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# Growth and Productivity of Research Articles of D-Lib Magazine: a bibliometric study

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## Abstract

The present study reveals the bibliometric analysis of research articles published in D-Lib Magazine from 2013 to 2017. The study covers the growth of literature and authorship patterns of the journal during the said period. Further, it analyzes various bibliometrics aspects such as authorship pattern, authors' degree of collaboration, geographical productivity in scholarly publications and form of citation. For this study, a total of 185 articles are taken up for the evaluation. Necessary bibliometric measures are applied to analyze different publication parameters. The study indicates that the maximum number of articles are in 2015, representing 25.94% of total contributions. The top contributing country during the said period is USA (41.21%). Multi-authored is the leading authorship trend, and the degree of collaboration is 0.76. It is found that the average productivity per author is 0.34, and the average number of authors per paper is 2.90. Out of 3271 citations appended from 185 articles are counted, and average 17.68 citations are published in each article. It is also revealed that journal articles are the popular form of literature in this area.

**Keywords:** *Authorship Pattern, Author Productivity, Bibliometrics, Citation analysis, Geographical productivity.*

## 1. Introduction

In 1969, Alan Pritchard first introduced the term 'bibliometrics' to describe the application of mathematics and statistical methods to various forms of communication (Pritchard, 1969). Bibliometrics is research process. Citation analysis and content analysis are commonly used in this process. It has wide applications not only in Library and Information Science, but also in other subject areas to explore the impact of their research fields, researchers, journals, papers, geographical patterns, extent of collaboration between the researchers etc.

Journal is one of the primary sources of information, which is reflects the critical issues of any field. It has traditionally been one of the most significant channels for publishing research. The journal's literature of any discipline reflects the critical issues of a field. D-Lib Magazine, one of the open-access journal and an electronic publication focusing on digital library research and

development, including new technologies, applications, and contextual social and economic issues. It was launched in July 1995 and it has more than 1000 research articles, calls, shorter pieces and lots of digital collection. *D-Lib Magazine* was published by Corporation for National Research Initiatives and made available to scholars for the advancement of knowledge and practice on digital library research and related matters. Still, from September 2017, it is suspended for publication of new issues. From July 1995 to April 2006, the journal was sponsored by the Defense Advanced Research Project Agency (DARPA), but from 2007 through 2017, it is supported by the D-Lib Alliance and other contributors (<http://www.dlib.org/about.html>).

The present study is a bibliometric analysis of the journal Dlib Magazine. The study has been undertaken to know the nature and contents of articles published in D-Lib Magazine. This study analyses published literature of D-Lib Magazine using different bibliometric approaches for the wider benefit of academicians as well as researchers.

