



A Bibliometric Analysis of Education for Sustainable Development in Asian Countries: Unveiling Trends and Patterns

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Abstract:

Achieving global prosperity and environmental stewardship is contingent upon sustainable development, which seeks to strike a balance between environmental preservation and socio-economic advancement. Within this broad area, Education for Sustainable Development (ESD) serves as a critical intermediary, preparing people to address complex environmental, social, and economic issues. A thorough bibliometric analysis of 1700 articles from the Scopus database was carried out for this study. With a focus on Asian publications in the field of education for sustainable development between 2019 and 2023, the study made use of bibliometric tools such as Biblioshiny, VOSviewer, Word, Excel, and PowerPoint. This thorough investigation sought to shed light on the academic conversation surrounding ESD by exposing trends, identifying significant writers, and emphasising thematic strands, ultimately clarifying the dynamic character of research in this vital area.

Keywords: Education, Sustainable Development, Asia, trend

1. Introduction

The concept of sustainable development, synthesizing societal, economic, and environmental aspects, aims to secure a balanced and prosperous future without compromising resources. Rooted in key publications like the Brundtland Commission's report "Our Common Future" (1987) and seminal works such as Rachel Carson's "Silent Spring" (1962), sustainable development emerged as a global priority, underscored by events like the 1992 UN Conference on Environment and Development in Rio de Janeiro. The pivotal 1972 UN Conference on the Human Environment in Stockholm laid the groundwork for integrating developmental and environmental concerns. Defined by the Brundtland Commission, "sustainable development" became a widely accepted term encapsulating the pursuit of present needs while safeguarding future generations' prospects. The 1992 Rio Summit solidified its global significance, and subsequent milestones like the 2002 World Summit on Sustainable Development addressed critical issues of energy, water, sanitation, production, and consumption. Contemporary endeavors, exemplified by the 2015 Paris Agreement and the UN's Sustainable Development Goals (SDGs), outline comprehensive strategies for poverty eradication, environmental sustainability, and social equality by 2030. These persistent initiatives reflect an unwavering commitment to forging harmony between human progress and environmental preservation, essential for a stable and flourishing planet for posterity.

1.1 Sustainable Development in Asia

Asia, characterized by rapid economic growth and simultaneous environmental and social challenges, remains dedicated to advancing sustainable development (Zu, 2023; The United Nations Economic and Social Commission for Asia and the Pacific, 2021; World Commission on Environment and Development, 1987). The region's intricacies stem from its diverse landscapes and burgeoning population, intersecting with numerous

sustainability issues. Global gatherings and transformative milestones have significantly influenced Asia's pursuit of sustainable development. From the 1992 Rio Summit emphasizing global environmental action to the 2002 Johannesburg Summit addressing production, consumption, and energy, Asia actively engaged in shaping the discourse. The 1972 Stockholm UN Conference on the Human Environment marked a pivotal moment by integrating developmental and environmental considerations (Bernstein & Yu, 2022; Mensah, 2019; Purvis et al., 2018; Egelston, 2012; United Nations n.d.). Asia's sustainable development aims to harmonize economic growth, environmental stewardship, and social equity, evident in policies aligned with these values, including the 2015 Paris Agreement and the 2030 UN Sustainable Development Goals (SDGs) focused on poverty eradication and environmental preservation. Asia's sustainable journey encounters challenges from rapid urbanization and industrialization, straining natural resources and ecosystems. Nonetheless, innovative solutions leveraging technology and community-driven approaches aim to overcome these obstacles (Karduri & Ananth, 2022). Initiatives centered on green technologies and renewable energy sources seek to mitigate environmental degradation and foster economic growth (Triyanayi & Li, 2022; Nepal et al., 2021; Economic and Social Commission for Asia and the Pacific United Nations, 2012). Asia's role as a global economic powerhouse necessitates its commitment to sustainable practices, evident in investments in education, healthcare, infrastructure, and conservation (Khanna, 2020; Visser & Tolhurst, 2017). Addressing disparities and fostering regional collaboration are essential for comprehensive progress. Collective action is crucial for addressing transboundary issues like pollution, climate change, and resource management. Asia's journey toward sustainable development symbolizes ambition, innovation, and collective action. Its commitment to addressing challenges while advancing economic growth and advocating social inclusion underscores its pivotal role in shaping a sustainable future. Embracing this holistic approach remains essential for Asia's prosperity and the global community's well-being while preserving the planet.

1.2 Education for Sustainable Development

Education for Sustainable Development (ESD) stands as a linchpin for fostering sustainable societies, particularly evident in Asia. This educational framework interweaves environmental stewardship, social equity, and economic viability, crucial for sustainable development endeavors (Ferguson et al., 2022; Kioupi & Voulvoulis, 2019; UNESCO, 2010). In Asia, ESD plays a pivotal role due to the region's swift economic growth, diverse cultural landscapes, and environmental complexities. Efforts in Asian countries toward ESD involve paradigm-shifting educational strategies, reflected in policy reforms, curriculum adaptations, and institutional collaborations, signaling a profound commitment to sustainable development. Asia's dedication to ESD is highlighted through the integration of sustainability principles into educational curricula, the establishment of specialized academic programs, and the promotion of sustainability-centric research initiatives. Emphasizing contextual relevance, Asian ESD initiatives tailor sustainability concepts to varied cultural and socio-economic backgrounds. Embracing indigenous knowledge systems and community engagement is imperative for these localized approaches. Employing experiential and project-based learning, along with interdisciplinary studies, empowers students to comprehend sustainability challenges and their potential solutions (Bramwell-Lalor et al., 2020). Leveraging educational technology further enhances the accessibility and adaptability of ESD across diverse Asian settings.

Asian countries' active participation in international sustainability platforms, notably the UN's Sustainable Development Goals (SDGs), underlines their commitment to ESD (Rahman et al., 2020; United Nations Economic and Social Commission for Asia and the Pacific, 2017). Collaborative endeavors aimed at aligning national education agendas with the SDGs demonstrate a collective aspiration to cultivate future generations capable of addressing intricate sustainability issues. However, despite these initiatives, Asian ESD frameworks

confront challenges like unequal educational access, resource constraints, and the imperative need for educator capacity enhancement. To address these gaps, inclusive education practices, equitable resource allocation, and professional development centered on sustainability-focused pedagogy are imperative. Effective evaluation of ESD initiatives necessitates robust methodologies and metrics to gauge their impact and efficacy. Comprehensive monitoring frameworks that assess learning outcomes, behavioral changes, and societal contributions resulting from ESD interventions are indispensable for enhancing their effectiveness and relevance. Asia's commitment to Education for Sustainable Development is transformative, fostering sustainable societies holistically by integrating sustainability principles into educational systems and accommodating diverse cultural contexts. Yet, overcoming persistent challenges demands innovative strategies, alignment with international frameworks, and addressing existing disparities to fortify Asia's education-driven sustainable development. The absence of Asian bibliometric or trend analysis studies in education for sustainable development literature prompted this comprehensive bibliometric analysis. This study aims to bridge this gap, offering valuable insights that can significantly advance scholarly discourse on Asian education for sustainable development. Its ultimate goal is to contribute to academic research by illuminating trends and patterns in this underexplored domain, thereby fostering the growth and development of this critical field.

1.3 Research Questions

The following research questions have been formulated to achieve the objectives of the research:

1. What were the article publishing trends on Education for Sustainable Development in Asian countries from 2019 to 2023?
2. Which journals have been frequently preferred by Asian authors to publish their articles on Education for Sustainable Development?
3. Which countries, organizations, and authors in Asia have been the most productive in producing articles on Education for Sustainable Development?
4. What are the citation trends and trending topics among researchers writing articles on education for sustainable development?
5. Which keywords and themes are frequently utilized by Asian authors in their articles focused on Education for Sustainable Development Goals?

