Citation Index (Science)	18
Book Citation Index (Science)	3
Arts and Humanities Citation Index	1

Table 3 presents the distribution of studies about sustainable leadership within the Web of Science (WOS) index. Upon careful examination of Table 3, it becomes evident that the majority of research publications addressing this topic are categorized under the "Social Sciences Citation Index." Specifically, the Social Sciences Citation Index encompasses a total of 152 studies conducted on this subject. Moreover, an investigation into various citation index categories, including the "Emerging Sources Citation Index", "Expanded Science Citation Index", "Conference Proceedings Citation Index (Social and Human Sciences)", "Book Citation Index (Social and Human Sciences)", and "Conference Proceedings Citation Index (Physical Sciences)," reveals that 99, 98, 83, 29, and 18 studies have been indexed in each of these respective categories. In contrast, the citation index categories with the lowest representation of related studies are the "Book Citation Index (Physical Sciences)" and the "Arts and Humanities Citation Index," each containing three and one study, respectively.

Keywords Analysis

A visual mapping analysis was performed employing the VOSviewer software to illustrate the prevailing keywords and their interrelationships within the body of literature about sustainable leadership as indexed in the Web of Science. By establishing a selection threshold of five within the VOSviewer software, a visual map was constructed, featuring 24 out of the 923 most frequently utilized keywords in this domain. Figure 2 illustrates the resulting visual map, while Table 4 presents the top 10 keywords, along with their corresponding frequencies, that were most frequently employed in the literature.
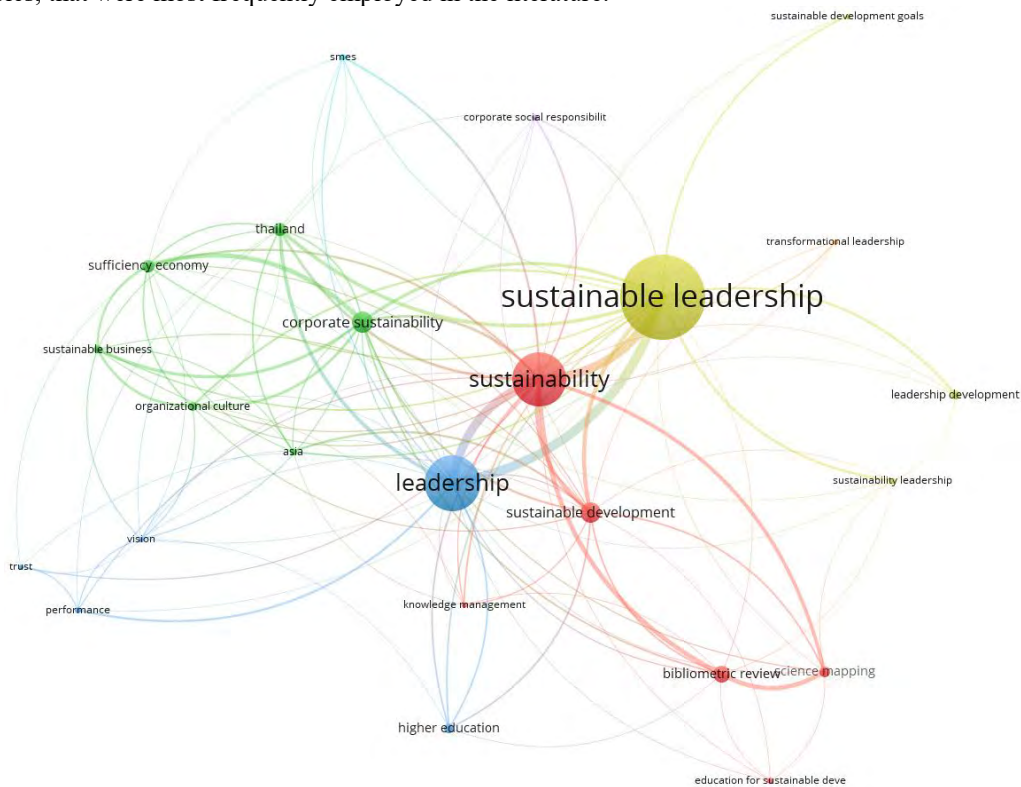

Figure 2. Types of words used related to sustainable leadership

As depicted in Figure 2, an analysis of studies about sustainable leadership reveals the prominence of three keywords: sustainability, sustainable leadership, and leadership. Furthermore, the subject is associated with several other significant terms, such as sustainable development, bibliometric analysis, corporate sustainability,

and higher education. An interrelation is observed between the terms sustainability and sustainable development and bibliometric analysis. Similarly, the term leadership exhibits close associations with higher education, success, trust, and vision. Figure 2 also illustrates the connection between sustainable leadership, leadership development, and transformational leadership. The keywords illustrated in Figure 2, along with the corresponding frequencies of their occurrences in the conducted studies, have been documented in Table 4. It is evident from Table 4 that the term "sustainable leadership" is the most prevalent keyword associated with the subject matter, occurring 104 times.