## **2. Literature Review**

Several studies on bibliometrics have already been carried out in different journals such as Journal of Documentation (Singh, Sharma & Kaur, 2011); Library Philosophy and Practice (Swarna, 2002; Thanuskodi, 2010); Annals of Library and Information Studies (Verma, Tamrakar & Sharma, 2007; Lochan, Swain & Sahoo, 2012); DESIDOC Journal of Library and Information Technology (Kumar & Moothy, 2011); D-Lib Magazine (Agrahari, Chaudhary & Singh, 2018) to show the overall growth and development of literature on different aspects. Authorship pattern is one of the essential aspects of bibliometric study. Several authors have studied authorship pattern (Mote & Deshmukh, 1996; Jena, 2006; Roy & Sen, 2007; Thanuskodi, 2010; Rattan & Gupta, 2012; Willett, 2008; Pandita, 2013). Das & Sen (2001) have analyzed 1049 citations appended to 34 research articles and reported that the authorship pattern of the citations shows that 18.68% of papers are single-authored, 52.71% are double- and triple-authored, and the remaining 28.61% articles are joint contributions of four or more authors. After analyzing the IJIPR from 2002-2010, Swain & Panda (2011) reported that most of the articles were solo contributions. The degree of collaboration in JIPR ranged from 0.19 to 0.41 during the period under study. Singh, Mittal and Ahmad (2006) also supported this view. After studying International Information and Library Review journal during the period from 2009 to 2013, Barik & Sa (2016) reported that a single authorship pattern is predominant with 78(55.3%) publications followed by 45(31.9%) publications in double authors' contribution. They also revealed that the average articles per author (AAPA) were found to be 0.62, whereas the Average Authors per Publication was 1.63. After analyzing the 114 articles of the Library Herald for the period between 2011 to 2014, Kumar (2014) reported that a single author contributed 65 (57.01%) articles while joint authors contribute the rest 49 (42.98%) articles. Jena, Swain & Sahoo (2012) have analyzed 36 issues of Annals of Library and Information Studies (ALIS) from 2002 to 2010 and stated that the majority of authors preferred to publish their research results in two authorship mode (47.4%) followed by individual authorship mode (32.4%) and three authorship mode (17.4%). Thanuskodi (2011) have analyzed "Library Herald" for the period between 2006 to 2010. The result showed that out of 138 articles single author contributed 72 (52.17%) articles while joint authors contribute the rest 66 (47.83%) articles. Another study (Naseer, Waris, Ahmad, Peter & Abdel-Magid; 2019) reported that authorship collaboration are

dominated by multi-authored (72.11%) contributions, where 27.89% of articles are single-authored, and the degree of collaboration of JOI communications found to be 72.1%.

### **3. Objectives of the study**

The present study has been undertaken to analyze the following two aspects, i.e., analysis of articles and analysis of citations.

#### **3.1 Analysis of Articles**

- Ø To determine the year-wise distribution of articles published in D-Lib Magazine;
- Ø To study the average length of articles in terms of pages;
- Ø To identify the productivity of authorship;
- Ø To find out the degree of collaboration; and
- Ø To identify the geographical distribution of contributions.

#### **3.2 Analysis of Citations**

- Ø To identify the year-wise distribution of cited documents;
- Ø To find out the ranges of citations;
- Ø To determine the average number of citations per article; and
- Ø To identify the forms of documents cited;

### **4. Scope and coverage of the study**

It has covered five years of publications (i.e. 2013-2017) published in D-Lib Magazine. The present paper covers a total of 85 articles published in the said period. A total of twenty eight issues from six volumes (except 2017, here only four issues have been covered) have been considered.

### **5. Methodology**

This paper has analyzed 185 articles and 3271 citations during the period 2013-2017. The related data of the articles are collected from the website <http://www.dlib.org/dlib.html>. Then all this information is calculated through Microsoft Excel and analyzed by using simple arithmetic and statistical methods. The results are shown through different parameters (i.e., year-wise distributions, length of articles, the productivity of authors, degree of collaboration, the geographical distribution of contributors, forms of citations, etc.).

### **6. Data analysis**

The analyses of data are shown in two parts: 6.1 Analysis of articles and 6.2 Analysis of citations.

## 6.1 Analysis of Articles

This section shows the analyses of articles published from 2013 to 2017 under different facets, and the results of the analysis are discussed below through different tables and figures.

### 6.1.1 Year-wise Distribution of Articles

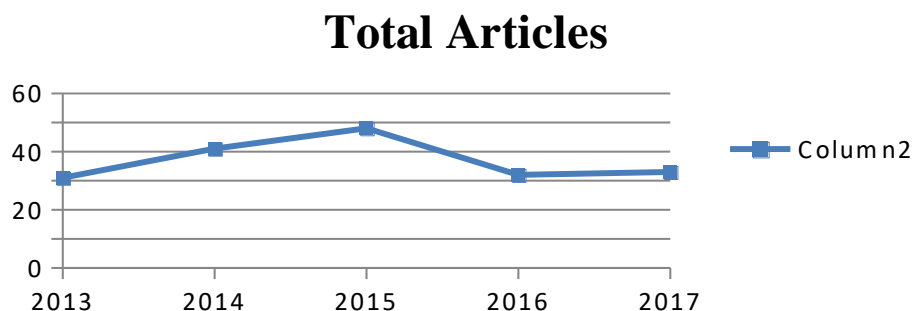
It shows the year-wise distribution of total articles published from 2013-2017 in D-Lib Magazine (Table 1 and Fig. 1).

