

## **Visualization of Research in Library and Information Science among BRICS Nations during 2019-2023: A Scientometrics Study**

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### **Abstract**

*This paper aims to explore the library and information science research output of the BRICS nations during year 2019-2023. This study used All Science Journal Classification (ASJC) covered by the Scopus citation database to collect data for five years. The bibliographic data have been downloaded through advanced search technique "SUBJTERMS (3309)" aims to covering subject area of "Information Science and Library Science" for BRICS countries. Total 16549 including all types of publication downloaded where 80 percent of papers found as articles. The Bibliometrix R (4.3.2) and VOS Viewer (1.6.20) used for the research visualization and analysis. Findings indicate that China emerge as the biggest research contributor followed by India, Brazil, Russia, and South Africa. The 6.13 annual publication growth rates were noted during the study period, with 6.99 citations per paper. It is found that 36% of total publications did not receive any citations. The journal Library Philosophy and Practice published ten % of total BRICS publications. The School of Information Management at Wuhan University noted as most productive organization, Author Xu Jie, Herman eti and rodríguez-bravo Blanca are the most collaborating authors. The authors' keywords analysis revealed that bibliometrics, scientometrics, Covid-19, social media and deep learning found as most frequent keywords. The thematic analysis represents that machine learning, artificial intelligence, big data, sentiment analysis and blockchain technology are most relevant emerging area of research finds during study. The totals of 85 percent of the documents published in English, followed by Chinese and Portuguese. The analysis will be helpful for LIS researcher to know the recent research trend of library and information science among BRICS nations.*

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**Keywords:** Bibliometric, Scientometric, BRICS nations, Co-authorship, Network visualization, Thematic evaluation, VoSviewer, Biblioshiny, R-Software.

### **1. Introduction**

BRICS is an acronym for the Brazil, Russia, India, China, and South Africa. The formal grouping known as BRIC was established after a meeting of the leaders of Russia, India, and China in 2006 during the G8 Outreach Summit in St. Petersburg. It's shared the 42% of the global population, 30% of the world's territory, 23% of GDP, and 18% of international trade.

In first “Goldman Sachs” used the term BRIC in 2001 in its Global Economics Paper. The formation was solidified at the first meeting of BRIC foreign ministers during the UNGA in New York later that year. The group expanded to BRICS by including South Africa in 2010. The BRICS forum is an independent international organization based on three pillars of cooperation political and commercial, financial and commercial, cultural and people to people. The Political and Security Cooperation Pillar is the core of BRICS cooperation, with leaders meeting twice annually, once for the BRICS Summit and another during the G20 Summit. In recent, South Africa hosted the 15th BRICS summit on 22-24 August 2023 in Johannesburg. During its initial decade, BRICS fostered sector-specific cooperation in diverse fields, including science and technology, trade promotion, energy, healthcare, education, innovation, and efforts to combat transnational crime.

Scientometrics is a branch of science dedicated to studying the organizational structures underpinning research, resource inputs, and outputs and developing benchmarks to evaluate the quality of information output. Scientometric research publications are a quantitative measure of the primary research activity in a country. Vassily V. Nalimov & Z. M. Mulchenko coined the Russian equivalent of 'scientometrics' ('naukometriya') 1969. It is “a quantitative method of investigating the development of science as an information process”. The term gained popularity by the foundation of the journal *Scientometrics* by Tibor Braun in Hungary in 1978. As per the subtitle of the journal, *Scientometrics* includes all quantitative aspects of the science of science, communication in science, and science policy.

## **2. Review of Literature**

Gupta et al. (2022) analyzed the library and information science research trends among BRICS countries. The Web of Science core collection database (WoSCC) was used to collect data from 1989 to 2020. The results reveal a positive upward growth rate presence during the study; and found China as most influential country. The journal *Scientometrics* noted as most influential journal with the highest number of publications. The keywords Deep learning, machine learning, sentiment analysis, altmetrics, and artificial intelligence noted as leading topics in LIS research among BRICS nations. Tripathi et al. (2018) analyzed the library and information science research in BRICS countries. The Social Science Index (SSCI) of the Web of Science (WoS) citation database collected data from 2005 to 2014. The results reveal that 90 percent of papers were articles; China has the most publications, followed by Brazil, South Africa, India, and Russia. Total one-third of articles did not receive a single citation; Emerald, Elsevier, and Springer noted as most influential journal publishers; the research in LIS is information systems, interdisciplinary applications, and management. Mangi (2014) analyzed the LIS research among BRIC (Britain, Russia, India, and China) during 1996-2012. The data was retrieved from SJR (SCImago Journal) result showed a mixed Trend with a slight increase and decrease in the research publications; negative growth was recorded in the research publications among all BRIC nations in cumulative. Kumar et al. (2011) studied comparative analysis of the scientific output among BRIC countries. The data were collected from the Scopus database during 1980-2009. Finding reveals that China’s research output is proliferating and may compete with the United States in terms of scientific journals; BRIC countries may emerge as the global leader in R&D output in future. Walters et al. (2015) analyzed the Worldwide contributors to library and information science literature during 2007-2012. Total of 31 top-cited journals were divided into four country groups of LIS professionals: the USA, the UK, Canada, and Others. Total 86.4 % authors have only single article; the top 50 authors have contributed eight or more articles during the study. Singh et al. (2015) discussed the Trends in research output and collaboration patterns among BRICS countries and explored that a maximum of 12.43% of papers were indexed in 2013 against

1.51% in 1994; the contribution of China is the highest by a total of 51.19% followed by India with 19.60%, USA is most collaborative countries, and Chinese Academy of Science found as most prolific institutions; Acta Crystallographica Section E Structure Reports Online is most influential journals. Das et al. (2021) discusses the digital library research in BRICS countries from 2000 to 2019. Total 1220 digital library-related papers were analysed in which, 225 were two-authored, degree of collaboration (0.84), collaborative index (4.14), collaboration coefficient (0.59), and the modified collaboration coefficient (0.61). Bornmann et al. (2015) examine the development of the BRICS countries in the domain of top-cited papers (top 10% and 1% most frequently cited documents) between 1990 and 2010. Patra (2021) studied the library and Information Science Research in 114 Indian Universities during 1964-2018; data was collected from Library, Information Science & Technology Abstracts (LISTA), out of 114, only DRTC, NISCAIR, University of Delhi, University of Mysore and University of Kashmir have more than 100 publications. SRELS Journal of Information Management, published by DRTC, Bangalore, noted as most prolific journal.

### **3. Objectives of the Study**

- 1) To evaluate the growth pattern of literature on Library and information science among BRICS countries during 2019 to 2023.
- 2) To analyze the citation pattern of published literature in LIS research among BRICS countries.
- 3) To find most productive sources and authors based on the number of publications and total citations.
- 4) To know the trending topics of research in LIS.
- 5) To analyze the thematic map of crucial words and know the recent trend of LIS research among BRICS nations.

