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Bibliometric Depiction of Library Science Research in Pakistan by using Co-word Analysis

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Abstract:

The purpose of this study is to explore the intellectual structure of Library and Information Science (LIS) in Pakistan during the period 2001 to 2018 applying the co-word analysis. The trends, patrons and tendencies of LIS in Pakistan will be explored by measuring the correlation coefficient of selected key words extracted from the articles indexed in Library and Information Science and Technology Abstracts (LISTA) by the Pakistani authors. To find out the dynamic change in the field of LIS, fifteen years was separated into further two periods i.e. 2001-2008 and 2009-2018. Through co-word analysis, and with the help of Gephi software (Sci2) the analysis was done and results shows that the trend was directed from library to information science and the word "research" was the most prominent in the network of data and in Pakistani LIS field.

Keyword: LIS-Pakistan, Co-word analysis, Research trends-Pakistan, science citation index, Bibliometric research

Introduction:

Due to new tools and technologies, the library science, all over the world, is reshaping in terms of resources and services. Particularly, after adoption of Information communication Technologies (ICTs) by the library professionals changed the domain of Library and Information Science (LIS). The trends, tendencies and inclinations of LIS has changed or still in process from traditional to modern libraries (Hjorland, 2002). The research in LIS has also got effects with these

new tools and technologies and received much attention in theoretical research and practical implication (Hu et al. 2013).

The scenario in Library and Information Science field (LIS) in Pakistan is also changed. Many developments and variation in research trends can be observed in recent years. Apart from using new tools and technologies, the research culture is also enhancing in Pakistan. Particularly, the enhancement can be seen in LIS domain as it is expanding its boundaries and new venues for research and practical implication can also be seen. It is very important to know the current status of LIS in Pakistan and its changing trends. There are several ways to map and know the relationship between different or similar concepts and ideas of LIS (Ding, Chowdhury & Foo, 2001). Bibliometric research is a good way to achieve this task from quantitative perspective.

To map the data and to check the relations among different key words, Bibliometric study are getting popularity at international level (Jabeen et al., 2015). This method involves some pragmatic methods like co-world analysis also called co-citation analysis, co-word analysis, co-occurrence and citation analysis (Ding, Chowdhury & Foo 2001). The co-word analysis have few different features as compare to other co-occurrence techniques like it's visualize the "intellectual structure of any specific discipline through measuring the association strength of keywords from publications" (Lie, Hu & Wang, 2011, p-783). But non availability of the literature in Pakistan shows that no single study has been conducting on LIS and in the Pakistani research environment.

Many researchers from different disciplines are using co-word analysis technique is to know the intellectual structure of specific field and also to find out the changes in respective discipline (Zong et al., 2013). In other disciplines like Bio material sciences (An & Wu, 2011), humanities (Ritzhaupt et al. 2010), the researchers from library and information also used this method to explore the changes in the conceptual space. Zheng et al. (2006) conducted the study and identifying the topics in a set of documents while using the co-word analysis. He got protein-related of text words from the documents available through MEDLINE database and concluded that the concepts of these words have rational and logical relations and have some connections with each other.

Gao et al., (2009) conducted their research while using bibliometric approach and done citation analysis of LIS research work in higher studies to know the relationship among research and to rank the subjects and the researchers. They analyzed 14 PhD theses in LIS, produced by the students of Wahan University. Franklin and Jaeger (2007) conducted a study to explore the LIS doctoral thesis by African American Women between 1993 and 2003 and divided the research areas into four categories (information issues, library/librarianship issues, literature, and technology). Same as previous, Sugimoto et al. (2011) explored through their research, they pointed out five core areas (library history, citation analysis, and information-seeking behavior). They analyzed 3121 theses completed during the period 1930-2009 at North American library and Information Science Program. While using the bibliometric approach, Schlater and Thomison (1982) conducted the study to investigate the methods used in the research of Library and Information Science. The results of the study (Jin, 2010) revealed that the PhD researches paid their close attention to research methods but usually ignore the methodology. She analyzed 256 theses of LIS in different Chinese Universities, during the period of 1994-2010.