Table 4. Mostly used sustainable leadership keywords

Word	Number of Uses
Sustainable leadership	103
Leadership	64
Sustainable	62
Corporate sustainability	22
Sustainability development	21
Bibliometric review	17
Thailand	13
Sufficiency economy	12
Science mapping	11
Higher education	10

Following this, the next frequently employed keywords are "leadership" and "sustainability," with frequencies of 64 and 62, respectively. The remaining terms, apart from the top three, exhibit comparatively lower usage frequencies, typically around 22 or less. These terms, listed in decreasing order of frequency, encompass "corporate sustainability", "sustainable development", "bibliometric analysis", "Thailand", "competency economy", "science mapping", and "higher education".
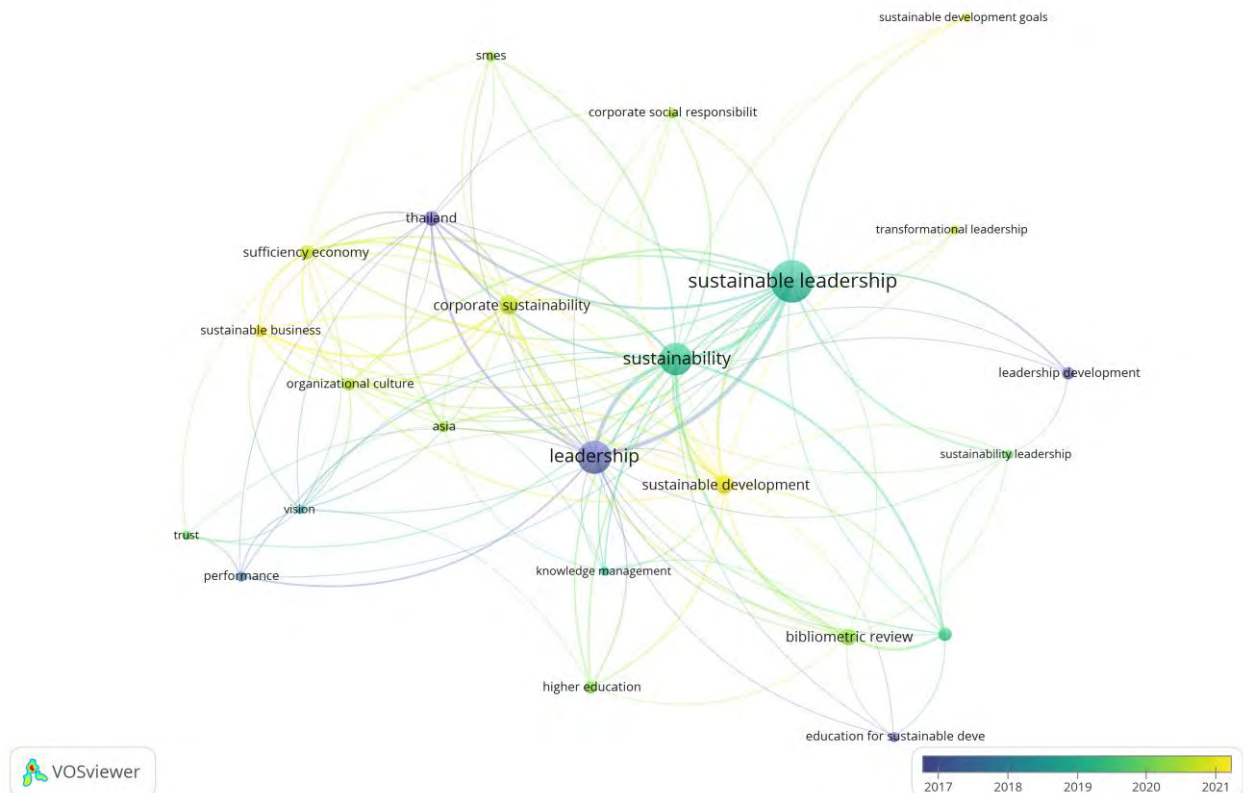

Figure 3. Distribution of keywords used regarding sustainable leadership by years

The VOSviewer software facilitates the retrieval of the temporal distribution of identified keywords about sustainable leadership. This functionality allows for an investigation into the periods during which these keywords garnered greater prominence. Figure 3 illustrates a visual map representing the chronological distribution of keywords utilized in research on sustainable leadership. Upon scrutiny of Figure 3, it is discernible that in 2017, the keywords "leadership", "Thailand", and "education for sustainable development" exhibited noteworthy prominence. Between 2018 and 2020, the keywords "sustainability", "sustainable

leadership", and "bibliometric analysis" assumed central positions, and their interconnections with previously prevalent keywords from earlier years are evident in Figure 3. In 2021 and subsequent years, keywords such as "sustainable development", "corporate sustainability", "competency economy", and "sustainable business" garnered substantial attention. Figure 4 provides a visualization of keyword density, with yellow signifying high density, green denoting moderate density, and navy blue indicating low density. Upon examination of Figure 4, it is apparent that "leadership", "sustainability", and "sustainable leadership" are the most heavily utilized keywords, while the other keywords mentioned in Figure 3 exhibit moderate levels of utilization.
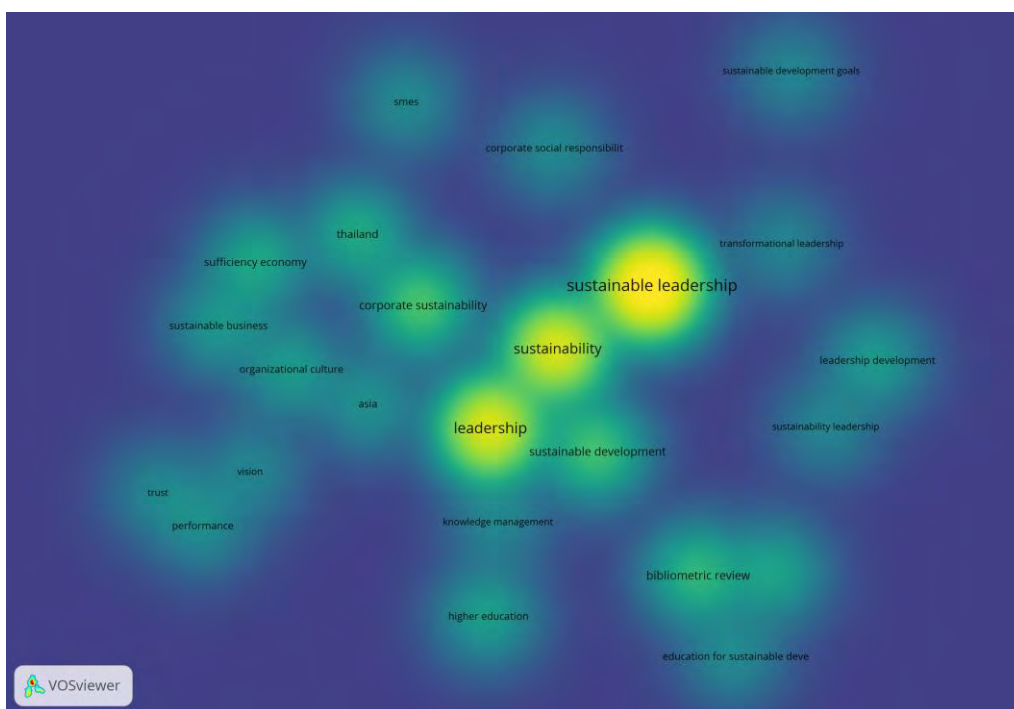