### **4. Data and Methodology**

For this study, data has been retrieved from the Scopus (provided by Elsevier in 2004) database. Total 16549 published documents were extracted over five years (2019–2023) on 12th October 2023. All extracted data were tabulated and analyzed using various scientometric indicators. The indicators were used to assess the scientific output, and to determine the impact of the publication output. The advanced search technique ((SUBJTERMS (3309) AND (LIMIT-TO (PUBYEAR,2023) OR LIMIT-TO (PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019))) used to download the data from Scopus database then refined by limitations like Countries/Regions (Brazil, Russia, India, Peoples Republic of China, or South Africa) and downloaded for the analysis in CSV format. The data included Article N=13561, Data Paper N=769, Conference N=725, Book Chapter N=516, review N=491, Editorial N=156, and others N=331 records from the downloaded data. For the analysis, VOSviewer used for co-authorship mapping and the R (Bibliometrix, version-4.3.2) package to analyze indicators, such as growth rate, citation trends, and thematic evolution.

### **5. Analysis and Results**

Over the past five years, 16,549 library and information science documents among BRICS countries have been published by 29,163 authors, and 252 sources which are considered for the study. The publication language shows that English (N=14,317) dominates the most, followed by Chinese (N=1186), Portuguese (N=857), Russian (N=108), Spanish (N=71) and other language in less than 10 documents. Table 1 (a) indicates that most common authorship

pattern of the publication found is multi-authorship (N=14,813), followed by single-authored (N=1736) during the timespan 2019-2023.

Table 1(a): Data generated through Scopus databases and processed by R Software

S.N.	Information/ data	Number
1	Sources (Journals, Books, etc.)	252
2	Annual Growth Rate (in %)	6.13
3	Document Average Age	1.92
4	Average citations per doc	6.993
5	Total Number of References	262073
6	Total Number of Keywords Plus (ID)	28799
7	Total Number of Author's Keywords (DE)	33689
8	Total Number of Authors	29136
9	Total Number of Documents Published	16549
10	Authors of single-authored document	1245
11	Number of Single-authored document	1736
12	Co-Authors per Documents	5.09
13	International co-authorships (in %)	27.03

Table 1 (b): Various type of the documents Published

S.N.	Type of documents	Number (Total 16549)
1	Article	13561
2	Book Chapter	516
3	Conference Paper	725
4	Data Paper	769
5	Editorial	196
6	Erratum	163
7	Letter	43
8	Note	78
9	Retracted	6
10	Review	491
11	Short Survey	1

Analysis shows that number of multi-author publications is the highest, but majority of the authors prefer to work collaboratively (89.50%) rather than individually (10.49%). The authors used (N=33,689) different keywords and (N=2,62,073) references with a 6.13% annual growth rate, an average citation per document of 6.993, and an average age of 1.92 per document.

## 5.1 LIS research output and citation pattern among BRICS nations

Figure 1 depicts the year wise research publication overview in LIS research from BRICS nations during 2019-2023. Results showed that China is the leading BRICS country with 7,966 (48.14%) publications, followed by India with 4,727 (28.56%), Brazil with 1,951 (11.79%), Russia with 1,062 (6.42%), and South Africa with 843 (5.09%). All five BRICS countries produced 16549 publications in the LIS research during 2019–2023. Figure 2 shows the year wise linear growth rate of publications during the study period. The year 2023 noted as is most productive year with 3703 (22.37%) followed by 3556 (21.48%) in 2020 and 3297

(19.92%) in 2022 where the 2019 noted as least productive year, with 2919 (17.63%) publications. The citation pattern shows an increase trend from 2019 to 2023 but suddenly falls in 2023 because of the less citation year. The year 2022 calculated as most cited year with citation, 64,325 (55.58%), and 2020 as least cited year with 5331 (4.60%) citations. The average number of citations per paper noted 6.99 during the five-year study period.