The research, published in journals can be a good source to analyze the current trends and the relationship between different areas and disciplines. Different sources like Journal Citation Report (JCR) by ISI web of knowledge provide the opportunity to compile the citation counts to

know the structure of intellectual production. Published journals also provide opportunity to analyzed their contents while using "co-citation with multidimensional scaling (MDS)" (Boyack, Wylie & Davidson, 2005, p-353) (2002). Leydesdorff (1991) used Science Citation Index (SCI) and Social Science Citation Index (SSCI) to map the journals in two different studies. In his first study, Leydesdorff (2004) he abstracted the data from 5748 journals from SCI and make clusters to know the relations of the abstracted themes. In his second study, he abstracted the themes from 1682 journals cited in SSCI and explored the different network connections between the themes. He paired those journals which are more enteral to their respective filed of clusters.

In recent years, while using the co-word analysis, lot of research has been done in LIS by the Chinese researchers (Qiu, Yang, Wang & Lie, 2009; Zhang, Wu & Wang 2011; Li, 2011; Sun and Zhang 2011, Zhang & Shi, 2010). Xiao and Yang (2009) revealed few core themes in LIS while using the co-word analysis. They abstracted the key words from nine LIS journals published in Chinses language. Basis on the data retrieved from the journals, they find out some emerging focal areas in LIS filed e.g. digital library, information retrieval, information services and resources. Through the findings of his research, Wang (2011) explored few core emerging areas in LIS field including information resources, construction, knowledge management, information retrieval, information service digital library etc. He uses co-word matrix and through the links between clusters he also explores some emerging areas in LIS in China. He also concluded that the current research theme will be stable in future. Yang (2012) also finds out through his study that there were 15 research areas in LIS and it is expanding with the advancement of the technology. He also concluded that University library, digital library, knowledge management and information service were the main cluster in overall co-word network.

In Asian countries, many researchers (Lin, 2006; Tianwei and Wei, 2006, Bhaskar, 2010) conducted the studies to know the status of research productivity and relationship between the different research areas. Tianwei and Wei (2006) explored the LIS research in Asia, produced during the year 1975-2004 and find out that Chinese LIS researchers produced 79% research work and indexed in Web of Science (WoS) databases. This study was based on the research production published in the database in WoS and during the period of 1975-2004. Bhaskar (2010) also conducted the research to know the status of research productivity of the LIS researchers of Asian countries. He finds out that research in LIS fields is not only increasing tremendously but also pushes new areas to emerge for LIS research. He also concluded that the trend for collaborative research is also emerging among the LIS scholars of Asian countries.

In Pakistani perspective, Naseer and Mahmood (2009) conducted a study to analyze the LIS research in Pakistan, published in "Pakistan Library and Information Science Journal" (PLISJ) and during the period of 1998-2007. "From 236 articles from 30 issues from PLISJ are examined for subjects covered, geographic distribution of authors, country of origin of authors, collaboration among authors, and gender of authors. Research type, language of articles and publication output of PLISJ were also analyzed (p-3)". The study explored that industry, libraries as physical collection and information and library technology were the top ranked subject, covered during the period, by LIS researchers from different areas of the world. In very recent era, Jabeen et al. (2016) conducted a study to "identify the capabilities and collaborative activities of LIS research through bibliometric analysis at three levels i.e. author level, institutional level and country level to evaluate the LIS publication produced by Asian researchers". The data were derived from the articles published in "Web of Science" (WoS) and during the period from 1993-2013. To analyze the data, analysis software entitled "New Modified Author Activity Index (NMAAI1, 2, 3)" was

used. The researchers concluded that "a) that LIS ―institutions collaboration pattern‖ outcomes did not yield strong collaboration with Asian countries or regions, (b) intra-continent and inter-continent collaboration was less harmonious on institutional and author levels, and (c) interpretation through NMAAI1,2,3 revealed that Asian countries did not produce collaborative LIS publications". This study also concluded that few countries like Taiwan, South Korea and Singapore ranked on top as they are producing plentiful research papers in LIS. The authors from Israel, Taiwan and Singapore declared as top Asian authors in LIS domain.