Figure 4. Density map of the keywords used for sustainable leadership

Co-Authorship Analysis

Through the utilization of co-authorship analysis, this study has discerned the key contributors, academic institutions, and international collaborators engaged in substantial collaborative efforts within the domain of sustainable leadership, as manifested in network visualizations. This co-authorship investigation has strategically underscored those scholars exhibiting the highest degrees of collaborative involvement in the realm of sustainable leadership research. Because of this comprehensive analysis, it was ascertained that 823 authors were encompassed within this purview. By imposing a criterion of a minimum of four publications and citations, it became evident that 13 researchers met this predefined threshold. Figure 5, provided herein, furnishes a network map delineating the identities of researchers who partake in the most robust collaborative endeavors amongst themselves.

Figure 5. Co-authoring network map

Upon thorough analysis of Figure 5, it becomes apparent that the researchers exhibiting the most substantial patterns of co-authorship within the field of sustainable leadership are, in respective order, Philip Hallinger,

Gayle C. Avery, Harald Bergsteiner, and Elizabeth More. Furthermore, Table 5 supplements Figure 5 by presenting detailed data on the authors who have contributed significantly to the literature on sustainable leadership, encompassing their publication counts and citation statistics.

Table 5. Authors engaged in research in the field of sustainable leadership, publication, and citation counts

Author	Number of publications	Number of citations
Philip Hallinger	24	604
Sooksan Kantabutra	21	289
Qaisar Iqbal	16	337
Gayle C.Avery	10	160
Suparak Suriyankietkaew	10	226
Harald Bergsteiner	8	118
Hazlina Ahmad Noor	8	281
Wadim Strielkowski	7	22
More Elizabeth	4	20

As illustrated in Table 5, the most prolific researcher in the field of sustainable leadership is undeniably Philip Hallinger, who has amassed 24 published articles and garnered 604 citations. Subsequently, other prominent researchers in the field, in descending order, include Sooksan Kantabutra, Qaisar Iqbal, Gayle C. Avery, and Suparak Suriyankietkaew, each contributing 21, 16, 10, and 10 published articles, respectively, and accumulating citation counts of 289, 337, 160, and 226, respectively. Harald Bergsteiner, Hazlina Ahmad Noor, Wadim Strielkowski, and Elizabeth More have also made notable contributions, producing 8, 8, 7, and 4 articles, respectively, and accumulating citation counts of 118, 281, 22, and 20, respectively.

In the context of identifying universities with significant engagement in sustainable leadership studies and presenting this information as a network map, a publication threshold of 4 was applied, resulting in the inclusion of 20 universities out of a total of 481 universities meeting this criterion. Table 6 provides an overview of these universities, detailing the number of studies conducted and citations received within their respective institutions.

Table 6. Universities working in the field of sustainable leadership

University	Number of publications	Number of citations
Mahidol University	66	1184
Johannesburg University	22	602
Macquarie University	17	252
Ural State University	17	6
Malaysia Sains University	12	290
Australian Catholic University	10	98

As evident from the data presented in Table 6, the universities that have made the most significant contributions in terms of publications related to sustainable leadership, ranked in descending order, include Mahidol University, the University of Johannesburg, Macquarie University, Ural State University, Malaysia Science University, and Australian Catholic University. Notably, Mahidol University stands out as the most prolific institution, having produced 66 articles and accumulated 1184 citations in the field of sustainable leadership. Following closely, the University of Johannesburg is positioned as the second most productive institution, with 22 articles and 602 citations associated with sustainable leadership.