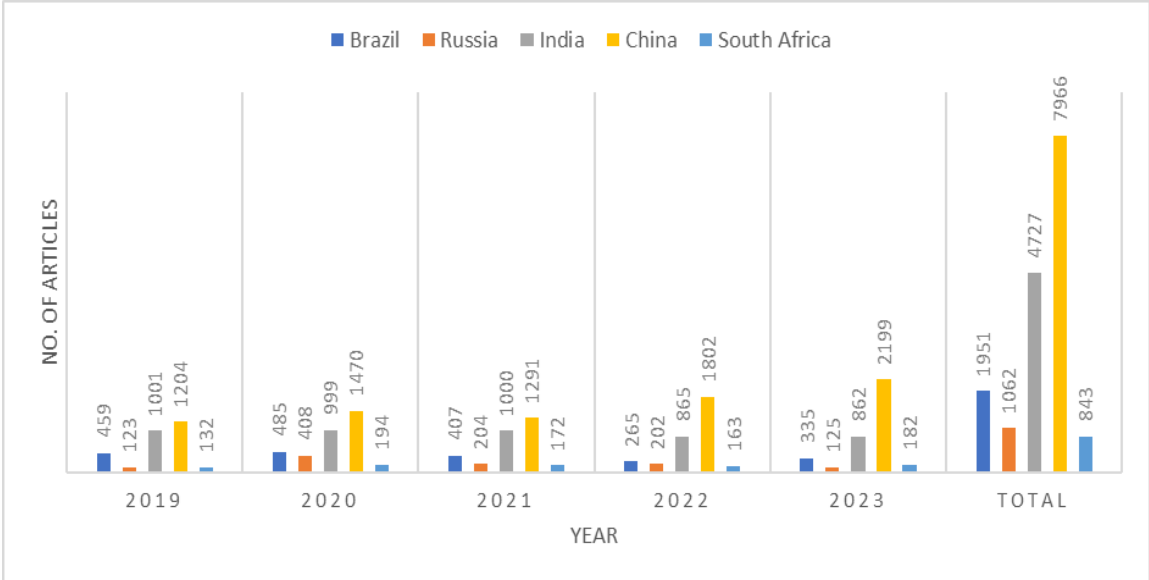


Figure 1: Country Wise-annual Scientific Growth of Publications

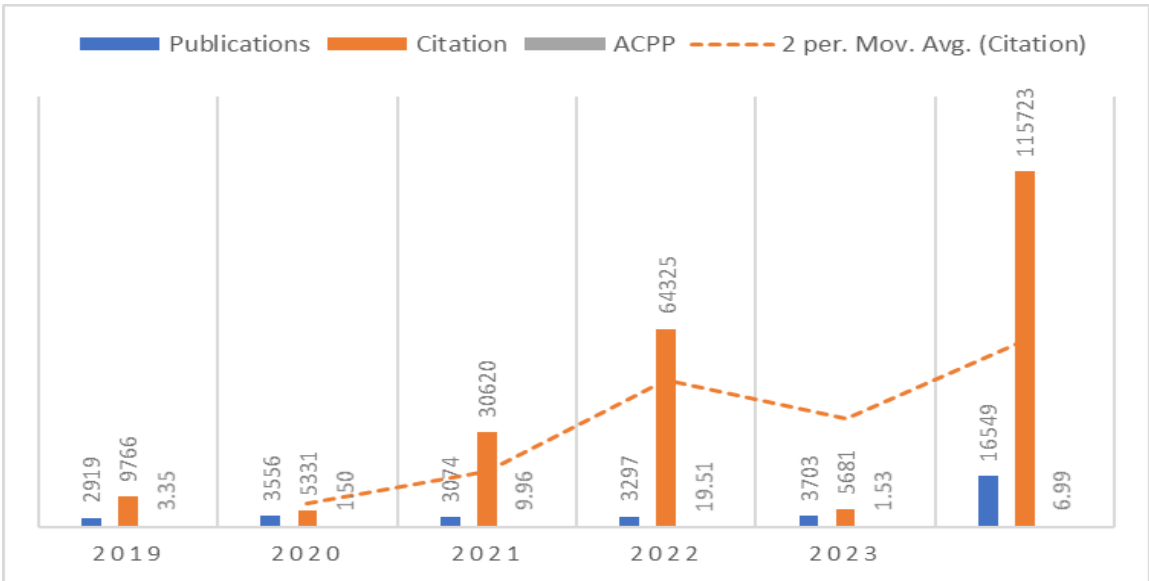


Figure 2: Year Wise-annual Scientific Growth or Publications of Literature

Table 2 represents the details of cited and non-cited documents among the BRICS countries along with Average citation per paper. Out of 16549, total 10,455 (63.18%) cited documents and non-cited 6094 (36.82%) documents with 6.99 average citations produced by BRICS countries in LIS research. China obtained first position with 7966 (N=33.51% cited and, N=39.71% non-cited) publications with 64325(55.5%) citations, followed by India 4727 (N=26.35% cited and N=32.36% non-cited) documents with 30620 (26.4%) citations and Brazil 1951(N=9.72% cited and 5.64% non-cited) documents with 9766 (8.4%) citations. Interestingly, China obtained the highest with 8.07 average citations per paper, whereas Brazil had the lowest, 5.01 average citations per paper during the study period. China has

produced 33% citable documents, which shows its higher productivity in LIS research. It is also seen that the average citation per paper in China is more significant than the overall 6.99 average citations per paper.

Table 2: Citation pattern of LIS research in BRICS countries (2019-2023)

Country	Cited Document			Non-Cited Document			TP	TC	ACPP
	Number	%	% of Country	Number	%	% of Country			
<b>Brazil</b>	1017	9.727	6.15	934	15.33	5.64	1951	9766	5.01
<b>Russia</b>	576	5.509	3.48	486	7.98	2.94	1062	5331	5.02
<b>India</b>	2755	26.351	16.65	1972	32.36	11.92	4727	30620	6.48
<b>China</b>	5546	53.046	33.51	2420	39.71	14.62	7966	64325	8.07
<b>South Africa</b>	561	5.366	3.39	282	4.63	1.70	843	5681	6.74
<b>Total</b>	10455	100	63.18	6094	100	36.82	16549	115723	6.99

## 5.2 Productivity among scientists

Lotka's law is used to know the scientific productivity patterns among scientists in a certified research field. By this law, the proportion of all contributors to a single item should be over 60%. According to the results shown in Fig. 3, total 29,136 authors wrote 9002 documents, of which 16,682 authors have published only one publication (57.25% of total author). The distribution of the publications is diversified where 4648 authors with two publications, 1909 authors with three publications, 1677 authors with four publications, 1650 authors with five publications, 666 authors with six publications, 220 authors with seven publications, 583 authors with eight publications, 151 authors with nine publications, 102 authors with ten publications and many single authors written more than a hundred articles.

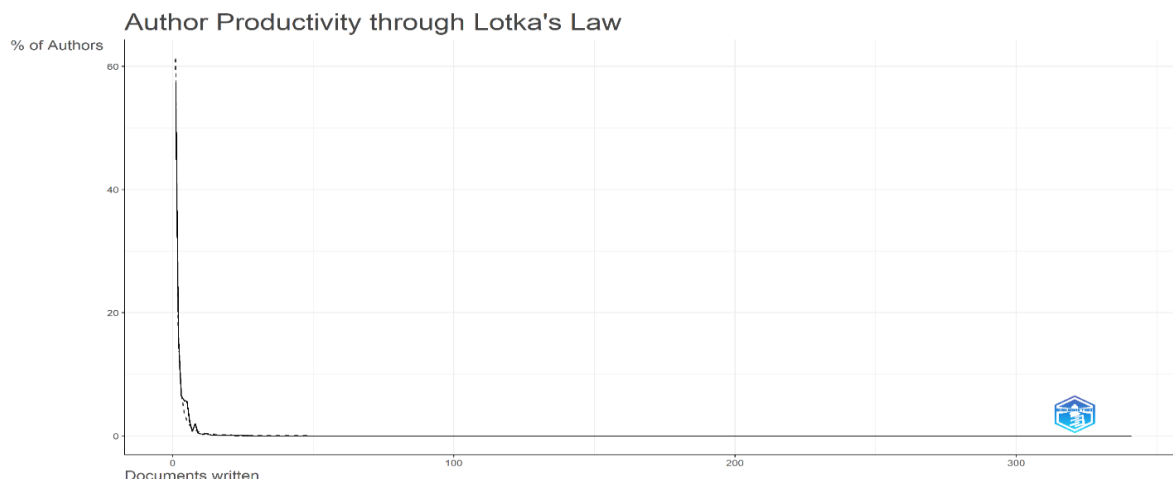


Figure 3: Productivity among scientists based on Lotka's Law

## 5.3 Top ten prolific authors

Table 3 indicates the top ten most prolific authors in LIS domains. The VOSviewer software has been used for the analysis. The criteria for the data visualization minimum 20 publications and citations sated and total 339 publications meet the threshold. Bu, Yi. noted as the most prolific author (Document, N=50; Citation, N=524), followed by Zhang,

Chengzhi (Document, N=46; Citaion, N=293). The citations pattern indicates that, Dwivedi, Yogesh K. with highest citation (N=315), followed by Rana, NP with citations (N=1741), where the lowest noted for Liu, Weishu with citation (N=595). It is found that Chinese authors dominates based on number of publications and Indian author dominance in quality of publications.

Table 3: Top ten authors with the highest publications and citations

Number of publications				Number of Citations			
Author Id	Author	Document	Citations	Author Id	Author	Document	Citations
2676	Bu, Yi	50	524	7165	Dwivedi, Yogesh K.	32	3158
34216	Zhang, Chengzhi	46	293	23331	Rana, N. P.	19	1741
17353	Lu, Wei	46	281	15555	Li, Xin	25	947
34544	Zhang, Lin	41	557	25203	Shan, Yuli	10	918
14992	Li, Gang	40	228	3471	Chatterjee, Sheshadri	12	687
29124	Verma, M. K.	39	126	25425	Sharma, Rohit	10	678
16908	Liu, Yang	34	212	16855	Liu, Xin	15	665
7165	Dwivedi, Yogesh K.	32	3158	16976	Liu, Yu	20	632
30977	Wu, Dan	31	238	13070	Kar, Arpan Kumar	11	610
9546	Gul, Sumeer	31	168	16785	Liu, Weishu	14	595

#### 5.4 Top ten cited publications

A minimum of 50 citation for each publication has been used for analysis, where 351 documents meet the thresholds. The top ten most cited articles depicted in table 4, which indicates the area of study in Research policy issues, Blockchain adoption, digital and social media marketing research, information management research and practice, Smart Cities, Blockchain research etc.