2. Methodology

2.1 Method

The bibliometric analysis method was used to study and identify publishing trends and patterns in Education for Sustainable Development. Bibliometric analysis is a quantitative/statistical method to analyse trends in publishing scholarly articles.

2.2 Database selection

There are numerous authoritative indexing and abstracting databases. Some databases are multidisciplinary (Scopus, WOS), whereas others are subject-specific (MEDLINE, PubMed, AGRICOLA, ERIC). Scopus is the most well-respected of these databases worldwide. It was selected for this study because it is regarded as the most trusted, potent, and reliable database in the world (Pranckut, 2021). The data was retrieved from the Scopus authentic indexing and abstracting scientific database, which contains scholarly work of high caliber. In the current study, both qualitative and quantitative aspects are explored. Notably, some papers indexed in other multidisciplinary and subject-specific databases may have been overlooked during the data retrieval process.

2.3 Search Query

The following search query was run in the topic search documents of the article title, abstract, and keywords of the Scopus core collection. The query was run 10 December 2023, at The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India.

Search documents = (TITLE-ABS-KEY ("sustainable development" AND education) OR TITLE-ABS-KEY ("education for sustainable development")) AND PUBYEAR > 2018 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (AFFILCOUNTRY , "China") OR LIMIT-TO (AFFILCOUNTRY , "India") OR LIMIT-TO (AFFILCOUNTRY , "Taiwan") OR LIMIT-TO (AFFILCOUNTRY , "Indonesia") OR LIMIT-TO (AFFILCOUNTRY , "South Korea") OR LIMIT-TO (AFFILCOUNTRY , "Russian Federation") OR LIMIT-TO (AFFILCOUNTRY , "Turkey") OR LIMIT-TO (AFFILCOUNTRY , "Japan") OR LIMIT-TO (AFFILCOUNTRY , "Saudi Arabia") OR LIMIT-TO (AFFILCOUNTRY , "Afghanistan") OR LIMIT-TO (AFFILCOUNTRY , "Armenia") OR LIMIT-TO (AFFILCOUNTRY , "Azerbaijan") OR LIMIT-TO (AFFILCOUNTRY , "Bahrain") OR LIMIT-TO (AFFILCOUNTRY , "Bangladesh") OR LIMIT-TO (AFFILCOUNTRY , "Bhutan") OR LIMIT-TO (AFFILCOUNTRY , "Brunei Darussalam") OR LIMIT-TO (AFFILCOUNTRY , "Cambodia") OR LIMIT-TO (AFFILCOUNTRY , "Georgia") OR LIMIT-TO (AFFILCOUNTRY , "Hong Kong") OR LIMIT-TO (AFFILCOUNTRY , "Iran") OR LIMIT-TO (AFFILCOUNTRY , "Iraq") OR LIMIT-TO (AFFILCOUNTRY , "Israel") OR LIMIT-TO (AFFILCOUNTRY , "Jordan") OR LIMIT-TO (AFFILCOUNTRY , "Kazakhstan") OR LIMIT-TO (AFFILCOUNTRY , "Lebanon") OR LIMIT-TO (AFFILCOUNTRY , "Macao") OR LIMIT-TO (AFFILCOUNTRY , "Malaysia") OR LIMIT-TO (AFFILCOUNTRY , "Maldives") OR LIMIT-TO (AFFILCOUNTRY , "Mongolia") OR LIMIT-TO (AFFILCOUNTRY , "Myanmar") OR LIMIT-TO (AFFILCOUNTRY , "Nepal") OR LIMIT-TO (AFFILCOUNTRY , "Oman") OR LIMIT-TO (AFFILCOUNTRY , "Pakistan") OR LIMIT-TO (AFFILCOUNTRY , "Palestine") OR LIMIT-TO (AFFILCOUNTRY , "Philippines") OR LIMIT-TO (AFFILCOUNTRY , "Qatar") OR LIMIT-TO (AFFILCOUNTRY , "Singapore") OR LIMIT-TO (AFFILCOUNTRY , "Sri Lanka") OR LIMIT-TO (AFFILCOUNTRY , "Syrian Arab Republic") OR LIMIT-TO (AFFILCOUNTRY , "Tajikistan") OR LIMIT-TO (AFFILCOUNTRY , "Thailand") OR LIMIT-TO (AFFILCOUNTRY , "Uzbekistan") OR LIMIT-TO (AFFILCOUNTRY , "United Arab Emirates") OR LIMIT-TO (AFFILCOUNTRY , "Viet Nam"))

2.4 Inclusion/Exclusion criteria

The research involved a comprehensive review of scholarly literature obtained from the Scopus database. Specific parameters were set to collect publications between 2019 and 2023 in the social sciences field. The study focused solely on articles published in Asian countries, encompassing China, India, Taiwan, Indonesia, South Korea, the Russian Federation, Turkey, Japan, Saudi Arabia, and several others. This approach aimed to center the analysis within this regional context for a more precise investigation of Education for Sustainable Development literature. A total of 1720 entries were initially gathered and organized in an Excel sheet. Using a double-extraction method, the titles and abstracts of each paper were meticulously scrutinized to exclude duplicates and irrelevant documents. This process resulted in a final set of 1700 records suitable for subsequent evaluation and analysis.

Data Extraction and Filtration Process



Figure 1
Data extraction and filtration flowchart

2.5 Data Analysis

Data analysis was performed using various tools and software, including MS Excel (v16.0), MS PowerPoint, VOS viewer (version 1.6.15), and Biblioshiny (version 2.0).

3. Data Analysis and Discussion

The study systematically reviewed scholarly literature via Scopus, focusing on social sciences publications between 2019 and 2023. It specifically targeted articles from Asian countries including China, India, Taiwan, and others. A focused approach aimed to analyze Education for Sustainable Development literature in this regional context. Out of 1720 outcomes extracted, 1700 unique records were thoroughly screened for relevance and duplicates.

Main Information about Data	
Information about data	
Timespan	2019:2023
Sources (Journals, Books, etc)	497
Documents	1700
Annual Growth Rate %	22.68
Document Average Age	1.57
Average citations per doc	7.435
References	90126
Document contents	

Keywords Plus (ID)	2840
Author's Keywords (DE)	5413
Authors	
Authors	4623
Authors of single-authored docs	165
Authors collaboration	
Single-authored docs	183
Co-Authors per Doc	3.5
International co-authorships %	29.18
Document types	
Article	1700
Table 1 Basic information about collected data	

3.1 Trend of Publication

A thorough analysis involving 1700 scholarly articles on education for sustainable development from Asian countries, spanning 2019 to 2023, was conducted. Table 2 presents a detailed breakdown of publication figures over these years. In 2019, 196 articles were published, followed by a notable increase to 256 articles in 2020, marking a 30.61% growth. Subsequently, 2021 experienced a further increase to 314 articles, signifying a 22.66% rise. Post-2020, a consistent enhancement in publications was observed, with a 22.66% increase in 2021. The highest publication volume was recorded in 2022, with 490 articles, indicating a substantial 56.05% increase. However, a slight decrease to 444 articles was seen in 2023, indicating a negative trend (-46 articles). Notably, 28.82% of total articles were published in 2022, followed by 26.12% in 2023, 18.47% in 2021, 15.06% in 2020, and 11.53% in 2019, demonstrating the distribution across the specified timeline.

