The Research Output of Bibliometrics using Bibliometrix R Package and VOS Viewer

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Abstract
Bibliometrics is one of the statistical methods to analyze the research output of books, articles, and other scientific publications. This paper attempts to study the three types of Bibliometric indicators such as quantity, quality, and structural indicators. This study pertains to the information on the research growth of Bibliometric study, especially in the subject category of Library and Information Science published in Web of Science Database. This paper presents the findings of a Bibliometric study, targeting five year period (2014–2018), with the aim of identifying emerging research directions, the top-20 institutions, coupling, and collaboration by applying VOS viewer and Biblioshiny for bibliometric tools.
Keywords: **Bibliometric research output, Scientometric, VOS viewer, Biblioshiny, BibliometrixR**

Introduction

Bibliometric analysis is the research area that helps to analyze current trends in the literature regarding a particular area and provides guidelines and motivations for future research work. It provides a general outline and overall structure of the research area. Bibliometric is one of the hottest topics in the field of library and information science, which primarily dealt three important indicators such as quantity indicator, which shows the productivity of a researcher; quality indicator, which measure the productivity of research by citation analysis and finally structural indicator which measures the connection between publications, authors, country collaboration and area of research. Information Science is a continuously growing research field derived from Library and Information Science since the 19th century. Correspondingly, the importance of bibliometrics has been widely recognized by scholars worldwide in the past decades. In this study, the author has retrieved 840 articles from the Web of Science database for the analysis of co-citation network analysis, bibliographic coupling, Co-occurrences, and co-citation by using open source software BibliometrixR and Vosviewer. To assess the research output and in the bibliometrics domain, we have used the systematic mapping study methodology to systematize the design and the reporting of this study.

Review of Literature

Anuradha (2007) analyzed the International collaboration pattern by Indian scientists through the analysis of multi-authored publications, correspondence analysis and resulted that data set in physics, chemistry, clinical medicine are the first, the second, and the third-largest subjects respectively, having international collaboration. Chen, Zhang, and Fu (2019) reviewed the intellectual base and main research trajectories of the IRC research domain over 1957–2015 through co-citation network analysis, main path analysis, and bibliographic coupling analysis and found that co-authorship analysis is the main research method to study research collaboration. Garfield (1955), explored in the article on "Citation Indexes for Science," made it clear that subject indexes could not identify the research fronts but could be traced out the historical development of the subject by direct citation analysis. Garfield (1964) explained that Co-occurrences are used to understand the underlying patterns of the document set under study. Co-citation, co-word, and co-link studies are the main aspects of co-occurrences in the information sciences.

Objectives

The goal of this study is to analyze the existing literature on bibliometrics research.

- To analyze the chronological growth of research in the field of Bibliometric study.
- To identify the top 10 countries publishing more research articles in this area.
- To figure out India's position in the publication of research in Bibliometric study.
- To find out the top 10 Institutions in Bibliometric study
- To spot out the most prolific authors and the citation impact of their research output
- To find the most preferred journals

Data Collection and Methodology

In this state-of-the-art study, we have gathered bibliometric data from two of the most widely referred repositories: Web of Science (WoS). Thus, the outcome of this database has been analyzed compared for all the various publication growth queries. The keyword used for the search query is: "Bibliometrics, Information Science, Library Science" in WoS, and the search was performed on 27 July 2019. The most widely used standard indexes used in the computer science and Social Science community Index have been considered, which are Science Citation Index Expanded (SCIE) and the Social Science Citation Index (SSCI). From WoS, we retrieved several tags such as author, title, abstract, country, citation record, author affiliation, etc. At the same time, WoS extracted 840 documents for the period of 2014-2018.

Results and Findings

Bibliometric results for the various performance parameters such as research growth, most productive and highly cited authors, most sought out discipline, top journals, wise country analysis, institution wise analysis, and highly influential papers in "Bibliometrics".

Chronological Growth of Publications

In Table 1, we present the chronological growth of bibliometrics research for the study period of 2014-2018. There is a gradual increase in records concerning bibliometrics, information science, and Library Science research.