Table 4: Top ten cited publications

S.N.	Author	Title and DOI	Citations	Journal Name and Year
1	Yogesh K. Dwivedi	Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice, and policy. <a href="https://doi.org/10.1016/j.ijinfomgt.2019.08.002">https://doi.org/10.1016/j.ijinfomgt.2019.08.002</a>	811	IJIM (2021)
2	Jie He	The first high-resolution meteorological forcing dataset for land process studies over China. <a href="https://doi.org/10.6084/m9.figshare.11558439">https://doi.org/10.6084/m9.figshare.11558439</a>	664	Scientific Data (2020)

3	Gilberto Pastorello	The FLUXNET2015 dataset and the ONEFlux processing pipeline for eddy covariance data <a href="https://doi.org/10.6084/m9.figshare.12295910">https://doi.org/10.6084/m9.figshare.12295910</a>	574	Scientific Data (2020)
4	Maciel M. Queiroz	Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA. <a href="https://doi.org/10.1016/j.ijinfomgt.2018.11.021">https://doi.org/10.1016/j.ijinfomgt.2018.11.021</a>	571	IJIM (2019)
5	Yogesh K. Dwivedi	Setting the future of digital and social media marketing research: Perspectives and research propositions. <a href="https://doi.org/10.1016/j.ijinfomgt.2020.102168">https://doi.org/10.1016/j.ijinfomgt.2020.102168</a>	557	IJIM (2021)
6	Yogesh K. Dwivedi	Impact of COVID-19 pandemic on information management research and practice: Transforming education, work, and life. <a href="https://doi.org/10.1016/j.ijinfomgt.2020.102211">https://doi.org/10.1016/j.ijinfomgt.2020.102211</a>	528	IJIM (2020)
7	Elvira Ismagilova	Smart cities: Advances in research—An information systems perspective. <a href="https://doi.org/10.1016/j.ijinfomgt.2019.01.004">https://doi.org/10.1016/j.ijinfomgt.2019.01.004</a>	480	IJIM (2019)
8	Rahul De	Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. <a href="https://doi.org/10.1016/j.ijinfomgt.2020.102171">https://doi.org/10.1016/j.ijinfomgt.2020.102171</a>	472	IJIM (2020)
9	Sachin S. Kamble	Modeling the blockchain enabled traceability in agriculture supply chain. <a href="https://doi.org/10.1016/j.ijinfomgt.2019.05.023">https://doi.org/10.1016/j.ijinfomgt.2019.05.023</a>	464	IJIM (2020)
10	Laurie Hughes	Blockchain research, practice, and policy: Applications, benefits, limitations, emerging research themes and research agenda. <a href="https://doi.org/10.1016/j.ijinfomgt.2019.02.005">https://doi.org/10.1016/j.ijinfomgt.2019.02.005</a>	450	IJIM (2019)

(IJIM: International Journal of Information Management)

Table 4 shows that article published by Yogesh K. Dwivedi, et al. (2021) on Artificial Intelligence, received the highest number of citations (N=811) published in the International Journal of Information Management. Jie He, et al. (2020) study published on topic data set, in the journal Scientific Data notes as second highest (N=664) total citation score. The title of top ten highest cited publication indicates that artificial intelligence, datasets, COVID-19 impact, blockchain research, Information system, social media marketing, dataset etc. Out of ten articles eight were published in the International Journal of Information Management and two highly cited articles in Scientific Data journal. However, the authors listed in this table has least publications except Y. K. Dwivedi.

### 5.5 Top productive sources

Bradford's Law (1934) generally used to locate the journal into core (Zone 1), moderately fertile (Zone 2), and consistently decreasing productivity (Zone 3) based on publication frequency. The analysis helps to highlight the concentration of productivity in core journals. The top 7 journals in Zone 1 are the concentrated journals repeatedly cited in the literature on library and information science. As shown in Fig. 4, Zone 1 represents seven journals (2.77%), Zone 2 represents 24 journals (9.52%), and Zone 3 represents 221 journals (87.69%). The first seven core publishing journals are Library Philosophy and Practice



(published by the University of Nebraska-Lincoln), Scientific Data (published by Springer Nature), Journal of Chemical Information and Modeling (published by ACS publications), Information Processing and Management (published by ScienceDirect), Scientometrics (published by ScienceDirect), Data Analysis and Knowledge Discovery (published by Chinese Academy of Sciences (CAS), IEEE Transactions on Information Theory.

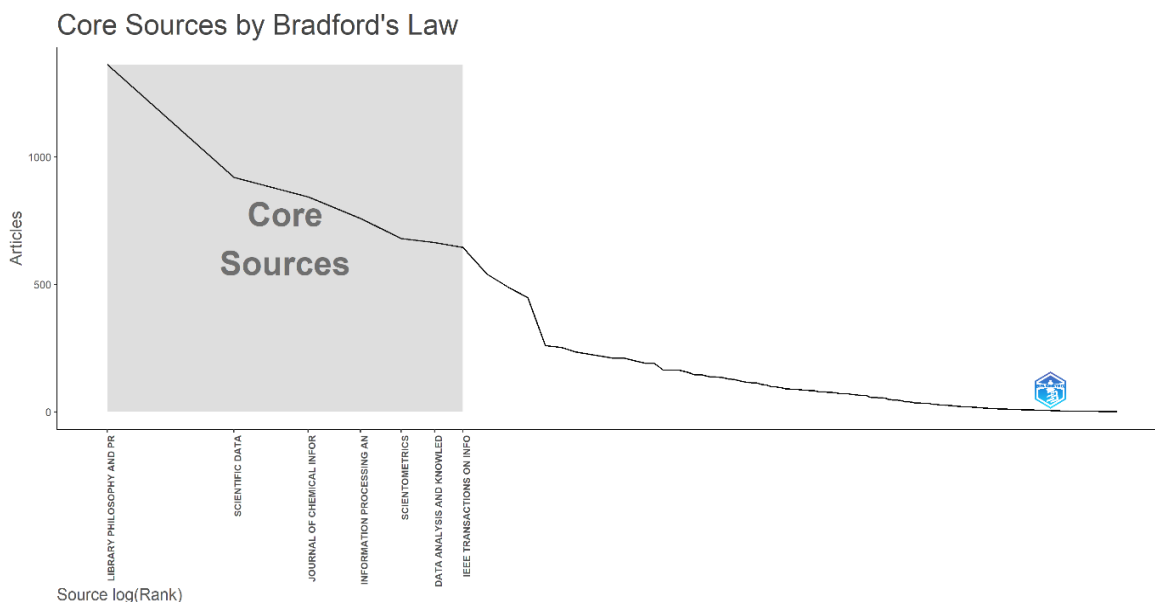


Figure 4: Core sources within the relevant literature

Table 5 presents the top 10 journals along with their total publication (TP), total citation (TC), SCImago score H-index, and Citation Index (CI) to understand the impact and efficiency of the sources. The Journal of Library Philosophy and Practice ranks first with N=1363 publications, followed by the Journal of Chemical Information and Modeling with N=831 publications. The highest citation (N=11834) and citation Index (N=15.84) were noted for the Journal of Information Processing and Management, and the highest H-index, 285, was pointed out for the Journal IEEE Transactions on Information Theory.