Annual Scientific Production on Education for Sustainable Development				
Year	Articles	Percentage	Increasement	Percentage of increasement
2019	196	11.52941176	-	-
2020	256	15.05882353	60	30.6122449
2021	314	18.47058824	58	22.65625

2022	490	28.82352941	176	56.05095541
2023	444	26.11764706	-46	-9.387755102

Table 2
Year-wise article production on education for sustainable development in Asian countries from 2019 to 2023 with percentage

Figure 2 illustrates an upward trajectory in publications from 2019 to 2022 regarding articles focused on education for sustainable development goals. However, a discernible shift is observed in 2023, indicating a downward trend in publications for this thematic area.

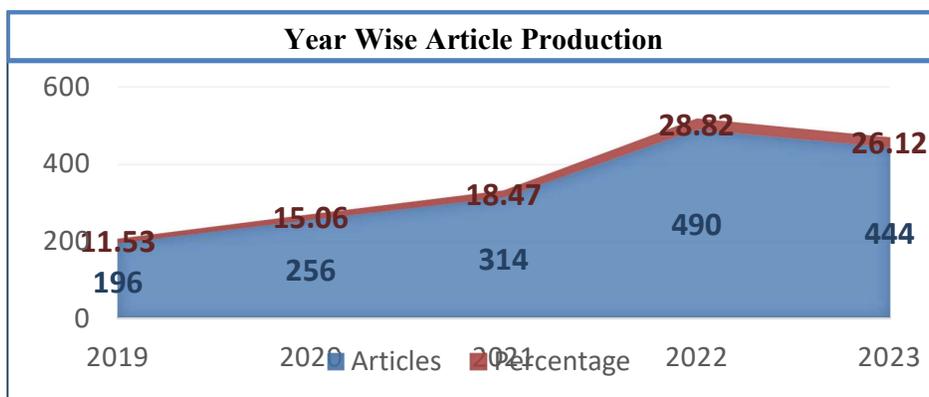


Figure 2
Year wise article publication trend on education for sustainable development in Asian countries from

Figure 3 illustrates the yearly average citation count within the study period. In 2020, the average citation count peaked at 3.82, surpassing other years. Conversely, 2023 displayed the lowest average citation count at 1.18, indicating a decline in citations over the five-year period. The initial three years (2019, 2020, 2021) exhibit averages above 3, contrasting with the subsequent two years falling below this mark. This shift indicates a notable decrease in yearly citation averages. Additionally, Figure 4 emphasizes the decreasing trend in average citation per article. Notably, the highest average citation per article was 15.8, while the lowest was 1.18 in 2023, indicating a declining pattern over the study's duration.

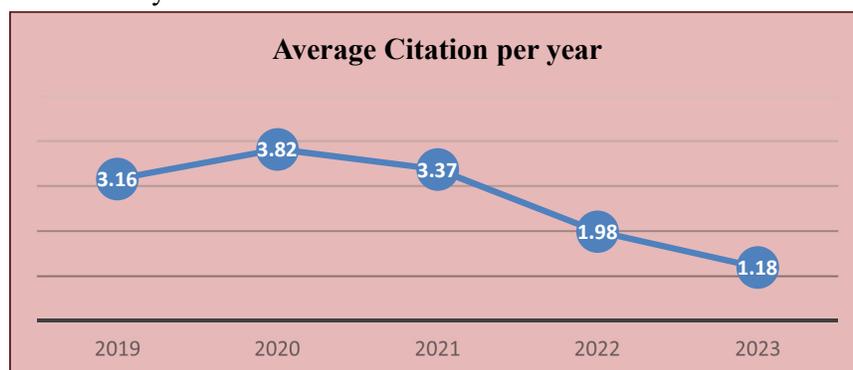


Figure 3

Year Wise average citation trend of articles on education for sustainable development from 2019 to 2023

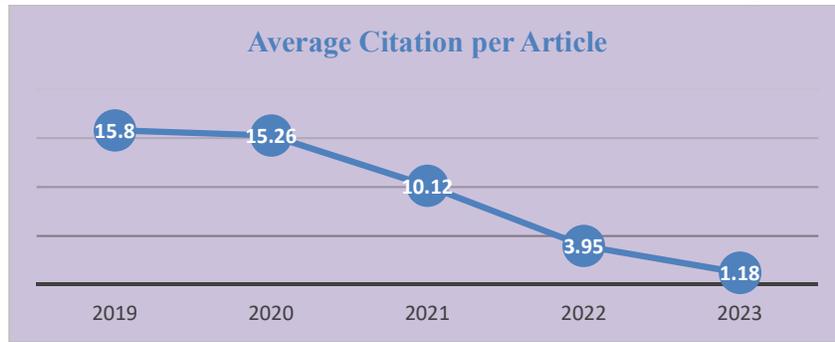


Figure 4

Year-wise average article citation trend of the published articles from Asian countries focused on Education for Sustainable Development between 2019-2023

Figure 3 depicts the annual average citation count across the study's duration. In 2020, the count peaked at 3.82, surpassing other years, while 2023 saw the lowest count at 1.18, indicating a decline in citations. The initial three years (2019-2021) show averages above 3, in contrast to the following two years below this threshold, reflecting a significant decrease. Figure 4 further emphasizes this declining trend in average citation per article. The highest recorded average was 15.8, contrasting with the lowest at 1.18 in 2023, showcasing a diminishing pattern over the study period.

Three-Fold Plot

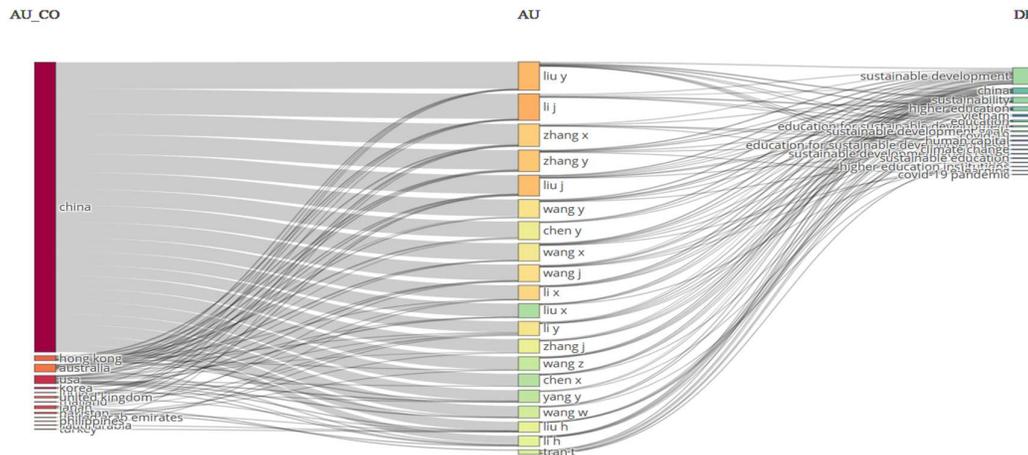


Figure 5

Three field plots on education for sustainable development of countries, authors, and keywords

Source: Bibliometric Analysis (Biblioshiny).

3.2 Journal analysis

The scrutiny of 1700 articles in the education for sustainable development domain from 2019 to 2023 revealed their distribution across 497 journals. Ten journals emerged as pivotal contributors during this period. Among these, Sustainability (Switzerland) notably published 610 articles, constituting 35.88% of the total, garnering 4528 citations with an h-index of 29. The International Journal of Sustainability in Higher Education contributed 38 articles (2.24% of the total), amassing 304 citations with an h-index of 10. Following suit, Sustainable Development Journal published 22 articles (1.29% of total publications), cited 732 times with an h-index of 11.

Other influential journals include Environment, Development, and Sustainability, Resources Policy, Journal of Teacher Education for Sustainability, Social Indicators Research, Education Sciences, International Journal of Sustainable Development and Planning, and Frontiers in Education, each contributing varying numbers of articles and accumulating diverse citation counts and h-indexes.