To visualize international collaborations in the context of sustainable leadership, a network map was generated by applying a publication threshold of four. This analysis identified that out of 76 countries, 29 surpassed the specified threshold, leading to the creation of the network map depicted in Figure 6. In Figure 6, these countries have been clustered into seven distinct groups. Notably, in the cluster marked in red, Russia and Germany emerge as the most actively participating nations, a finding further supported by the data presented in Table 7. Additionally, Malaysia is highlighted in the blue cluster, while China and Australia are prominent in the green cluster. The light blue cluster is characterized by South Africa and Thailand; the purple cluster includes the United Kingdom; the orange cluster features the United States; and the yellow cluster displays Brazil as the leading country engaged in collaborative research efforts concerning sustainable leadership.
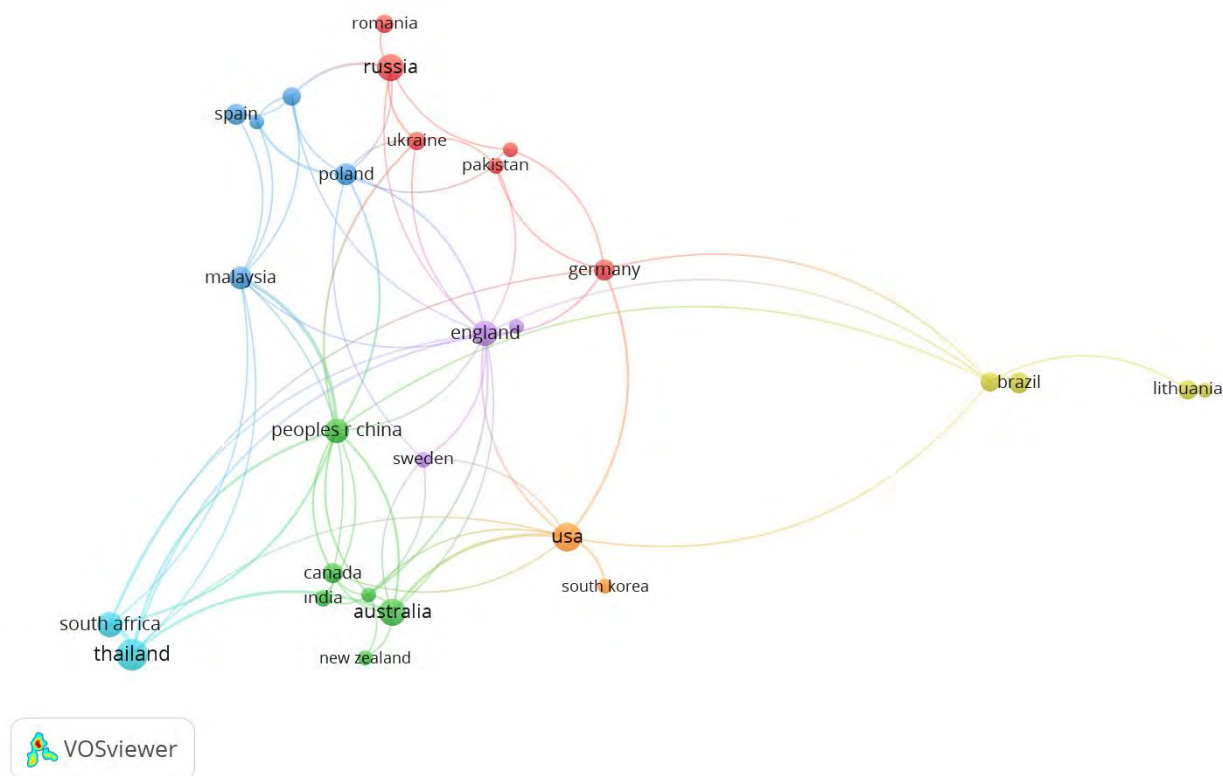
Figure 6. Cross-country collaboration visual network map

Considering the data presented in Table 7, it is evident that Thailand has taken the forefront in research productivity within the field of sustainable leadership, boasting 69 articles and 1230 citations. Subsequently, the United States, Australia, and Russia hold the second, third, and fourth positions, respectively, in terms of prolific research activity in this domain. Germany and Brazil are situated in the tenth and eleventh rankings, respectively, with both countries contributing 15 articles and garnering 29 and 183 citations, respectively.

Table 7. Countries working in the field of sustainable leadership

Country	Number of publications	Number of citations
Thailand	69	1239
United States of America	48	632
Australia	39	349
Russia	39	43
South Africa	30	632
England	28	290
Chinese	27	432
Malaysia	18	329
Poland	16	83
Germany	15	29
Brazil	15	183

Citation Analysis
In the context of conducting a citation analysis within the realm of sustainable leadership, comprehensive examinations of citations about documents, references, and countries were undertaken. To generate a network map depicting the most highly cited documents in the field of sustainable leadership, a citation threshold of two was applied, resulting in the inclusion of 212 documents out of 390 that met this specific criterion. The network map visualizing the citation analysis of these documents is presented in Figure 7. Within Figure 7, the presence of prominent and sizable circles signifies documents that have garnered a substantial volume of citations. Notably, researchers such as Sahlberg (2007), Hallinger (2018a), Macke (2019), and Iqbal (2020b) have authored the documents with the highest citation counts.
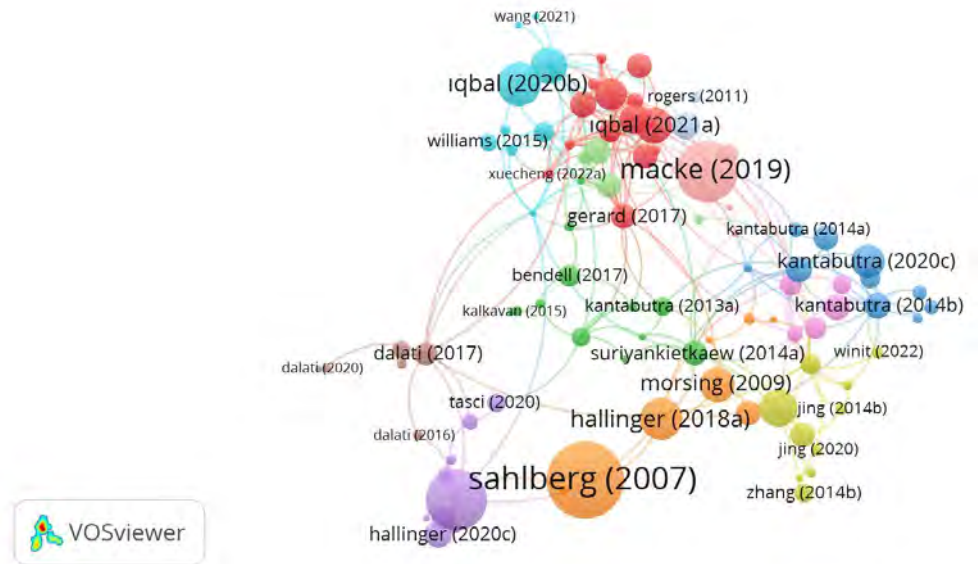
Figure 7. Visual network map of citations to documents

In Figure 7, a visual network map is provided, displaying the top 11 documents that have garnered the highest number of citations, along with details about their respective authors and citation counts. Notably, Sahlberg (2007), Osterblom (2015), Hargreaves (2004), and Macke (2019) have received 225, 149, 142, and 142 citations, respectively, for their respective works, establishing them as the authors of the most highly cited documents in the field to date. Additionally, Liu (2018), Udomsap (2020), Iqbal (2020b), Hallinger (2018a), McSherry et al. (2012), Park (2021), and Suriyankietkaew (2016a) have each contributed documents that have earned 87, 83, 75, 67, 57, 55, and 54 citations, respectively, thereby solidifying their positions as prominent researchers of the most highly cited documents within the field.