Table 5: Top ten sources with publications and citations

S.N.	Journal	NP	TC	CI	H-index
1	Library Philosophy and Practice	1363	1680	1.23	25
2	Journal of Chemical Information and Modeling	831	8942	10.76	182
3	Scientific Data	812	11180	13.77	101
4	Information Processing and Management	747	11834	15.84	114
5	Scientometrics	669	5720	8.55	133
6	Data Analysis and Knowledge Discovery	665	1036	1.56	6
7	IEEE Transactions on Information Theory	633	4204	6.64	285
8	Education and Information Technologies	537	3648	6.79	61
9	Intelligent Systems Reference Library	481	1736	3.61	35
10	Journal of Library and Information Science in Agriculture	448	244	0.54	3

## 5.6 Co-authorship network Organizations

The co-authorship pattern among leading research organizations has been obtained from VOS viewer software (Fig. 5). The minimum ten records published by each organization and ten citations were considered, and 148 organizations have been found. The final analysis selected the authors with the greatest total link strength. The authors are scattered in twelve different clusters depicted in various colors in Fig. 5. In cluster 1 (red), 13 organizations are visible, where the School of Information Management, Wuhan University, Wuhan, China (document N=185, TLS=77) collaborative clusters. In Cluster 2 (green) has ten organizations where the school of information management, Nanjing University, Nanjing, China has the highest (document N=106, TLS=40) is most collaborative cluster, In cluster 3 (blue), among 10 organizations School of Management, Hua Zhong University of Science and Technology, Wuhan, China on top with (document N=22, TLS=120. Cluster 4 (yellow) has 10 organizations, where the top position held by School of Information Management, Wuhan University, Wuhan, China (document N=108, TLS=46). In cluster 5 (purple), nine organizations are depicted: National Science Library, Chinese Academy of Sciences, Beijing, 100190, China with (document N=86, TLS=61) is the top scorer organization. Cluster 6 (Sky blue) Department of the Library, information and archives management, school of Economics and Management, University of Chinese Academy of Sciences, Beijing, 100190, China (document N=43, TLS=44) is a highly influential organization. Cluster 7 (orange), seven organizations depicted, belong to specifically Indian-origin Library and Information Science departments, including the Department of Library and Information Science, University of Kashmir, Srinagar, India (document N=29, TLS=2), followed by the Department of Library and information science, Mizoram University, Aizawl, India (document N=18, TLS=7) and Department of Library and Information Science, Babasaheb Bhimrao Ambedkar University, Lucknow, India (document N=11, TLS=4). Cluster 8 (brown), six organizations depicted, School of Information Management, Central China Normal University, Wuhan, 430079, China (document N=35, TLS=11) is the most influential organization. Cluster 9 (pink) depicts six organizations that belong to South Africa, and the University of South Africa (document N=45, TLS=2) is the most influential organization. Cluster 10 (Saffron), five organizations depicted, Wuhan University, Wuhan, China (document N=28, TLS=7) are the top-scoring organizations. Cluster 11 (parrot green), four organizations defined the School of Economics and Management, Nanjing University of Science and Technology, Nanjing, China (document N=23, TLS=21) as the most influential organization. In cluster 12 (light blue), four organizations are depicted. The analysis shows that clusters consist of similar institutions with local co-authorship patterns.