List of Relevant Sources

SI NO	Sources	h_index	Number of Publication	Percentage of Publication	Total no of Citation	Year of Publication
1	Sustainability (Switzerland)	29	610	35.88	4528	2019
2	International Journal of Sustainability in Higher Education	10	38	2.24	304	2019
3	Sustainable Development	11	22	1.29	732	2019
4	Environment, Development, and Sustainability	8	21	1.24	257	2020
5	Resources Policy	7	21	1.24	142	2020
6	Journal of Teacher Education for Sustainability	5	18	1.06	81	2019
7	Social Indicators Research	7	13	0.76	133	2019
8	Education Sciences	5	12	0.71	58	2021
9	International Journal of Sustainable Development and Planning	4	12	0.71	46	2020
10	Frontiers in Education	2	11	0.65	5	2021

Table 3
Top 10 journals on education for sustainable development for Asian countries, their h-index, total no of citations, total no of publications, and year of publication

3.3 Author analysis

Within the academic sphere of Asia, Education for Sustainable Development holds immense significance. Data analysis from 2019 to 2023, as depicted in Table 1, reveals the involvement of 4623 authors in Scopus-indexed journals, presenting 165 single-authored papers. The average co-authorship per article is 3.5, with 29.18% featuring international collaborations. Notably, all top ten prolific authors in this field are affiliated with Chinese universities, underscoring China's scholarly prominence. Among them, Li J from The Second Xiangya Hospital of Central South University stands out, contributing 24 articles, representing 1.41% of Scopus-indexed publications on sustainable development goals. Li J's work garnered 171 citations, reflecting an impactful h-index of 8. Similarly, other influential authors like Liu Y, Liu J, Zhang Y, Zhang X, Li X, Wang J, Wang Y, Li Y, and

Wang X made substantial contributions, publishing 15 to 20 articles each, with citations ranging from 79 to 209 and respective h-indexes between 5 and 8, accentuating their scholarly influence in sustainable development education.

The scholarly landscape of education for sustainable development goals in the Asian continent, notably dominated by Chinese authors, reflects a concentrated and impactful presence within Scopus-indexed journals. These prolific authors have made significant contributions, demonstrated by their extensive publications, citations, and notable h-index scores, signifying their influence and recognition within this field.

List of Most Relevant Authors							
Sl no	Authors	Affiliation	Country	Articles	h_index	Total no of citations	Percentage of publication
1	Li J	The Second Xiangya Hospital of Central South University	China	24	8	171	1.41
2	Liu Y	Nanjing Normal University	China	20	8	209	1.18
3	Liu J	China University of Geosciences	China	18	5	82	1.06
4	Zhang Y	Nanjing Forestry University	China	18	6	132	1.06
5	Zhang X	Shanxi Vocational University of Engineering Science and Technology	China	17	5	79	1.00
6	Li X	Zhejiang University of Technology	China	16	7	131	0.94
7	Wang J	Qingdao Binhai University	China	16	5	130	0.94
8	Wang Y	Shandong Normal University	China	16	6	132	0.94
9	Li Y	Shanghai University	China	15	5	94	0.88
10	Wang X	Chengdu University of Technology	China	15	5	93	0.88

Table 4
Top 10 Most relevant author in education for sustainable development in Asian countries between 2019-2023 and their local impact

Table 1 demonstrates an average co-authorship of 3.5 per article among 1700 publications, reflecting a collaborative culture in this field. A stringent co-authorship analysis ensued, with criteria limiting countries per

document to 25, necessitating a minimum of 3 documents and 5 citations per country. Consequently, 104 countries met these parameters. Figure 6 visually delineates 8 collaborative clusters, revealing 705 links and a robust total link strength of 1683. These clusters signify closely interwoven collaborative networks, classified by collaborative intensity. The dominant red cluster encompasses nations like Austria, Belgium, Egypt, France, India, Israel, Lithuania, Nepal, Netherlands, Nigeria, Norway, Palestine, Slovakia, and Switzerland. The adjacent green cluster includes Brazil, Colombia, Finland, Greece, Hungary, Mexico, Poland, Portugal, Serbia, South Africa, Spain, Sweden, and Turkey. Other clusters portray various countries, delineating complex interconnections.

Figure 6 demonstrates robust collaborative research in education for sustainable development goals, notably featuring prolific contributions from Chinese authors. It highlights extensive partnerships between Asian and Western authors, showcasing a robust intercontinental research network. This visual emphasizes the significant impact of cross-continental collaborations, particularly from Chinese contributors, in shaping this critical domain.

Coauthor Analysis

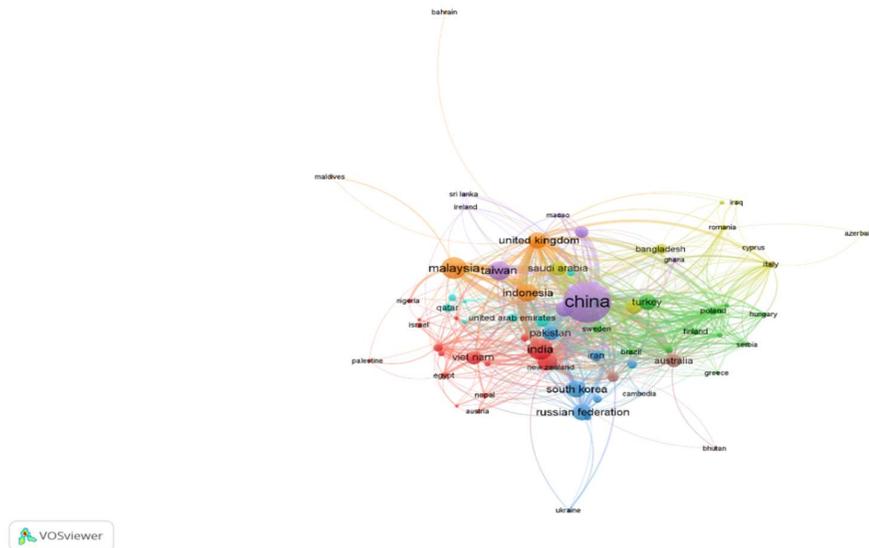


Figure 6

Co-author analysis of different Asian countries authors with other countries authors on the published articles of education for sustainable development from 2019 to 2023

3.4 Institution analysis

In academia, institutions play pivotal roles in scientific advancements, especially in the context of education for sustainable development across Asian nations. Table 5 offers a detailed snapshot, delineating the top ten institutions and their substantial contributions in this specialized domain. Employing color-coded cells, the table showcases diverse productivity levels, depicting high-output periods in green and comparatively lower activity in red across institutions. Beijing Normal University notably emerges, publishing 68 articles on sustainable development goals within education and experiencing peak productivity in 2022. Other significant contributors encompass University Kebangsaan Malaysia, China University of Geosciences, East China Normal University, National Taiwan Normal University, University Sains Malaysia, Zhejiang University, Central China Normal University, Tsinghua University, and Universitas Pendidikan Indonesia, each presenting 26 to 42 papers.

Significantly, the most productive years span from 2019 to 2023, with 2022 witnessing heightened productivity across several institutions. Furthermore, this table highlights a geographic concentration, with six of the top ten contributors situated in China, two in Malaysia, and one each in Taiwan and Indonesia. This distribution emphasizes regional research efforts in sustainable development education, reflecting dynamic research landscapes, collaborative networks, and regional concentrations in this pivotal academic realm.