Table 8. The top eleven most cited documents

Author	Number of publications
Sahlberg (2007)	225
Osterblom (2015)	149
Hargreaves (2004)	142
Macke (2019)	142
Liu (2018)	87
Udomsap (2020)	83
Iqbal (2020b)	75
Hallinger (2018a)	67
McSherry (2012)	57
Park (2021)	55
Suriyankietkaew (2016a)	54

To identify the most highly cited sources, a threshold of 5 documents was chosen, resulting in 7 sources meeting this criterion out of a total of 204 sources. Figure 8 provides a visual representation of the citation network among these sources.
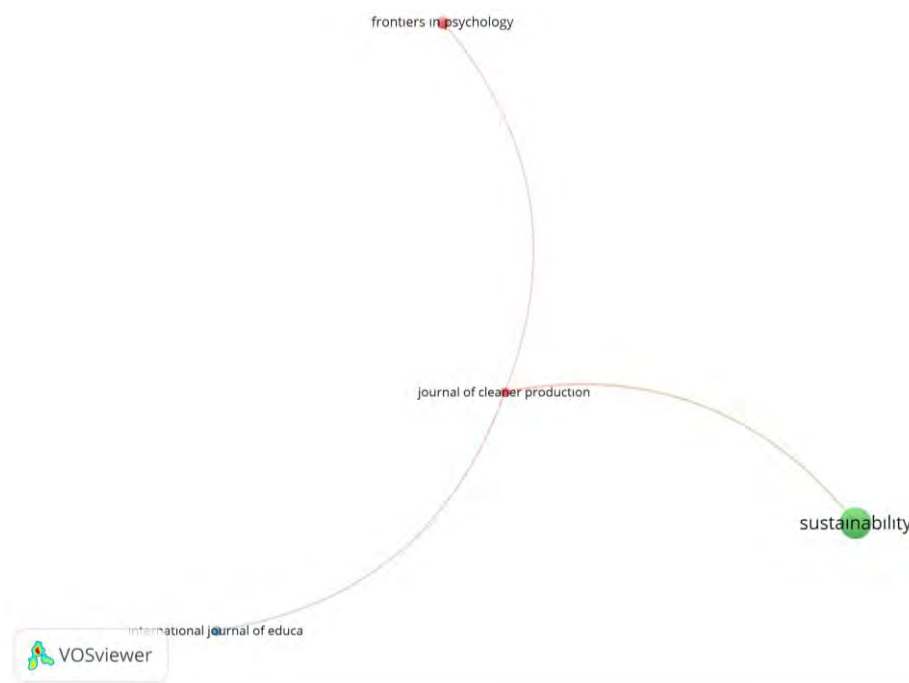
Figure 8. Link network map of citations to sources

Figure 8 illustrates the collaborative network of the most cited publications in the field of sustainable leadership, encompassing four key sources. The analysis reveals that the most frequently cited source is the "Sustainability" journal, with 678 citations. Following closely, the "Journal of Cleaner Production" ranks second with 362 citations. In the third position, we find the "International Journal of Education" with 47 citations, while "Sustainable Leadership for Entrepreneurs" occupies the fourth position with 36 citations. By applying a citation count threshold of 5 to articles in the domain of sustainable leadership, it was observed that 21 out of 76 countries met this criterion in terms of being cited. Figure 9 provides a citation network map by country. According to Figure 9, countries receiving the highest number of citations in the field of sustainable leadership are grouped into three distinct clusters. Thailand stands out as the most cited country with 1239 citations, followed by South Africa with 632 citations in second place. The United States and China rank third and fourth, respectively, with 632 and 432 citations each.

Figure 9. Visual map of citations to countries

The visual map depicted in Figure 9 has been converted into a tabular representation, as shown in Table 9. Table 9 provides information regarding the countries that receive the highest number of citations in the domain of sustainable leadership, including the respective quantities of documents and citations originating from these countries related to the subject.

Table 9. Distribution of documents and citation numbers by country

Country	Number of documents	Number of citations
Thailand	69	1239
South Africa	30	632
United States of America	48	632
Chinese	27	432
Australia	39	349
Malaysia	18	329

England	28	290
Finland	10	290
Canada	11	242
Brazil	15	183

As illustrated in Table 9, the country that garners the highest number of citations about the subject is Thailand. Thailand boasts a total of 69 scholarly works in this domain, accompanied by a substantial citation count of 1239. In the second position, South Africa emerges as the recipient of the second-highest citations (632 citations), supported by a document count of 30. Meanwhile, the United States is recognized as the primary contributor to the most-cited documents, amassing 632 citations. This commendable citation tally is underpinned by the publication of 48 documents. Ranking subsequently, China, Australia, and Malaysia secured the fourth, fifth, and sixth positions, amassing 432, 349, and 329 citations, respectively. Continuing down the list, the table proceeds to feature the rankings of the United Kingdom, Finland, Canada, and Brazil. These nations have garnered 290, 290, 242, and 183 citations, respectively, while the document counts for these countries are 28, 10, 11, and 15, respectively.