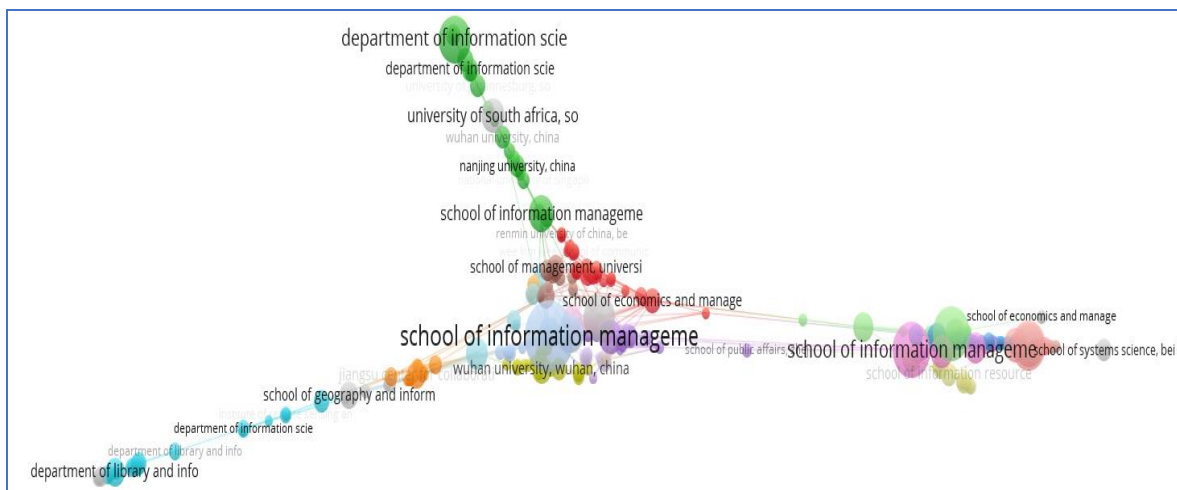


Figure 5: Organizations collaboration network in LIS research by BRICS nations

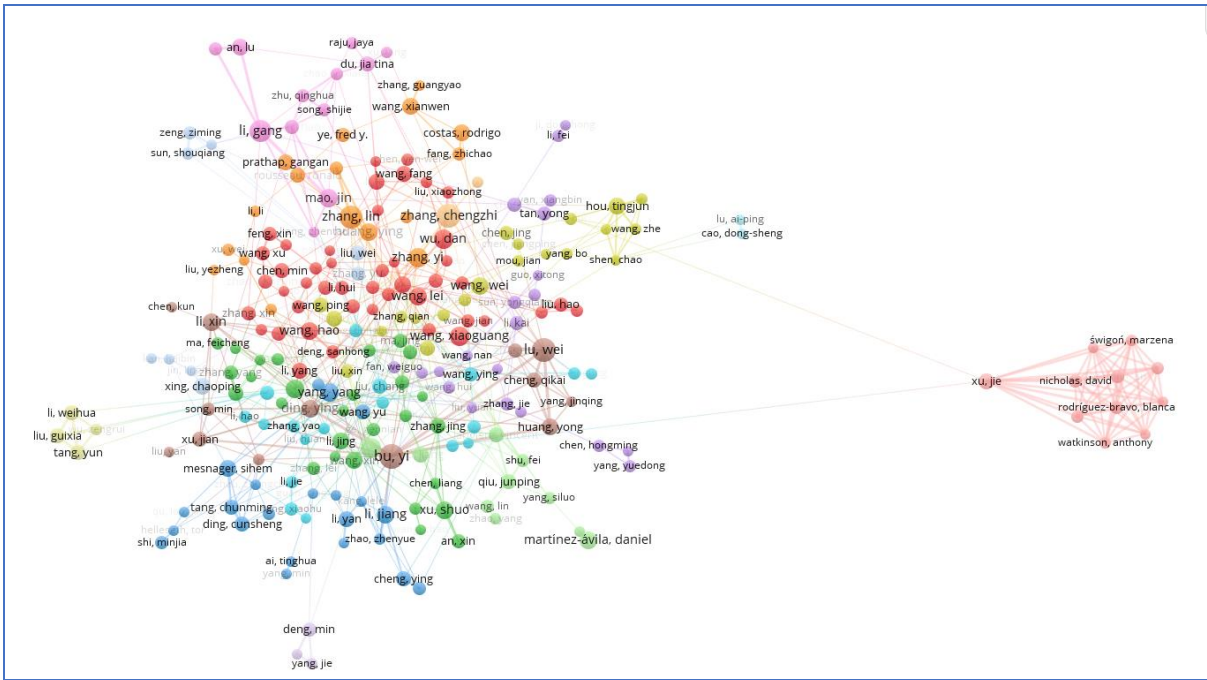


Figure 6: Author Collaboration network in LIS research of BRICS nations

Figure 6 represents the network visualization map showing collaboration among the most productive authors (authors who published over ten papers and citations, 339 meet the threshold) in LIS education in the BRICS nations in five years (2019-2023). Xu Jie (China), Herman et (Israel), *rodríguez-bravo, Blanca* (Spain), Nicholas, David (China), and Abrizah, Abdullah (Malesia) can be considered the most collaborative authors in this network because they collaborate with 36,613, and 596 links, respectively.

### 5.7 Evaluation of keywords and research Hotspot

Total 33,615 author keywords are identified while setting 25 minimum occurrences, 157 were selected for the analysis. Based on Scopus index keywords with same parameters, the results were different; a total of 28,687 keywords were identified, and 237 met thresholds. Table 6 depicts the top 20 most common keywords. Bibliometrics is the most occurred (occurrence, N=1757, TLS=506) keyword where noted, followed by Scientometrics (occurrence, N=277, TLS=432) and Covid-19 (occurrence, N=264, TLS=357). In the Scopus index keywords list, Human has the highest (occurrence, N=463, TLS=2678), followed by Article (occurrence, N=328, TLS=1311) and Social Networking (Online) (occurrence, N=273, TLS=1001). The most common term shows that some of the specific areas of research among BRICS countries in the field of LIS are bibliometric and Scientometrics, citation analysis, authorship pattern area belonging to the most influential area followed by Artificial intelligence, Deep learning, and Machine learning. Academic library and knowledge management were the third most influential research areas during the period.

Table 6: Top 10 keyword occurrence of Author and Scopus Index keywords (obtained by VOS Viewer data mining)

S.N.	Author Keywords			Scopus Index Keywords		
	Keyword	Occurrences	TLS	Keyword	Occurrences	TLS
1	Bibliometrics	338	506	Human	463	2678
2	Scientometrics	277	432	Article	328	1311

3	Covid-19	264	357	Social Networking	273	1001
4	Social Media	253	270	Humans	244	1576
5	Deep Learning	235	196	Chemistry	240	1906
6	India	231	312	Molecular Dynamics	232	1748
7	Machine Learning	226	230	Design/Methodology/ Approach	187	727
8	Artificial Intelligence	185	207	Learning Systems	187	921
9	Open Access	153	181	Nanotechnology	187	114
10	Bibliometric Analysis	152	205	Deep Learning	180	951

The overlay visualization of keywords co-occurrence based on authors' keywords (nodes) depicted using VOS viewer in Fig. 7. The time evolution indicates the hot spot area of the research between the years 2020 and 2023. The color of the nodes (from blue to yellow) is the variation in the average publications per year in which they appeared, and the size of the nodes is the degree of occurrence. The figure represents the library and information science research among BRICS countries' shift from bibliometric and Scientometrics research to artificial intelligence or machine learning-related research.

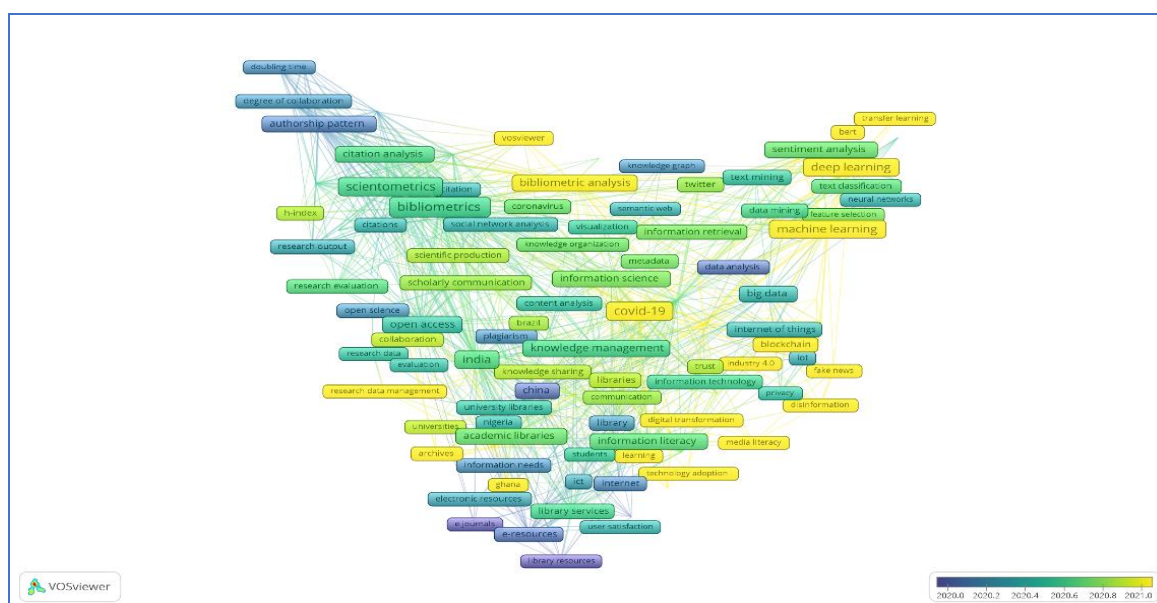


Figure 7: Time evolution of term cooccurrence

## 5.8 Conceptual Analysis of LIS research among BRICS nations

### 5.8.1 Thematic evolution of author keywords

R (biblioshny) software facilitates the creation of thematic maps, offering insights into patterns within a particular theme. It categorizes words from author keywords, keyword combinations, titles, and journal abstracts, arranging themes based on centrality and density in the text. Centrality measures the interaction between keyword networks, while density gauges internal cohesion. By assessing centrality and density, themes can be classified into four distinct groups, providing a nuanced understanding of their relationships within the thematic map.