Year	Volume	Issue Number						Total Articles	Annual Average growth rate
		1&2	3&4	5&6	7&8	9&10	11&12		
2013	19	5	6	4	5	5	6	31(16.75%)	-0.21*
2014	20	5	4	4	6	8	14	41(22.16%)	0.32
2015	21	10	9	7	6	6	10	48(25.94%)	0.17
2016	22	3	5	5	6	9	4	32(17.29%)	-0.33
2017	23	9	4	14	6	- *	- *	33(17.83%)	0.03
		<b>32</b>	<b>28</b>	<b>34</b>	<b>29</b>	<b>28</b>	<b>34</b>	<b>185(100%)</b>	

**Table 1: Year-wise Distribution of Articles \*(in 2012 (vol.18) total 39 papers published)**

There are a total of 28 issues and 185 articles have been published in five volumes. It showed that the highest number of papers was in 2015 (vol. 21) with 48 (25.94%) articles and lowest in 2013 with 31 (16.75%) articles. Again, it was found that the maximum 34 papers were published in the 5 & 6<sup>th</sup> and 11 & 12<sup>th</sup> issues of the journal and annual average growth rate of the paper published ranges from -0.33 to 0.03.

Fig. 1 shows the graphical representation of year-wise Distribution of Articles.



**Fig. 1: Year-wise Distribution of Articles**

### 6.1.2 Average length of articles

Table 2 shows the range of pages. It comprises 5 differences ranges that have been formulated to measure the length and pages of the whole in 28 issues and 185 articles.

Year	Volume	Length of pages				Total
		1-5	6-10	11-15	16 & above	
2013	19	1	18	10	2	31
2014	20	8	18	11	4	41
2015	21	1	20	20	7	48
2016	22	2	16	6	8	32
2017	23	4	14	7	8	33
		<b>16 (8.65%)</b>	<b>86 (46.49%)</b>	<b>54 (29.19%)</b>	<b>29 (15.67%)</b>	<b>Total= 185 (100%)</b>

**Table 2: Length of articles**

According to analysis of length of articles, it shows that 86 (46.49%) articles are published within the page range of 6-10. The next 54 (29.19%) articles are published within the page range 11-15 and 29 are published within the page range 16 and above. It also shows that only 16 (8.65%) articles are appeared with 1-5 pages.

### 6.1.3 Authorship Pattern

Table 3 shows the authorship pattern of papers during the period from 2013 to 2017 in D-Lib Magazine.

Year	Volume	One	Two	Three	Four	Five	Six & above	Total
2013	19	10	8	7	2	1	3	31
2014	20	9	11	10	5	3	3	41
2015	21	13	12	12	5	2	4	48
2016	22	9	9	4	2	6	2	32
2017	23	3	8	6	6	6	4	33
<b>Total</b>		<b>44</b> (23.78%)	<b>48</b> (25.94%)	<b>39</b> (21.09%)	<b>20</b> (10.81%)	<b>18</b> (9.73%)	<b>16</b> (8.65%)	<b>185</b> (100%)

**Table 3: Authorship Pattern**

It reveals that out of 185 papers, maximum 44 (23.78%) articles have been written by single authors, followed by 48 (25.94%) articles contributions by two authors, 39 (21.09%) articles contributions by three authors, 20 (10.81%) articles contributions by four authors, 18 (9.73%) articles contributions by five authors and 16 (8.65%) articles contributions by six and more authors respectively. It also reveals that single author contributions are 23.78%, where as 76.22% are multiple authors contributions. It also shows that maximum 13 numbers of papers are contributed by single author which have been published in vol. 21(2015).