Based on the literature reviewed and with the directions of the relevant research, this study aims to explore the intellectual structure and relations among the LIS research in Pakistan. Co-word analysis will be used to explore the phenomena. Data will be retrieved from Library and Information Science and Technology Abstracts (LISTA) and only those research articles will be considered which will be published by Pakistani authors and during the period of 2001-2018. The trends, patrons and tendencies of LIS Pakistan will be explored by using co-word analysis.

Research Design

Co-world analysis assumed a useful tool to know the co-assurance of the data and effective method to map the relationship between concepts and ideas (Small and Griffith, 1974; Callon et al, 1991). It's also assumed that the key word of any paper represent the theme of the research and a close description of the contents. The key words in the paper also provide the indication of a relationship between two or more themes ((Ding, Chowdhury & Foo, 2001). Analysis through co-word analysis represents the specific research trends and tendencies of a specific field or even in specific period. "High co-word frequency means stronger correlation in key word pairs, which can further suggest that two keyword are related to a specific research topic" (Camborosio et al. 1993). The co-word analysis also has strength to present the intellectual structure of one specific discipline through visualization. The researcher can also explore the research tendencies of a specific discipline within a specific period.

Co-word analysis was adopted as methodology and key words were abstracted from the database containing the LIS articles published by the Pakistani authors and during the period from 2001 to 2018. Data were retrieved in MS Word note pad along with nodes and terms. Terms represents the key words of each article. A co-word matrix was generated to know the co-assurance of the key words. The researchers used Sci2 software to know the relationship between different key words and to explore the research phenomena of LIS in Pakistan.

Data Collection and Pre Processing

There can be various resources for this study but due to its range, variety and quality contents, the researchers decided to use EBSCOhost research database entitled Library and Information Science & Technology Abstracts (LISTA). This free database provides the indexing and abstracting services of journals, books and research reports. LISTA indexes more than 700 core journals of Library and Information Science and Technology domains. This database also has archive of some journals and magazines from mid-1960's (www.ebscohost.com, 2016).

On December 9, 2018, the first author consulted the EBSCOhost site[1] and with the help of filters a) Scholarly (Peer reviewed) journals b) Year 2001 to 2009 c) Subject Library and Information Science d) Pakistan. The researcher could retrieve 1253 articles, documents, reports and books. The researcher only selected article to get the key words for further data processing.

[1] http://web.a.ebscohost.com/ehost/results?sid=fbaf98d0-e49a-4b0f-aa4d-a13b03ef5d33%40sessionmgr4003&vid=2&hid=4106&bquery=pakistan&bdata=JmRiPWx4aCZ0eXBlPTAmc2l0ZT1laG9zdC1saXZl

After filtering the data obtained, 297 articles published during year 2001-2008 and 682 article published during the period 2009-2018.

To standardize the key words, subject terms of EBSCOhost were used and initially all the data were copied on notepad (of windows 8) with the headings Nodes and Terms respectively.

Method of Data Analysis

Key words occurring in scholarly literature selected for this study during the period 2001-08 were adjusted to csv file format. It was loaded on Sci2 software. Word co-occurrence networks were extracted and visualized by Gephi software. It was visualized on undirected graph types. Total number of nodes was 628 and total number of edges was 3098 in uploaded data. Node properties were labeled while edge properties were given on the basis of their weight. Node rankings were visualized on degree metrics. Force atlas layout were selected (having values as; Repulsion strength = 10000, Attraction strength = 10.0, Maximum displacement = 10.0, Autostab strength = 80.0, Gravity = 400, and Adjust by sizes). Minimum size of node was selected as 20 and maximum size of node was selected as 100. Its results are given in the table 1.

Top twenty edges of data keywords during 2001-08

Table 1 shows top ten mutual relationships between different nodes and their respective weight. Node labelled as 'libraries' was the most prominent as a target node and a source node. It means that most of the researchers used 'libraries' as a keyword in their research studies during the period 2001-08. Edges detail of top twenty pairs of nodes has range between five (5) and seventeen (17). It implied that maximum co-occurrence of two keywords (i.e., librarians and libraries) in selected scholarly literature is seventeen times during specified publishing period (i.e., 2001-08). Minimum weight value (i.e., 5) popped up among top twenty pairs indicated that there was high diversity of keywords (i.e., nodes in visualized data) used in selected scholarly literature during 2001-08.