The standard set for thematic analysis based on the Author's Keyword as a minimum number of keywords is N=250, cluster frequency (per thousand publication) N=3, number of labels N=5, label Size N=0.3, and walk trap clustering algorithms used for analysis [27]. Twenty-nine keywords were noted and distributed in 5 clusters, each representing a group of keywords related to similar characteristics. Themes are reflected in Figure 8, where rank centrality, rank density, and keyword frequency have been shown in Table 7. In these 5 thematic axes, we retrieved studies to contextualize and understand the themes in the Library and Information Science field among BRICS nations. Based on cluster frequency, cluster 2 indicates that COVID-19 (basic theme) was most relevant, with N=1391 cluster frequencies, rank centrality N=5, and rank density N=1. The bibliometric was the second most important (cluster 2) with N=11162 cluster frequency, four rank densities, and four rank centralities. The highest rank density five found for keyword knowledge management N=8 (cluster 4), followed by bibliometric N=7 (cluster 1), and machine learning N=5 (cluster 5) whenever knowledge management (cluster 4) is highest rank centrality with N=105.1 relevance followed by deep learning (cluster 3) with N=238 relevance and machine learning (cluster 5) with N=141.4 relevance.

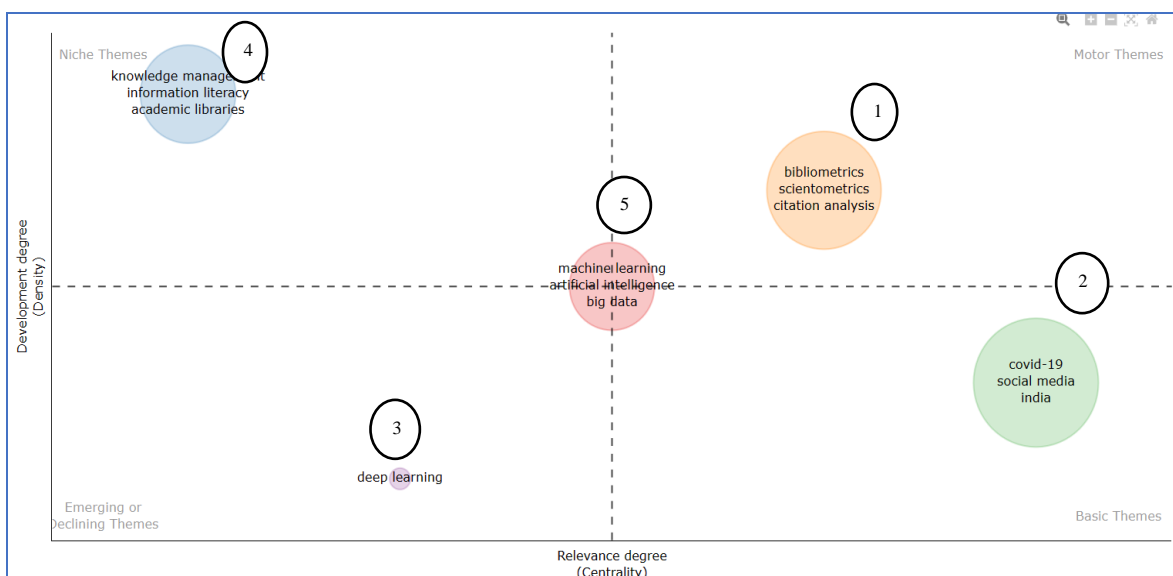


Figure 8: Thematic map of LIS research

Table 7: Thematic Map of Emerging Subjects

Cluster Number	Cluster Name	Rank Centrality	Rank Density	Cluster Frequency	No. of Keywords	Relevance
Cluster 3	Deep Learning	2	1	238	1	238.0
Cluster 2	Covid-19	5	2	1391	8	173.9
Cluster 1	Bibliometrics	4	4	1162	7	166.0
Cluster 5	Machine Learning	3	3	707	5	141.4
Cluster 4	Knowledge Management	1	5	841	8	105.1

1. **Motor Theme:** it represents the High centrality and density, well-developed and essential research field structuring themes. On the strategic map, it appeared in the upper right quadrant. Bibliometrics, Scientometrics, citation analysis, and authorship patterns are well-established research fields in LIS education among BRICS nations.

2. **Niche themes:** it is found in the upper left quadrant and exhibits low centrality and high density. They are specialized and often related to the environment but may lack relevance due to limited background or being shadowed by emerging concepts or technologies. Knowledge management, information literacy, academic libraries, library services, e-resources, and libraries are peripheral and specific topics for LIS research between BRICS nations.
3. **Emerging or declining themes** represent the low centrality and density in the lower left quadrant, which signify emerging or declining trends. Qualitative analysis is required to distinguish whether these themes are rising or waning. Deep Learning, Neural Networks, text classification, optimization, transfer learning, genetic algorithms, and feature extractions are the Emerging areas of LIS research in BRICS nations.
4. **Basic themes** are represented and positioned in the lower right quadrant and are characterized by high centrality and low density. These themes are significant but are not fully developed in the research field. Information science, social media, India, digital preservation, institutional repositories, digital libraries, research data, open data, surveys, etc., are popular subjects of LIS research in BRICS nations. Inter quartile's themes of machine learning, artificial intelligence, big data, sentimental analysis, and blockchain are found in the centrality of the above four themes.

### 5.8.2 Thematic Evolution in LIS

The thematic evolution of keywords represents different changes, like the themes between subjects within the specific period. Figure 9 shows that bibliometric, deep learning, and information literacy is the central area of research between 2019-2021, while machine learning, COVID-19, open access, South Africa, Knowledge management, and artificial intelligence are the main area of research between 2022-2023 are found among BRICS nations.