Top 10 Institutions of Article Production								
Sl No.	Affiliation	Country	2019	2020	2021	2022	2023	Total Published Articles
1	Beijing Normal University	China	2	7	12	30	17	68
2	University Kebangsaan Malaysia	Malaysia	19	0	8	11	4	42
3	China University of Geosciences	China	4	4	17	1	10	36
4	East China Normal University	China	1	3	3	24	5	36
5	National Taiwan Normal University	Taiwan	5	4	10	12	3	34
6	University Sains Malaysia	Malaysia	2	5	8	14	5	34
7	Zhejiang University	China	1	7	2	6	17	33
8	Central China Normal University	China	2	6	7	11	1	27
9	Tsinghua University	China	8	1	1	12	4	26
10	Universitas Pendidikan Indonesia	Indonesia	0	5	0	11	10	26

Table 5

Year-wise Article production of top 10 institutions on education for sustainable development in Asian countries from 2019 to 2023

3.5 Country Analysis

In an extensive investigation, the study rigorously analyzed corresponding authors and their institutional affiliations within articles, identifying significant contributors in education for sustainable development. Encompassing 77 countries and regions, the scrutinized articles represent a global commitment to sustainable development goals in education. Figure 7 visually illustrates the geographical distribution of article production, portraying a comprehensive view of scholarly contributions across regions. Table 6 provides statistical insights into the top 5 Asian countries or regions, emphasizing their cumulative publications in the realm of education for sustainable development. China emerges prominently, contributing 539 articles, equivalent to 31.71% of the entire corpus. Following China, Malaysia, India, Korea, and Indonesia also exhibit substantial contributions. Detailed analysis in Table 6 shows China's contributions of 424 singularly authored articles and 115 collaborations, with a multiple-country publication ratio of 0.213. Other leading nations likewise present varying

counts of singular and multiple country publications. For instance, Malaysia, India, Korea, and Indonesia have contributed 68, 88, 67, and 42 singular country publications, respectively, along with collaborative publications ranging from 6 to 36 articles. Collectively, these top 5 nations have contributed 887 articles in the field. Their positions in the Sustainable Development Goals Index Rank for 2023 mirror their relative roles in global sustainable development initiatives. This statistical analysis underscores diverse research landscapes, entwining research productivity with national development agendas and highlighting the fusion of academic pursuits with broader developmental frameworks.

Top 10 Corresponding Author's Countries							
Sl No	Country	Articles	Percent	SCP	MCP	MCP-Ratio	SDG Index Rank (2023)
1	China	539	31.71	424	115	0.213	63
2	Malaysia	104	6.12	68	36	0.346	78
3	India	102	6.00	88	14	0.137	112
4	Korea	81	4.76	67	14	0.173	31
5	Indonesia	61	3.59	42	19	0.311	75
SCP- Single Country Publications							
MCP- Multiple Country Publications							
Freq- Frequency							
SDG- Sustainable Development Goals							

Table 6

Top 5 Corresponding Author's Countries on published articles on education for sustainable development in Asian countries from 2019 to 2023

Country Scientific Production

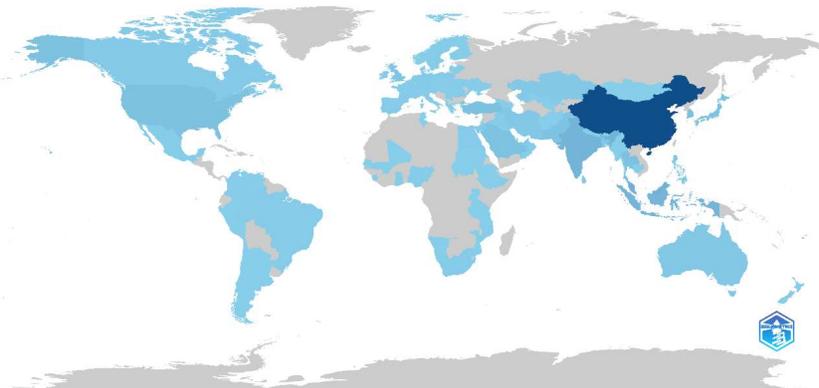


Figure 7

The investigation into countries' scientific contributions to education for sustainable development involved a threshold criterion, setting the minimum article publication count at 5 within VOSviewer. This rigorous criterion was met by 61 countries among the 104 countries enlisted in VOSviewer, revealing a subset of nations actively engaged in scholarly production within this domain. The visualization presented in Figure 8 offers a graphical representation of these selected countries, employing distinct color-coded circles to denote individual nations. The size of each circle corresponds to the volume of article publications attributed to each country in the field of education for sustainable development goals. Larger circles denote countries with a higher volume of scholarly

contributions in this specific field, providing a comprehensive visual overview of the diverse levels of scientific output across various nations.

Countries Articles Production

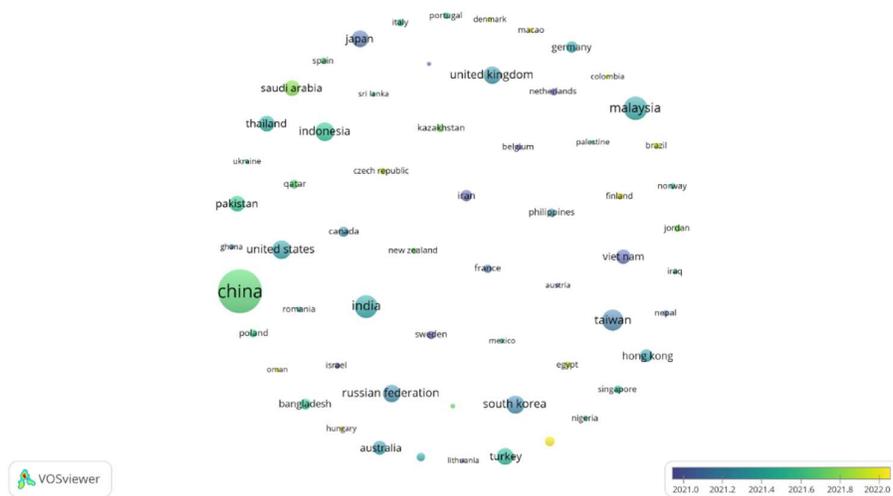


Figure 8

Asian countries article production on education for sustainable development from 2019 to 2023

3.6 Citation analysis

A meticulous bibliometric analysis sought influential articles in Asian education for sustainable development, imposing a stringent criterion of 10 citations per article among 1700 publications using VOSviewer. This criterion narrowed the selection to 359 significant articles, showcasing their prominence in the field. Figure 9 visually encapsulates these impactful articles, employing color variation and circle sizes to denote diverse citation counts. Table 7 provides a detailed account of the top 10 globally cited articles, ranked by normalized total citations. Notably, the article "A Green Ideology in Asian Emerging Economies: From Environmental Policy and Sustainable Development," published in 2019, secured the foremost position with 285 citations between 2019 and 2023, averaging 57 citations annually. Other articles, including "Enabling Technologies and Sustainable Smart Cities," "Impact of COVID-19 Pandemic on the Mental Health of Children in Bangladesh," and "Key Competencies in Sustainability in Higher Education," obtained substantial citations ranging from 109 to 253 times, reflecting diverse annual citation counts. Analysis of Table 7 delineates publication years, emphasizing the varied temporal distribution of highly cited articles within the specified timeframe.

The analysis presented in Table 7 sheds light on the impactful and extensively cited articles within the education for sustainable development goals sphere. These top-cited articles, spanning a diverse range of topics, underscore their substantial influence within the field, illuminating key research directions and themes that have garnered considerable attention and recognition within scholarly discourse.