Table 1. Top twenty edges detail of scholarly literature data keywords 2001-08.

Sr. No.	Source	Target	Weight
1	Librarians	Libraries	17
2	Library Science	Libraries	14
3	Universities & Colleges	Libraries	12
4	Library Science	Librarians	12
5	Library Science	Information Science	11
6	Academic Libraries	Universities & Colleges	10
7	Librarians	Information Professionals	10
8	Library Administration	Libraries	8
9	Universities & Colleges	Librarians	8
10	Libraries	Information Science	8
11	Academic Libraries	Libraries	7
12	Public Libraries	Libraries	7

13	Library Education	Library Science	7
14	Academic Libraries	Librarians	6
15	Universities & Colleges	Library Science	6
16	Librarians	Associations	6
17	Libraries	Education	6
18	Libraries	Associations	6
19	Library Administration	Library Science	5
20	Universities & Colleges	Collection Development in Libraries	5

Network of selected data had its diameter value 8, modularity value 0.511, modularity with resolution value 0.511, number of total communities 26, average clustering coefficient 0.843, and total number of triangles 8080. Top ten node details are given in the table 2 and in figure 1.

Table 2. Top ten node details of scholarly literature data keywords 2001-8.

Sr. No.	Node	Betweenness centrality	Eigenvector centrality	Clustering coefficient	Number of triangles	Modularity
1	College Students – Services For	0	0.233	1	190	2
2	Information Resources – Use Studies	0	0.233	1	190	2
3	Information Needs	0	0.233	1	190	2
4	Academic Libraries – Acquisitions	0	0.233	1	190	2
5	Libraries – Data Processing	0	0.233	1	190	2
6	Library Editions	0	0.233	1	190	2
7	Libraries & Teachers academic	0	0.233	1	190	2
8	Libraries – Use Studies	0	0.233	1	190	2
9	Conferences & Conventions	0.02	0.23	0.202	88	24

10	National Libraries	0.007	0.23	0.297	129	2

Table 2 and relevant figure 1 are reflectors of top ten node details in the network of keywords data 2001-08 selected in this study. Node details of top eight nodes are almost same except the last two nodes that have minor differences to others. All nodes have between centrality value zero except 'conferences and conventions' (i.e., 0.02) and 'national libraries' (i.e., 0.007). It means most of the nodes have no potential control in the network. Eigenvector centrality or Eigen centrality value (i.e., 0.233 or 0.23) reflected the links among nodes. There were not considerable differences in links to other important nodes in the network. Clustering coefficient value (i.e., 1) in most of the nodes indicated equal tendency among nodes to cluster together. The situation for number of triangles in most of the nodes. Anyhow, modularity value (i.e., 24) in case of 'conferences and conventions' showed that there is good strength in this node regarding its division into different clusters, communities, and groups.

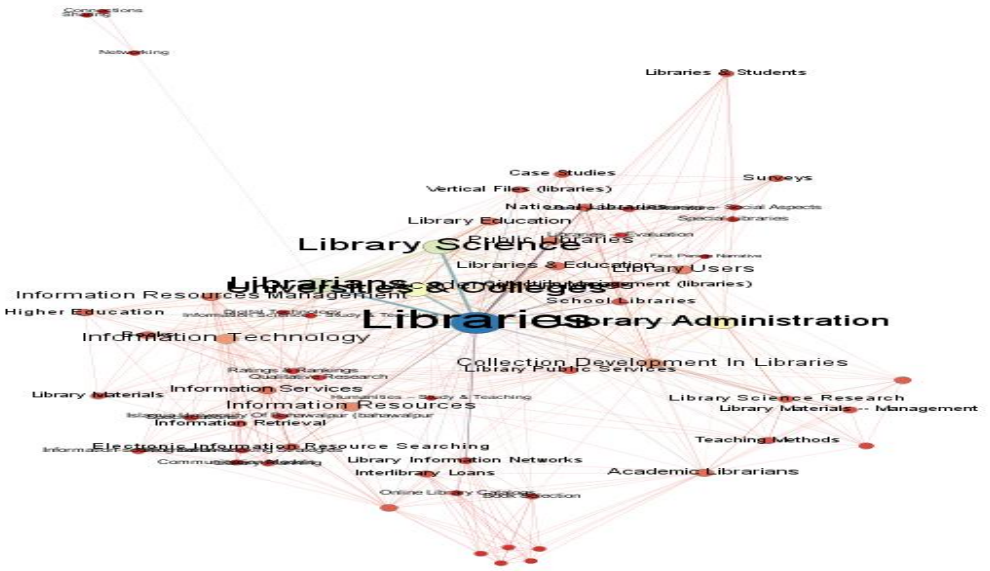

Figure 1. Short preview of words co-occurrence networks on keywords data 2001-08.