Table 1: Chronological Growth of Publication

Years	No of Records	% of 840
2018	181	21.55
2017	186	22.14
2016	195	23.21
2015	175	20.83
2014	103	12.26

Top Institutions in Information Science Research

Figure 1 presents the top-25 institutions, based on the number of papers that involve authors affiliating the specific organizations. Most of the papers are published by the Max Plank Society (60) for the period of study.

Figure 1: Most Active Institutions

Predominant Source for Information Science Research

Figure 2 presents the top-25source of publications, based on the number of papers published in the research area. Scientometrics is the predominant source of publication, as shown below, with 301 publications for 2014-2018, followed by the Journal of Informetrics (89). Concerning India for the study period, DESIDOC Journal of Library information technology is the predominant source of publication by the researchers of India in the domain of Information Science, as shown in Figure 3.

Table 2 shows the Clustering of sources through Bradford Law using the Biblioshiny tool for the Information Science research output. It clearly shows that DESIDOC Journal of Library and Information Technology ranks first in the predominant choice

of publication, especially India has contributed 68 publications for the study period as shown below.

Figure 2: Predominant Source of Publication-World wide
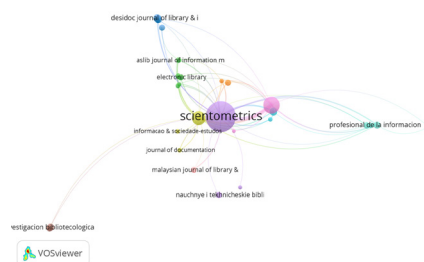
Figure 3. Predominant Source of Publication vs. Citation

Table 2: Source Clustering through Bradford's Law

Biblioshiny for Bibliometrix- Source Clustering through Bradford's Law				
Source	Rank	Freq	Cum Freq	Zone
Desidoc Journal of Library & Information Technology	1	21	21	Zone 1
Annals of Library and Information Studies	2	12	33	Zone 1
Journal of Scientometric Research	3	11	44	Zone 2
Scientometrics	4	11	55	Zone 2
Collnet Journal of Scientometrics and Information Management	5	3	58	Zone 3
Electronic Library	6	2	60	Zone 3
Collection and Curation	7	1	61	Zone 3
Collection Building	8	1	62	Zone 3
Information and Learning Science	9	1	63	Zone 3
Library Review	10	1	64	Zone 3
Malaysian Journal of Library & Information Science	11	1	65	Zone 3
New Library World	12	1	66	Zone 3
Performance Measurement and Metrics	13	1	67	Zone 3
Qualitative & Quantitative Methods in Libraries	14	1	68	Zone 3
Total publication of Indian authors		68		

From the extracted data, the top 10 most productive countries in terms of the number of publications, from WoS are presented in Table 3, which shows the order of the countries sorted by several records published by the countries in the area of bibliometrics. The USA tops the list with 117 publications, followed by China, Germany, and Spain with 89, 79, and 75 publications, respectively. The below table projects the top 10 country-wise research outputs in the area of study. India is positioning in 5th place of publishing articles related to Bibliometrics study.

Table 3: Top 10 Country wise Research Output

Country	No of Records	% of 840
USA	117	13.93
PEOPLES R CHINA	89	10.60
GERMANY	79	9.41
SPAIN	75	8.93
BRAZIL	69	8.21
INDIA	68	8.10
ITALY	62	7.38
ENGLAND	43	5.12
NETHERLANDS	41	4.88
CANADA	38	4.52

Figure 4 depicts the network analysis of citation versus country. The USA has a prominent network citation compared to other countries, followed by China, Germany, and Italy.
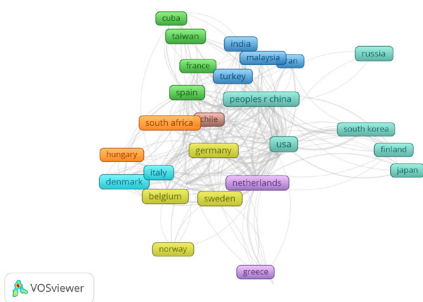
Figure 4: Citation Vs. Country