Co-Citation Analysis

Co-citation analysis stands as an innovative method employed to comprehend the cognitive structure within a scientific domain. This analysis technique encompasses the tracking of pairs of source articles that are co-referenced within source articles. When specific pairs of articles are co-referenced by multiple authors, it leads to the emergence of research clusters. In the context of this study, the examination of research related to sustainable leadership through co-citation analysis involves the creation of network maps that depict the interrelationships between cited references, source articles, and authors (Gerçek and Gerçek, 2022).

By imposing a minimum citation count threshold of 20 to determine the network map of co-cited references on sustainable leadership, it was ascertained that 10 references out of a total of 17,193 citations met this threshold. Figure 10 provides a visual representation of the network map obtained from this analysis. As delineated in Figure 10, a majority of the studies within this subject area predominantly co-cite the reference with the highest co-citations, which is Avery (2011), accounting for 59 co-citations. The second-most co-cited reference, with 34 co-citations, is Hallinger (2018). Hargreaves (2007) ranks as the third-most co-cited reference, with 27 co-citations. Zupic and Čater (2015) claim the fourth position, having garnered 25 co-citations.
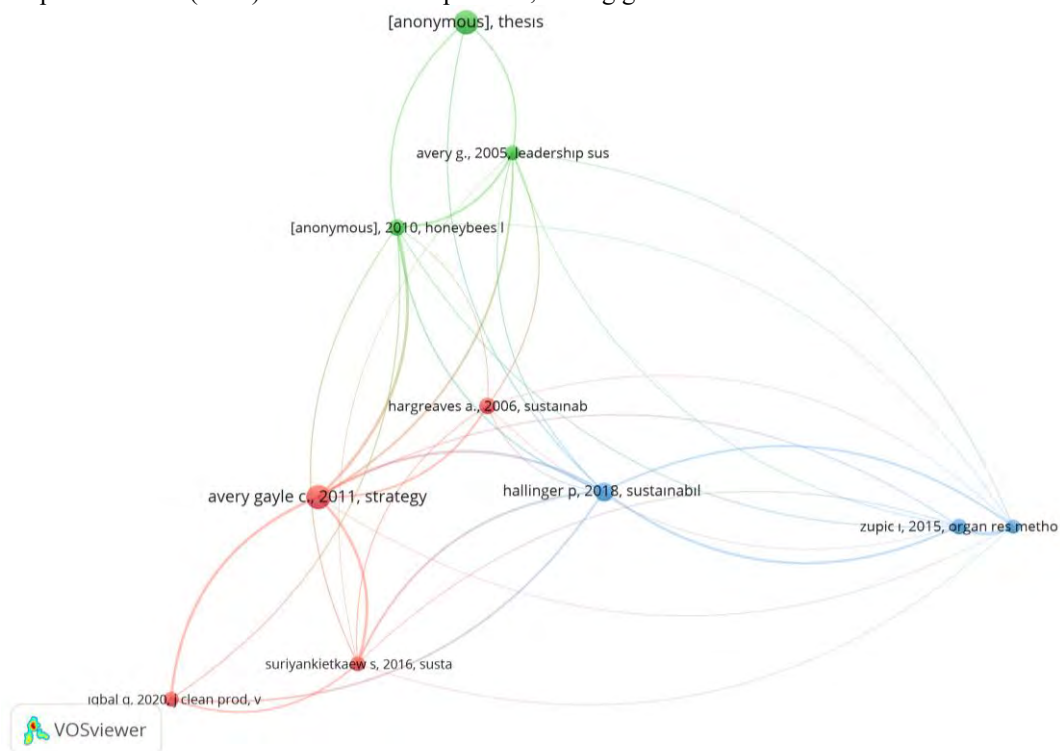

Figure 10. Network image of the most commonly cited references

To establish the network map of co-cited references on sustainable leadership, a minimum citation count threshold of 60 was imposed, revealing that 29 references out of 8,444 citations met this criterion. Figure 11, displayed herein, provides the visual representation of the resulting network map. As elucidated in Figure 11, the reference receiving the highest degree of co-citation is the journal "Sustainability-Basel," which amasses 490 citations. Conversely, the "Journal of Clean Production" has achieved the second-highest co-citation count, with 462 citations.
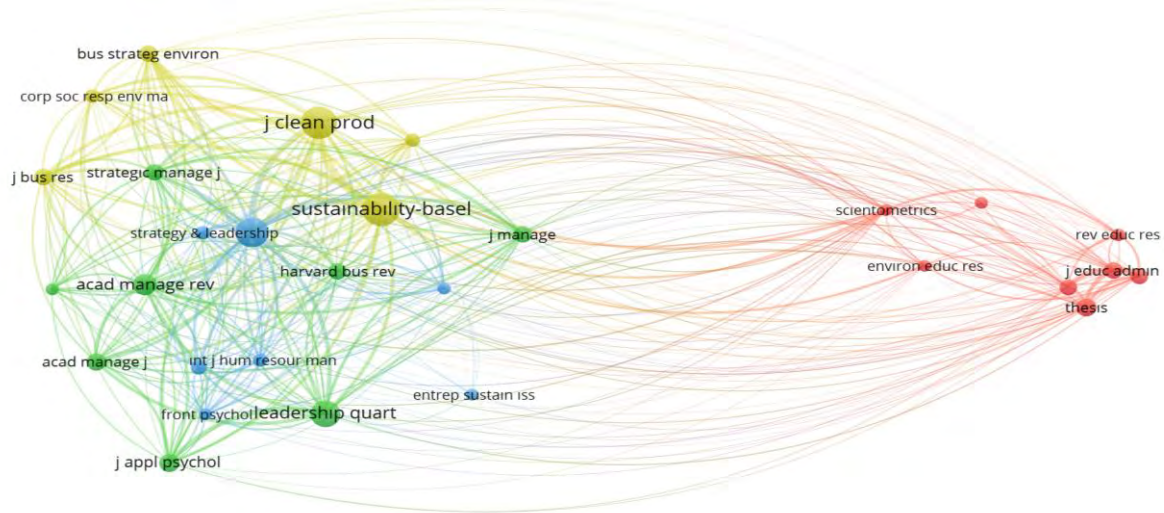