Top twenty edges of data keywords during 2009-18

Key words occurring in scholarly literature selected for this study during the period 2009-18 were adjusted to csv file format. It was loaded on Sci2 software. Word co-occurrence networks were extracted and visualized by Gephi software. It was visualized on undirected graph types. Total number of nodes was 1164 and total number of edges was 5600 in uploaded data. Node properties were labelled while edge properties were given on the basis of their weight. Node rankings were visualized on degree metrics. Force atlas layout were selected (having values as; Repulsion strength = 10000, Attraction strength = 10.0, Maximum displacement = 10.0, Autostab strength = 80.0, Gravity = 400, and Adjust by sizes). Minimum size of node was selected as 20 and maximum size of node was selected as 100. Its results are given in the table 3.

Table 3. Top twenty edges detail of scholarly literature data keywords 2009-18.

time	Source	Target	Weight
1	Library Science	Information Science	53
2	Pakistan	Libraries	48
3	Pakistan	Librarians	40
4	Libraries	Librarians	35
5	Pakistan	Universities & Colleges	30
6	Pakistan	Research	28
7	Libraries	Academic Libraries	28
8	Pakistan	Academic Libraries	26
9	Libraries	Library Science	26
10	Research	Universities & Colleges	24
11	Research	Librarians	23
12	Pakistan	Library Science	22
13	Research	Library Science Research	22
14	Research	Academic Libraries -- Research	20
15	Information Professionals	Librarians	19
16	Pakistan	Library Science Research	18
17	Universities & Colleges	Academic Libraries	18
18	Universities & Colleges	Faculty	18
19	Library Science Research	Information Science -- Research	18
20	Libraries	Information Science	18

Table 3 shows edge details of top twenty pairs of nodes in keywords data of selected scholarly literature published during 2009-8. It was observed that node labelled as ‘Pakistan’ was the most frequently used in top twenty edges. It means that selected data indicated most of the research studies published during period 2009-18 used keyword ‘Pakistan’. It was also an indicator of the discussion of geographic perspectives in research during the specified period. As a whole, there was a blend of keywords such as ‘library science’, ‘information science’, ‘libraries’, ‘librarians’, ‘academic libraries’, and so on. Edge weight range of top twenty pairs of nodes was between fifty three (53) and eighteen (18).

Network of selected data had its diameter value 7, modularity value 0.469, modularity with resolution value 0.469, number of total communities 47, average clustering coefficient 0.803, and total number of triangles 12543. Top ten node details are given in the table 4 and in figure 2.

Table 4. Top ten node details of scholarly literature data keywords 2009-18.

Sr. No.	Node	Betweenness centrality	Eigenvector centrality	Clustering coefficient	Number of triangles	Modularity
1	Research	0.234	1	0.04	1720	14
2	Pakistan	0.113	0.803	0.05	1161	0
3	Libraries	0.104	0.672	0.063	898	3
4	Universities & Colleges	0.047	0.665	0.092	944	0
5	Librarians	0.06	0.597	0.082	745	12
6	Library Science	0.074	0.595	0.071	755	8
7	Library Science Research	0.027	0.47	0.13	534	14
8	Education	0.053	0.429	0.088	525	0
9	Information Services	0.02	0.403	0.166	401	3
10	Information Science	0.021	0.402	0.132	408	8

Table 4 and figure 2 showed that node labelled as ‘research’ was the most prominent in the network of data. Its highest between centrality (i.e., 0.234), highest eigenvector centrality (i.e., 1), highest number of triangles (i.e., 1720), and high modularity value (i.e., 14) made it a node that has the most potential control on the other nodes in network, a node that has its connections to the most important nodes in network, and of considerably good strength of dividing entire network into different communities, clusters, and groups. Other nodes included in the top ten nodes had mixed values having different variations. Anyhow, nodes labelled as ‘library science research’, ‘information services’, and ‘information science’ had comparatively high tendency in the network to cluster due to their high clustering coefficient values.