Most Global Cited Documents							
Sl No	Articles	Journal	Year of publication	DOI	Total Citations	TC per Year	Normalized TC

1	A green ideology in Asian emerging economies: From environmental policy and sustainable development	Sustainable Development	2019	10.1002/sd.1958	285	57	18
2	Enabling technologies and sustainable smart cities	Sustainable Cities and Society	2020	10.1016/j.scs.2020.102301	253	63.25	16.6
3	Impact of COVID-19 pandemic on the mental health of children in Bangladesh: A cross-sectional study	Children and Youth Services Review	2020	10.1016/j.chilyouth.2020.105277	202	50.5	13.2
4	Key competencies in sustainability in higher education—toward an agreed-upon reference framework	Sustainability Science	2021	10.1007/s11625-020-00838-2	196	65.33	19.4
5	“I’m not against online teaching, but what about us?”: ICT in Ghana post Covid-19	Education and Information Technologies	2021	10.1007/s10639-020-10331-z	148	49.33	14.6
6	Higher education for sustainable	Sustainability Science	2019	10.1007/s11625-018-0628-4	118	23.6	7.47

	development: actioning the global goals in policy, curriculum and practice						
7	Strategic assessment of COVID-19 pandemic in Bangladesh: comparative lockdown scenario analysis, public perception, and management for sustainability	Environment, Development and Sustainability	2021	10.1007/s10668-020-00867-y	114	38	11.3
8	Nudging toward diversity in the boardroom: A systematic literature review of board diversity of financial institutions	Business Strategy and the Environment	2021	10.1002/bse.2665	110	36.67	10.9
9	From goals to joules: A quantitative approach of interlinkages between energy and the Sustainable Development Goals	Energy Research & Social Science	2019	10.1016/j.erss.2018.11.016	109	21.8	6.9

10	Stretching “smart”: advancing health and well-being through the smart city agenda	The International Journal of Justice and Sustainability	2019	10.1080/13549839.2017.1360264	91	18.2	5.76
TC- Total Citation							
Table 7 Top 10 globally cited documents on education for sustainable development goals							

Article Production And Citation

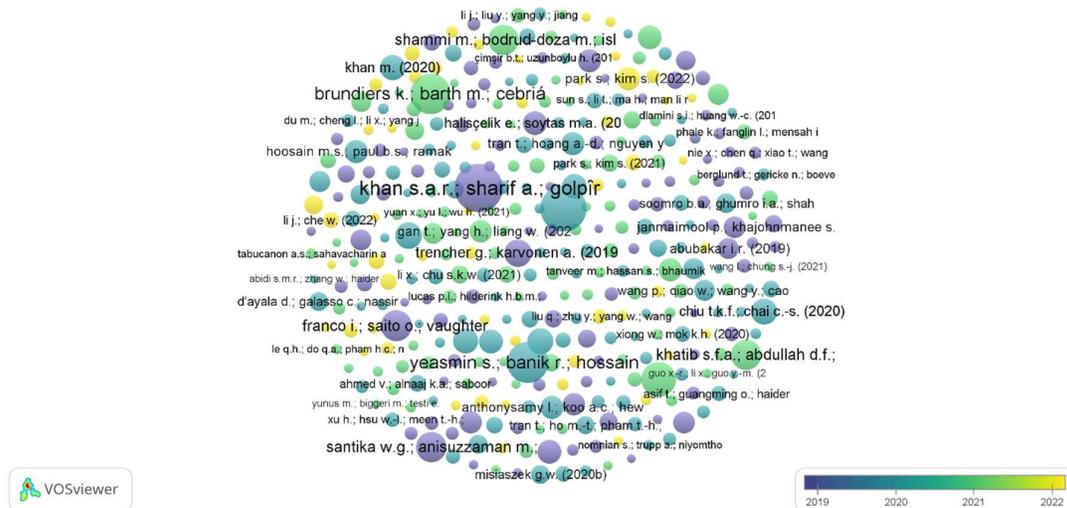


Figure 9

Articles on education for sustainable development published from Asian countries from 2019 to 2023 and their citation

Table 8 provides a meticulous breakdown of the top 10 articles with the highest local citations, arranged by normalized total citations. Notably, the article titled "Higher Education for Sustainable Development: Actioning the Global Goals in Policy, Curriculum and Practice," published in 2019, stands out as the most locally cited, gathering 14 citations within the local domain and 118 citations globally. This article maintains a normalized citation count of 23.86 locally and 7.47 globally. Following this, articles like "Challenges and Coping Strategies of Online Learning for College Students in the Context of COVID-19," "Promoting STEAM Education in Primary School through Cooperative Teaching," and "The Quest for Sustainable Graduate Education Development" have attracted significant local attention, securing normalized local citations ranging from 17.86 to 23.86.

An analysis of these top 10 locally cited articles reveals an interesting pattern in their publication years. Specifically, 8 articles were published in the year 2022, with two articles surfacing in 2019 and 2021, showcasing a predominant concentration of locally cited articles within the recent publication years. The meticulous

compilation in Table 8 illuminates the local citation impact of articles within the field of education for sustainable development goals. These top-cited articles, exhibiting significant local recognition, underscore their influence and relevance within the local academic context, offering insights into prevalent research trends and areas of particular interest within the specified geographical scope.

Most Locally Cited Documents						
Sl No	Article	Year of publication	Local Citations	Global Citations	Normalized Local Citations	Normalized Global Citations
1	Higher education for sustainable development: actioning the global goals in policy, curriculum and practice	2019	14	118	23.86	7.47
2	Challenges and coping strategies of online learning for college students in the context of COVID-19: A survey of Chinese universities	2022	9	31	22.97	7.85
3	Promoting STEAM Education in Primary School through Cooperative Teaching: A Design-Based Research Study	2022	9	8	22.97	2.03
4	The Quest for Sustainable Graduate Education Development: Narrative Inquiry of Early Doctoral Students in China's World-Class Disciplines	2022	9	2	22.97	0.51
5	Unpacking the Policies, Historical Stages, and Themes of Education Equality for Educational Sustainable Development: Evidence from China	2022	9	7	22.97	1.77
6	Exploring High-Quality Institutional Internationalization for Higher Education Sustainability in China: Evidence from Stakeholders	2022	9	10	22.97	2.53
7	Web GIS for Sustainable Education: Towards Natural Disaster Education for High School Students	2022	9	8	22.97	2.03
8	Key competencies in sustainability in higher education—toward an agreed-upon reference framework	2021	8	196	20.42	19.37
9	Educational attainment, use of numeracy at work, and gender wage gaps: Evidence from 12 middle-income countries	2022	7	1	17.86	0.25
10	Innovation of Teaching Tools during Robot Programming Learning to Promote Middle School Students' Critical Thinking	2022	7	1	17.86	0.25

Table 8

Top 10 locally cited articles and their year of publication, local citations, global citations, normalized local

Reduction, Addis Ababa Action Agenda on Financing for Development, and the Paris Agreement on Climate Change, pivotal to global sustainability endeavors.

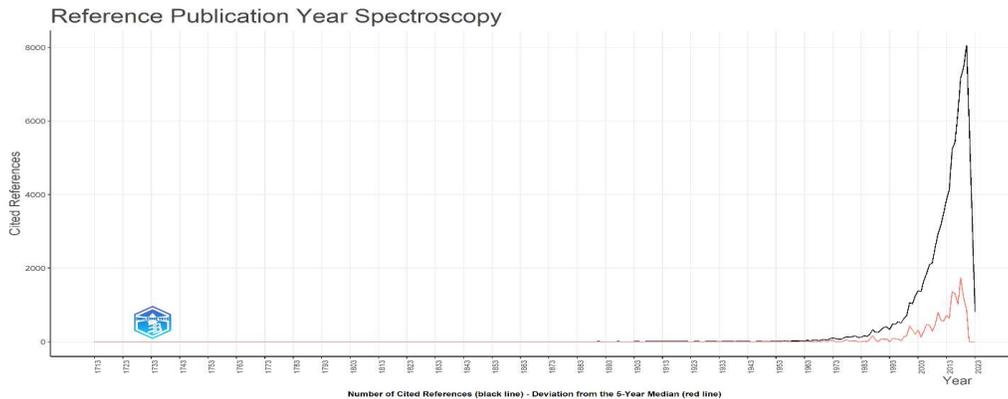


Figure 11

Reference spectroscopy of articles published from Asian countries on education for sustainable development between 2019-2023

3.7 Trend Topics

Between 2019 and 2023, a thorough analysis reveals education for sustainable development as a pivotal research domain. This period witnessed substantial scholarly engagement in varied subjects like alternative energy, sustainable development, sustainability, education, university sector, decision making, numerical model, urban area, adolescent studies, and attitude surveys, as displayed in Figure 12. Comparative and cross-sectional studies notably prevailed as research methodologies, particularly in perception and attitude studies within Asia. Table 5 highlights China and Indonesia among the top 5 contributors to articles on sustainable development goals in education, affirming this trend in Figure 9. This robust academic activity emphasizes the regional significance in this critical field.