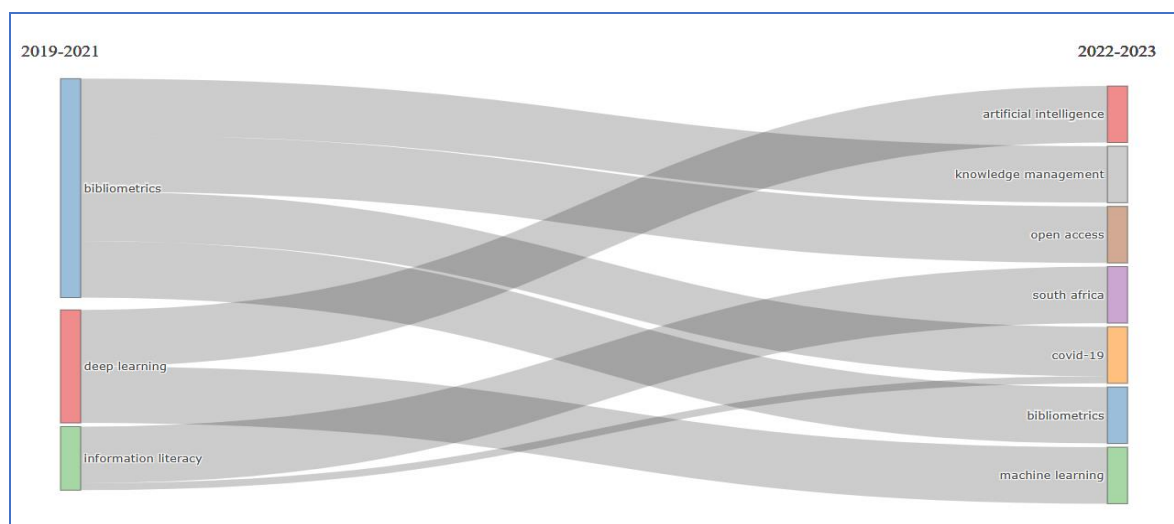


Figure 9: Thematic evolution of LIS research

Table 8 demonstrate the comparison of changes of subject groups based on common similarities in various themes, in niche theme information literacy related concepts; in basic themes, bibliometric related subject and deep learning, the corresponding subject in the centrality of four quadrants are the central area of research field found during the year 2019-2021, whenever in the time frame 2022-23 south Africa, knowledge management, and open access related subject concepts belong to niche themes, Covid-19 and machine learning belongs to basic themes, bibliometrics related concepts divided in-between motor and

fundamental themes and artificial intelligence related themes divided in-between emerging and basic themes are central area of research during 2022-2023 among BRICS countries.

Table 8: Thematic Evolution of Library and Information Science

Themes Name	2019-2021	2022-2023
Motor	Nil	Nil
Niche	<b>1. Information Literacy</b> (academic Library, Library Services, E-resources, Higher education, ICT, Internet, digital library, public library, university library, internet, Information)	<b>1. South Africa</b> <b>2. Knowledge Management</b> (scholarly communication, institutional repository, plagiarism). <b>3. Open Access</b>
Emerging or declining	Nil	Nil
Basic	<b>1. bibliometric</b> (social media, open access, citation analysis, authorship pattern, knowledge management, altmetrics, research productivity, scientometrics, scholarly communication, Covid-19)	<b>1. Covid-19</b> (India, social media). <b>2. Machine learning</b> (deep learning, transfer learning, classification).
In-Between Motor and Basic	Nil	<b>1. Bibliometrics</b> (citation, altmetrics, Scientometrics, research evaluation)
In-Between emerging and Basic	Nil	<b>2. Artificial intelligence</b> (data science, topic modeling, internet of things, virtual reality, block chain)
In-Between all Four quadrant	<b>1. Deep Learning</b> (machine learning, artificial Intelligence, big data, sentimental analysis, blockchain, text mining, internet of things, classification and information management)	Nil

During the period 2019-21, noted focused on various clusters of research topics like information literacy (N=931), Bibliometrics (N=2040), and Deep Learning (N= 893), the focus is research whenever South Africa cluster (N=36), Knowledge management (N=37), Open Access (N=38), Covid-19 (N=288), machine learning (N=166), Bibliometrics (N=260) and artificial intelligence (N=78) are noted area of research in 2022-23. Bibliometrics and artificial intelligence are common research topics pointed out for the whole period of study whenever artificial intelligence, data science, and the Internet of Things virtual reality are emerging research areas indicated among BRICS nations during the survey.

## 6. Discussion

The aim of this study is to assess the Library and Information Science (LIS) research output among BRICS countries between year 2019 and 2023. The study uncovered a rising publication trend from 2019 to 2022, with a noticeable slowdown in 2023 in LIS research output from BRICS countries. The analysis identified a N=6.19 percent annual scientific growth rate in the field of LIS research within these nations. The growth trend in LIS

research productivity was evident, with the number of published papers increasing from N=2919 in 2019 to N=3703 in 2023. Among the BRICS countries, China exhibited a relatively higher research contribution in LIS research, accounting for approximately 50% of BRICS publications (N=7966 from N=15,088). This was attributed to higher research and development (R&D) expenditures at both institutional and national levels. Compared to other BRICS countries, India demonstrated relative growth in LIS publications compared to its counterparts. The study highlighted China as the leading contributor, responsible for 53.04% of cited and 14.62% of uncited documents, with Bu Yi as the most prolific author (N=50). Dwivedi, Yogesh K. emerged as the most cited author, with N=3158 citations and 32 publications. The most influential article, "Artificial Intelligence (AI): Multidisciplinary Perspectives on Emerging Challenges, opportunities, and Agenda for Research, practice, and Policy," authored by Yogesh Kumar Dwivedi, was published in the *International Journal of Information Management. Library Philosophy and Practice* was identified as the preferred journal for publication among LIS researchers from BRICS nations. Strong research collaborations were observed between organizations such as the School of Information Management, Wuhan University, China, and the Center for Studies of Information Resources, Wuhan University, China. Notably, Chinese organizations exhibited robust collaboration with Indian and South African researchers but weaker collaboration with Brazil and Russia. The author collaboration shows that Xu Jie, Herman, et al., Rodríguez-bravo, Blanca, Nicholas, David and Abrizah, and Abdullah are the most collaborating authors among BRICS nations. In country collaborations, China, the USA, the UK, India, and Australia unite solid nations. Analysis of authors' keywords occurrences revealed that bibliometrics, scientometrics, Covid-19, social media and deep learning were the most frequently mentioned keywords during the study. In terms of thematic trends, bibliometrics, deep learning, and information literacy are emerging areas of research noted in 2019-2021 whenever knowledge management, open access, COVID-19, machine learning, and artificial intelligence are the hot topics of research recorded during 2021-2022 among BRICS nations. These findings align with prior research indicating that deep learning, machine learning, sentiment analysis, Altmetrics, and artificial intelligence are notable research areas in this domain (Gupta et al., 2022).

## 7. Conclusion

This research will contribute significantly to understand different emerging research trends in LIS and provide scholars with valuable insights for identifying research areas. Future investigations may involve engaging authors from BRICS countries through surveys or interviews to understand and observed patterns and trends comprehensively. This approach has the potential to unveil underlying reasons for these patterns and provide information on potential barriers to collaboration, challenges in adopting open-access publishing, and obstacles hindering the growth of research output in these nations. By delving into these aspects, researchers can contribute to a more holistic approach on research landscape, informing policies and targeted interventions.

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