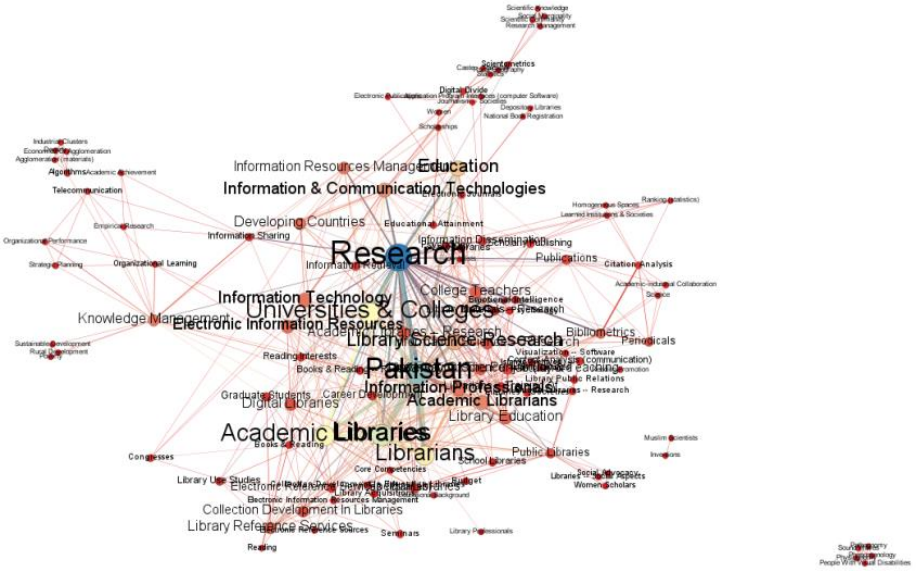

Figure 2. Short preview of words co-occurrence networks on keywords data 2009-18.

Conclusion Limitations and Implications:

The present study was conducted to know the research trends of library and information science in Pakistani perspective from 2001 to 2018. For this purpose, the co-word analysis was adopted a method and key words were abstracted from EBSCOhost database entitled Library and Information Science & Technology Abstracts (LISTA) and only those articles were included which are already published during 2001 to 2018 and retrieved with keyword Pakistan. Sci2 software was used for data analysis.

The study found that during the year 2001 to 2008, the keyword "libraries" was the most prominent keyword, during the period. It also concludes that the libraries have close relation with the word librarians. During this period the focus of the researchers was the libraries and the librarian in context of administration, education and little bit trends can be observed for information science. This study also concludes that top nodes are almost same and have no or minor differences but "conferences and conventions' have good strength regarding its division into different clusters, communities, and groups. During period 2009-18, the keyword "Pakistan" was used most frequent by LIS researchers. It was also an indicator of the discussion of geographic perspectives in research during the specified period. As a whole, there was a blend of keywords such as 'library science', 'information science', 'libraries', 'librarians', 'academic libraries', and so on. During this period, the keyword "research" was the most prominent in the network of data. Library science research', 'information services', and 'information science' had comparatively high tendency in the network to cluster due to their high clustering coefficient values.

This study has many limitations like the researchers prefer different databases for the publication of their research work and selection of one database for this study can be a limitation of this study and can effect the results. Another limitation of this study is the keyword by the authors of the publications. Mostly authors may not use the standard keywords so it might not reflect the real status of the research trends during the period under study.

Keeping in view the importance of the study, we can claim that this study can be a valuable contribution in the existing literature. This study will give some directions of the research about the new topics and their relations with the other areas in Library and Information Science field. The present study also has few implications for faculty, research mentors and LIS researchers to know the route of the area and will also help to fill the gap in the field.

The researchers recommend further research on this topic with different periods, databases and even other subject areas like engineering, medical, pure sciences. Humanities and social sciences.

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