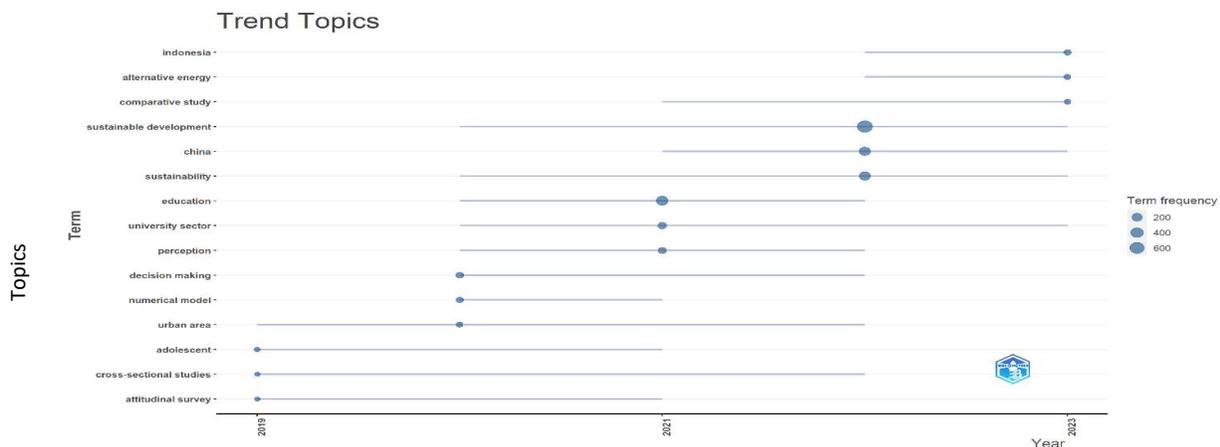


Figure 12

Trending topics and their frequencies on education for sustainable development in Asian countries between 2019-23

In the analysis of diverse research topics, Table 9 delineates the top ten trends, notably featuring Urban Area, Education, University Sector, Perception, Decision Making, Numerical Model, and Sustainable Development. Survey and Cross-Sectional Studies notably emerge as significant trends within the top 10, as observed in biblioshiny. This table offers a comprehensive overview, detailing trending items, their frequencies, and quartile years. It provides insights into the publication years' distribution for each subject. For instance, "sustainable development" spans from 2020 to 2023, evident from its quartiles: first quartile (year_q1) of 2020, median (year_med) of 2022, and third quartile (year_q3) of 2023, demonstrating its publication timeline. Other items similarly present their respective quartiles, indicating the dispersion of their publication timelines.

Trending Topics					
1	Adolescent	6	2019	2019	2021
2	Attitudinal Survey	5	2019	2019	2021
3	Cross-Sectional Studies	5	2019	2019	2022
4	Decision Making	40	2020	2020	2022
5	Numerical Model	24	2020	2020	2021
6	Urban Area	20	2019	2020	2022
7	Education	307	2020	2021	2022
8	University Sector	95	2020	2021	2023
9	Perception	65	2020	2021	2022
10	Sustainable Development	714	2020	2022	2023
Q_1- Quartile one					
Q_3- Quartile three					
Med- Midian					

Table 9
Trending topics on education for sustainable development in Asian countries between 2019-2023 and their frequencies

3.8 Analysis of Keywords

The aim of the keyword co-occurrence analysis is to explore the interrelationships among keywords within a corpus of publications, providing insights into prevalent themes within contemporary scientific discourse. Utilizing VOSviewer, co-occurring keywords from the Scopus database were scrutinized, comprising 7536 keywords, with 209 recurring more than ten times. Figure 13 presents a visual representation of the network map illustrating keyword co-occurrences. Nodes of varied colors signify distinct clusters, node size reflects keyword frequency, and thicker connections indicate stronger associations between items. The top ten keywords include "sustainable development" (879 occurrences), "sustainability" (351), "China" (270), "higher education" (233), "learning" (187), "student" (168), "sustainable development goal" (153), "teaching" (149), "sustainable development goals" (106), and "innovation" (60 occurrences).

Keywords of Published Articles

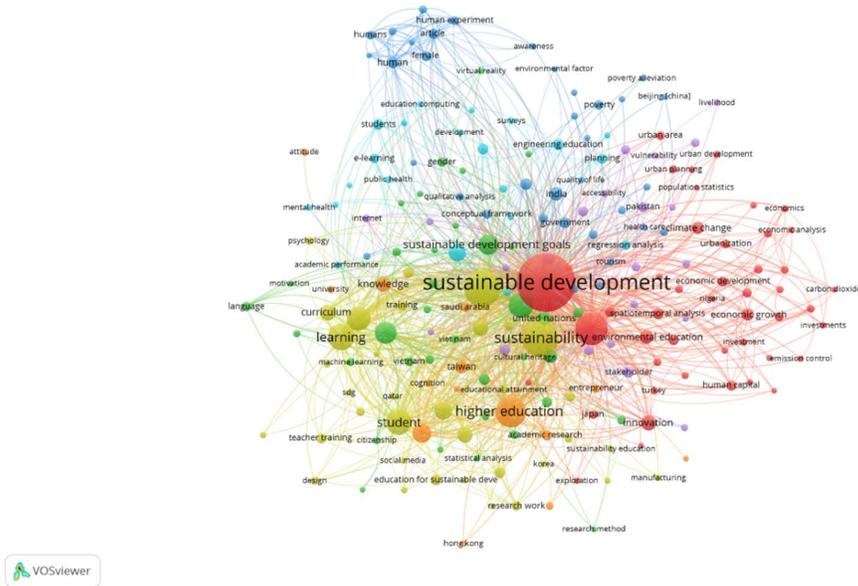


Figure 13

Co-occurrence of keywords of published articles on education for sustainable development in Asian countries between 2019 and 2023

3.9 Thematic analysis

Thematic analysis involves scrutinizing authors' keywords to uncover prevalent themes within a domain. Figure 15 depicts 15 discernible clusters in articles pertaining to education for sustainable development in Asian countries. These clusters encapsulate diverse themes, starting with "online learning." Subsequent clusters encompass keywords related to various aspects like COVID-19, Sustainable Development, Human Capital, and more. Table 13 elaborates on each cluster's specific keywords, offering a detailed thematic breakdown.