Figure 11. Network image of the most commonly cited sources (journals)

Lastly, to construct the network map of co-cited authors in the context of sustainable leadership, a minimum citation count threshold of 20 was applied, revealing that 35 authors out of a total of 12,234 citations satisfied this criterion. Figure 12, presented herewith, offers a visual representation of the resultant network map. As delineated in Figure 12, the most co-cited authors are organized into three distinct clusters. Notably, Philip Hallinger ranks as the foremost co-cited author, amassing 196 citations. Conversely, Sooksan Kantabutra has achieved the status of the second most co-cited author with 173 citations, while Qaisar Iqbal, with 135 citations, holds the position of the third most co-cited author.
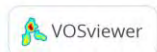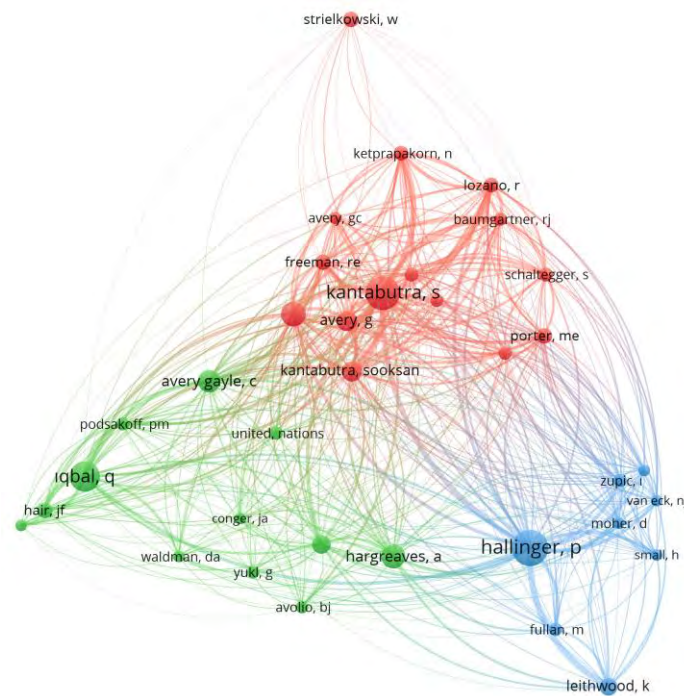

Figure 12. Network image of the most commonly cited authors

Conclusion

This study seeks to conduct a bibliometric analysis of works containing the term "sustainable leadership" in the Web of Science database, aiming to provide an updated overview of the field. VOSviewer software was utilized for visualizing the data extracted from the Web of Science database. The bibliometric analysis conducted within the scope of this research revealed that studies related to "sustainable leadership" first emerged in 2002, with a total of 390 studies being conducted between 2002 and 2023. The prevalence of articles as the predominant document type suggests that this field has garnered substantial interest and scholarly inquiry within academic circles. Nevertheless, the relatively lower representation of non-article document types, such as conference papers, book chapters, and review articles, indicates a demand for a greater diversity of document types in this area of study.

A closer examination of studies conducted between 2002 and 2023 on sustainable leadership demonstrates a consistent upward trajectory of interest in this subject. This upsurge in interest can be attributed to the United Nations' establishment of sustainability goals, which have precipitated significant transformations in the realm of education. Education has been recognized as a fundamental instrument in achieving sustainability objectives, thereby prompting an increase in research endeavors related to sustainable leadership (Bulut et al., 2018). This phenomenon reflects a shift in focus from imparting solely academic knowledge to students to also encompassing topics such as sustainability, ethics, and social responsibility (Çalık, 2006). This paradigm shift necessitates an enhancement of knowledge and competencies on sustainability among educational leaders. Furthermore, evidence suggests that climate change and environmental issues have redirected educational leaders and institutions towards adopting more sustainable approaches (Ay et al., 2020), stimulating the examination and development of sustainable leadership in education. It underscores the role of educational institutions in modeling sustainable leadership and posits that their management and leadership approaches, serving as exemplars for other sectors, inevitably lead to an increase in research on sustainable leadership (Özüdoğru et al., 2014). This phenomenon underscores the rising awareness and activism related to sustainability among the younger generation. These young individuals demand that educational leaders and institutions take more effective steps toward sustainability, thereby driving an increase in research on sustainable leadership (Sezgin et al., 2021). It reflects the need for the education system to adapt rapidly to changing conditions related to sustainability. This, in turn, necessitates that leaders embrace flexible, innovative, and sustainable approaches (Tüm, 2020). The growing sustainability expectations of society and the business world are pushing educational leaders towards more sustainable strategies, thus contributing to the growth of research on sustainable leadership (Erol, 2011).

The study's findings reveal that Thailand is the country with the highest number of publications on sustainable leadership. Various dynamics underlie the intense academic interest in sustainable leadership observed in Thailand (Kantabutra, 2012). Firstly, Thailand's geographical location and economic growth potential incentivize a particular emphasis on sustainability issues. Thailand occupies a strategic position in Southeast Asia, which brings with it significant environmental sustainability and leadership challenges. Furthermore, the country's rapidly growing economy has made sustainability principles more prominent in both the business world and society at large (Suriyankietkaew & Avery, 2016). This economic transformation and growth have triggered research into sustainable leadership within academia. Secondly, Thailand's cultural and societal context plays a pivotal role in shaping studies on sustainable leadership. Thai society places great importance on environmental issues and the preservation of natural resources. Societal values and sensitivity towards environmental conservation motivate academic research on sustainable leadership (Suriyankietkaew, 2016). Additionally, the increasing activism and environmental awareness among the younger generation are pushing educational institutions and research centers in the country to put more effort into sustainable leadership. When these factors converge, it becomes clearer why research on sustainable leadership has become so concentrated in Thailand.