Keyword Analysis

Figure 5 represents the most prominent keywords used by the authors of Bibliometrics research. VOSviewer, which is the most widely used information visualization software, selects the topmost keywords used by the authors in their papers. As shown in figure 5, Bibliometrics is surrounded by Citation Analysis, Network Analysis, Science Mapping, Co-Citation, Altmetrics, Mendeley, and so on. Figure. Five show the connected network of the most common keywords indexed in WoS.
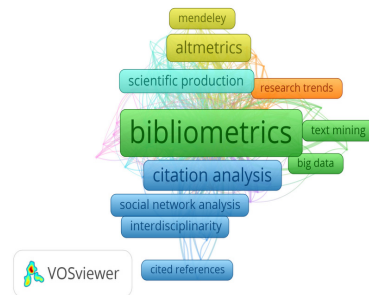
Figure 5: Most Common Keywords

Figure 6 shows the co-concurrence of the author's major keyword used for the bibliometric study for the period of study. The below figure identifies the network of authors' major keywords used for the Information Science research.

Figure 6: Co-concurrence of Keywords

Author Analysis
Bibliographic Coupling of Authors

Figure 7 shows the bibliographic coupling of authors for the bibliometrics research for the study period. Bornmann, Lutz has a very good network of bibliographic coupling of research work with Abramo, Giovanni.

Figure 7: Bibliographic Coupling of Authors

Prominent Authors from India

Figure 8 clearly shows the topmost authors in the field of Bibliometrics research for the study period of 2014-2018, as reflected in the Web of Science database. Dhawan S.M is a prominent author from India, having a good number of publications and a citation in recent years, followed by Gupta b.m and Garg K.C.

Figure 8: Prominent Authors from India

Co-Author Vs. Country Collaboration

Figure 9 identifies the collaboration of authors with other countries. The USA has a good number of collaborations of Co-authors because of the good number of research in this area has taken place followed by China, Germany, Brazil, and so on.

Figure 9: Co-Author vs. Country Collaboration

Co-Citation Vs. References

Figure 10 depicts that co-citation versus reference for the publications done during the study period.

Most of the references occurred from early 1970s articles since the study is confined with Bibliometric tools, Bradford Law, and other scientific parameters. The below figure can identify the co-citation of articles with the references.

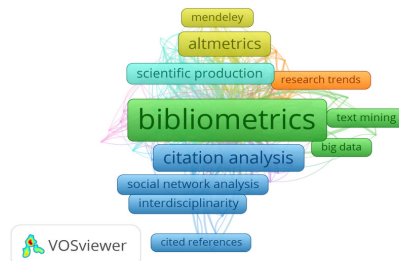**Figure 10: Co-Citation Vs. References**

Discussion and Conclusion

In this paper, a detailed bibliometric analysis in ''Bibliometric Research'' has been conducted. The bibliometric analysis helped to discover the structures and development in this area. The most widely used database, Web of Science, was used for the bibliometric analysis. Eight hundred forty publications are indexed in WoS, as it indexes various kinds of sources. Bornemann is the most productive author Worldwide, having a good network with various countries, and in India, Dhawan is the most prominent researcher in the field of Information Science research. Scientometrics, Altmetrics are the subject areas that are mostly targeted in Bibliometrics research. DOC Journal of Library and Information technology is the most productive journal in the research area. USA and China are the most productive countries in Bibliometrics research, while the Max Plank University is the institute with the highest number of publications. The bibliometric analysis in this paper provided the intrinsic structure of the publications on Information Science and Library Science. This is a much-needed study for the traditional field like Bibliometrics so that the research community could probe more advancement of the publication hierarchy in this area. Data visualization of the most common keywords in Bibliometrics is presented. The most common keywords are Citation Analysis, Network Analysis, Science Mapping, Co-Citation, Altmetrics, and Mendeley. Finally,

the contribution of the publication of authors from various countries and India is extensively discussed. The overview of the published work in Bibliometrics is categorized into various sub-sections, which would help the reader get an overall representation of the current trending areas. The limitation of this study is that the bibliometric study provides the number of papers and their citations. It is evident that numbers represent the quantity, but citations do not signify quality.

Moreover, the study covered the Web of Science database for the bibliometric study. However, there are some other sources which include open-access journals and more indexed journals on Library Science and Information science. Thus, more analysis with other indexing databases could be considered as the future scope of this study.

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