Cluster and Their Keywords		
Cluster No	Cluster Label	Key Words
1	Online Learning	online learning, distance education
2	Education for Sustainable Development	education for sustainable development (esd), sustainable development goals (sdgs), covid-19 pandemic, curriculum, professional development
3	Covid-19	covid-19, sustainable education, e-learning, Bangladesh, gender, ICT, sustainable development goal
4	Attitude	Attitude, university, Saudi Arabia, learning, and knowledge

5	Sustainable Development	sustainable development, sustainability, education for sustainable development, higher education, sustainable development goals, education, China, SDGs, environmental education, higher education institutions, India, climate change, Pakistan, ESD, , Malaysia, early childhood education, teacher education, corporate social responsibility, engineering education, systems thinking, Japan, leadership, SDG, sustainability education, awareness, content analysis, education for sustainability, science education, AND stem education
6	Thailand	Thailand, poverty
7	Artificial Intelligence	artificial intelligence, machine learning, global citizenship education, international students, case study, sustainable development education, and Taiwan
8	Bibliometric Analysis	bibliometric analysis
9	Human Capital	human capital, economic growth, renewable energy, environment, Indonesia, and natural resources
10	Innovation	innovation
11	Sustainable Learning	sustainable learning
12	Vietnam	Vietnam, quality education, and motivation
13	Education Policy	education policy
14	Entrepreneurship Education	entrepreneurship education
15	Development	development

Table 13
Cluster number, Name, and keywords of published article on education for sustainable development in Asian countries from 2019-2023

The presented clusters in Figure 14 demonstrate discernible properties, primarily measured in terms of density and centrality, wherein density represents the vertical axis and centrality the horizontal axis. These metrics serve as indicators of topic significance within the analyzed corpus. The figure delineates several clusters: the first, focusing on online learning, displays a higher developmental degree but lower relevance. The second cluster, centered on education for sustainable development, exhibits moderate developmental progress alongside considerable relevance. The third cluster, addressing COVID-19's impact on education, reveals high relevance but limited developmental progression due to articles published during the pandemic's influence from 2019 to 2023. The fourth and fifth clusters, encompassing themes like "attitude," illustrate varying degrees of developmental progress and relevance. Moreover, keywords categorized in Table 13, such as "Thailand," "Artificial Intelligence," and "Education Policy," align with distinct thematic orientations, representing diverse thematic clusters ranging from emerging or declining to niche or motor themes.

Thematic Map

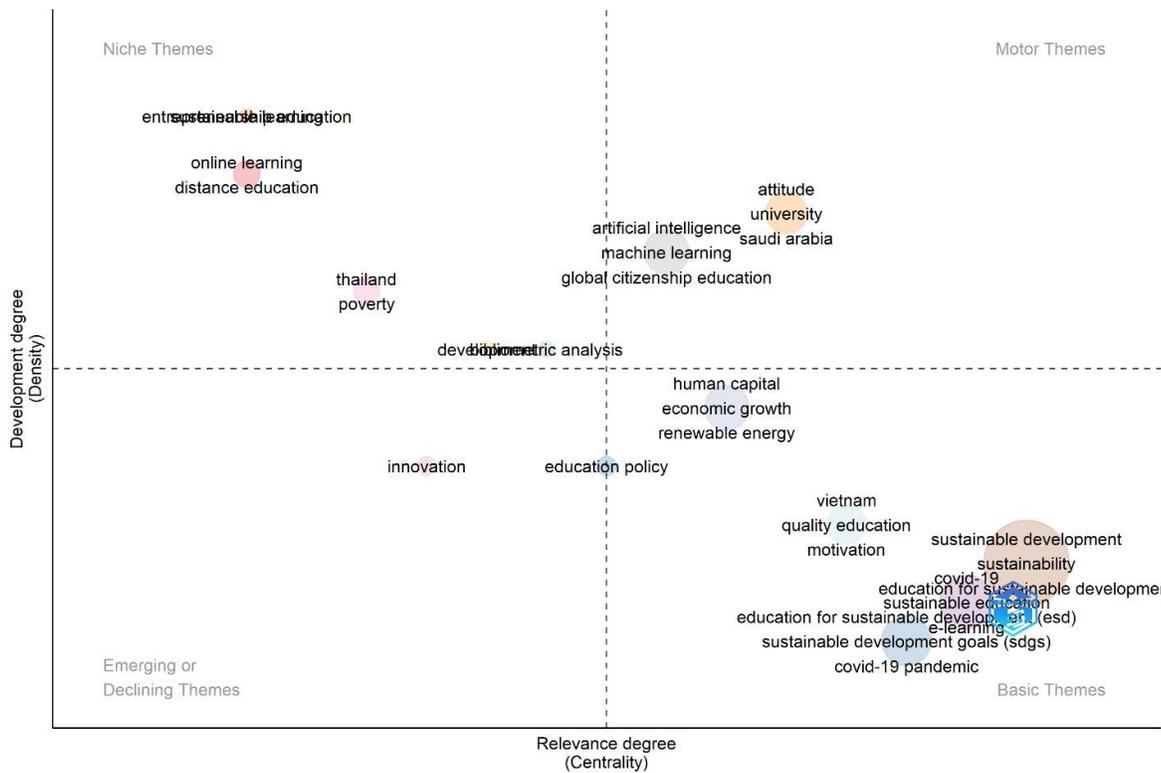


Figure 14

Thematic map of articles published from Asian countries from 2019-2023 on education for sustainable development

The discourse on sustainable development continues its evolutionary path, advancing steadily yet remaining in a formative phase. Diverse organizations, spanning local, regional, national, and international domains, have actively propelled this agenda, extending beyond the confines of the Asian continent. Researchers globally have ardently contributed to this realm, exemplifying a concerted pursuit of sustainable livelihoods. This study, scrutinizing articles published from Asian countries between 2019 and 2023 on education for sustainable development, observed an average publication growth trend of 22.68 percent within this period. Notably, the journal "Sustainability" emerged as the favored avenue for Asian authors, in agreement with findings from Mishra et al., 2023; Mittal & Jora, 2023; and Yang & Xiu, 2023. China surfaced as the most prolific country within Asia for articles on education for sustainable development, while the United States led global contributions according to Mishra et al., 2023; Mittal & Jora, 2023; and Yang & Xiu, 2023. Beijing Normal University in China emerged as the primary institution for prolific articles within Asia, paralleling Arizona State University's global position between 1992 and 2022. Moreover, the University of Oxford notably spearheaded articles on sustainable development goals between 2015 and 2022. Assessing author productivity, Li, J from the Second Xiangya Hospital of Central South University in China was the most prolific Asian author in this domain, while Walter Leal Filho held this distinction on a global scale according to Yang & Xiu, 2023. Mittal & Jora, 2023 identified Bringle R G as the most prolific author in student community engagement in higher education for sustainable development from 2010 to 2023. Chinese authors and China substantially contributed to publishing articles on education for sustainable development within Asian countries, signifying a significant role in propelling this field. Notable articles in frequent citation highlighted "A Green Ideology in Asian Emerging Economies: From Environmental Policy and Sustainable Development," published in the journal "Sustainable Development," as a prominent reference in this domain. Thematic analysis from 2019 to 2023 unveiled prevalent topics like energy, sustainable development, education, university sector, decision making, numerical models, urban areas,

adolescent studies, and attitude surveys, with sustainable development emerging as the most relevant theme. Themes such as innovation and policy surfaced prominently, underscoring escalating attention within this sphere.

4. Conclusion

Education for sustainable development is a critical aspect in the global pursuit of sustainable goals. Institutions and organizations, including those in Asia, are actively engaged in fostering sustainable practices. This study emphasizes China's substantial role, exhibiting notable research output and a robust citation index compared to regional counterparts. The analysis reveals consistent growth in article production and authorship, underlining a positive annual growth rate. However, disparities exist across Asian nations, highlighting varying levels of contribution to this field. This research underscores the pivotal role of Asian countries in advancing education for sustainable development, indicating an expanding scope for this domain. China's influence is anticipated to remain significant, alongside the individual growth demonstrated by other nations, signifying collective progress in this critical area.

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