Scientific investigations into sustainable leadership have centered around three key terms to facilitate in-depth understanding. These pivotal concepts are sustainability, sustainable leadership, and leadership. Building on these conceptual foundations, other significant terms related to the subject, such as sustainable development, bibliometric analysis, corporate sustainability, and higher education, have also been examined, incorporating noteworthy insights into the topic. Particularly, the term sustainability exhibits meaningful overlaps with sustainable development and bibliometric analysis, while the term leadership extends beyond effective management within higher education institutions, encompassing the construction of success, trust, and vision. In this context, research on sustainable leadership provides a critical framework for comprehending how leadership approaches and the role of educational institutions in the context of sustainability can be optimized in the pursuit of sustainability goals.

Using VOSviewer for the analysis of the field of "sustainable leadership" the most frequently used terms were categorized into three distinct clusters: "sustainability", "sustainable leadership", and "leadership". This clear conceptual clustering reflects the fundamental keywords at the core of studies on sustainable leadership. While the concept of sustainability aligns with terms such as sustainable development and bibliometric analysis, the leadership concept extends beyond the effective management of higher education institutions to play a decisive role in the construction of success, trust, and vision. In this context, research on sustainable leadership presents a crucial framework for in-depth comprehension of the complexity and significance of sustainability and leadership in this field.

The analysis of the network map of countries collaborating on research related to "sustainable leadership" was conducted to reflect the intensity of collaboration among countries. In this context, countries with at least four publications were considered for the creation of the collaboration network map, and the results obtained were presented. The analysis, which included 76 countries, revealed that 29 countries exceeded the defined threshold for collaboration. The complexity of collaborating countries is reflected in the network map, which concentrates on seven distinct clusters. Russia and Germany, highlighted in red, emerge as the most prolific countries with the highest number of studies in a cluster. Other clusters, denoted by blue, green, light blue, purple, orange, and yellow, respectively, feature countries such as Malaysia, China, and Australia; South Africa and Thailand; the United Kingdom; the United States; and Brazil as the most actively contributing nations These findings indicate that research on sustainable leadership enjoys a broad international presence with extensive collaboration among countries.

In the analysis focusing on the authors of the most cited documents in the field of sustainable leadership, several prominent authors were identified: Sahlberg (2007), Osterblom (2015), Hargreaves (2004), Macke (2019), Liu (2018), Udomsap (2020), Iqbal (2020b), Hallinger (2018a), McSherry et al. (2012), Park (2021), and Suriyankietkaew (2016a). These authors have garnered the highest citation counts for their respective works on sustainable leadership. Furthermore, the analysis considered the most frequently cited sources, highlighting journals such as "Sustainability", "Journal of Cleaner Production", "International Journal of Education", and "Sustainable Leadership for Entrepreneurship". These sources exemplify widely referenced journals and publications within the field of sustainable leadership. The distribution of articles related to sustainable leadership based on the countries they cite reveals that Thailand, South Africa, the United States, and China are the countries with the highest number of citations. These findings underscore that research in the field of sustainable leadership commands extensive international interest and influence.

The analysis of common references that receive joint citations in the context of sustainable leadership indicates that Avery G.C. (2011) is the most frequently cited reference among studies related to the subject, with a total of 34 citations. Following closely is the reference Hallinger (2018), which also boasts 34 citations. In third place is the reference Hargreaves (2006), cited 27 times. Similarly, Zupic and Čater (2015) exert significant influence in the field of sustainable leadership, with 27 citations. Moreover, when examining the common references that receive the most citations, the "Sustainability-Basel" journal leads with 490 citations as the most frequently cited source. This underscores the far-reaching impact of studies on sustainable leadership in the academic literature. The "Journal of Clean Production" closely follows, with 462 citations, as the second most frequently cited source. Lastly, when analyzing the authors commonly cited in the context of sustainable leadership, the most frequently cited authors are categorized into three groups. According to this analysis, Philip Hallinger emerges as the top author with 196 citations. Sooksan Kantabutra stands out as the second most cited author with 173 citations, and Qaisar Iqbal ranks third with 135 citations. These authors occupy prominent positions due to their contributions and influence in the field of sustainable leadership.

Recommendations

To stimulate an increase in research on sustainable leadership in Turkey, several strategic recommendations can be devised. Firstly, universities and academic institutions can heighten awareness of this field by crafting course content and programs that encompass sustainable leadership. The adoption of an interdisciplinary approach that enables students from diverse disciplines to comprehend and apply sustainable leadership principles is essential. School administrators, educators, and academic staff can benefit from training and workshops designed to enhance their knowledge and competencies in sustainable leadership, thereby cultivating a culture of qualitative research in the field.

Secondly, the encouragement of collaborations between the public and private sectors can contribute to an upswing in research and practical applications related to sustainable leadership. Collaborative initiatives with

the business world and civil society organizations can engender research that furnishes solutions to real-world challenges. Such partnerships can amplify the impact of academic research and translate it into tangible outcomes in the sphere of sustainable leadership. Additionally, providing research grants and support to researchers and academics engaged in the field of sustainable leadership is a significant stride toward increasing the quantity and quality of research.

Author (s) Contribution Rate
The author independently conducted each stage of the research study.

Conflicts of Interest
There are no conflicts of interest.

Ethical Approval
The study does not contain any material that would require ethical permission.

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