#### 6.1.4 Degree of Collaboration

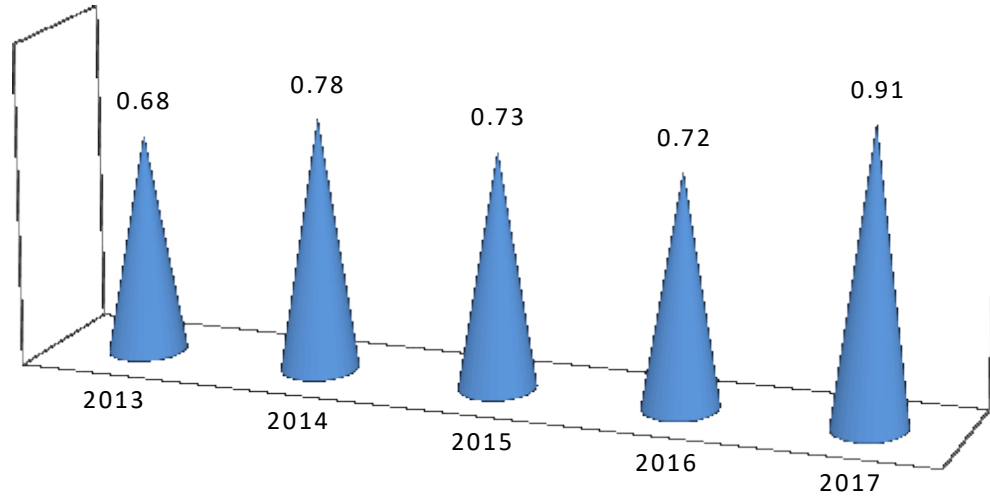
Table 4 shows that the applications of K. Subramanian's (Subramanyam, 1983) equation to calculate the degree of authors' collaboration during the period under study i.e. from 2013 to 2017 in D-Lib Magazine. It is the ratio of multi-authored papers published during a year and the total number of papers published during the year (Fig.2).

Year	Volume	Single authors papers	Multi-authors papers	Total papers	Degree of Collaboration
2013	19	10	21	31	<b>0.68</b>
2014	20	9	32	41	<b>0.78</b>
2015	21	13	35	48	<b>0.73</b>
2016	22	9	23	32	<b>0.72</b>
2017	23	3	30	33	<b>0.91</b>
<b>Total</b>		<b>44 (23.78%)</b>	<b>141 (76.22%)</b>	<b>185</b>	<b>0.76</b>

**Table 4: Degree of Collaboration**

Fig. 2 shows the graphical representation of Degree of Collaboration

## Degree of collaboration



**Fig. 2: Degree of Collaboration**

It is observed that the degree of collaboration is 0.76, where single author contribution is 44 (23.78%) and multi-authors' contribution is 141(76.22%). However, volume-wise degree of authors' collaboration has ranged from 0.68 to 0.91 during the period under study. It also reveals the good presence of collaborative research among authors of the journal.

### 6.1.5 Author Productivity

Data related to authors' productivity is presented in Table 5. It shows the average productivity per author and average number of author during the period under study.

Year	Volume	Papers	Authors	Avg. Productivity per Author	Avg. no. of authors
<b>2013</b>	<b>19</b>	31	79	0.39	2.54
<b>2014</b>	<b>20</b>	41	114	0.35	2.78
<b>2015</b>	<b>21</b>	48	127	0.37	2.64
<b>2016</b>	<b>22</b>	32	93	0.34	2.90
<b>2017</b>	<b>23</b>	33	124	0.26	3.75
<b>Total</b>		<b>185</b>	<b>537</b>	<b>0.34</b>	<b>2.90</b>

**Table 5: Author Productivity**

*Productivity per author= Number of papers/ Number of authors.*

*Average no. of Authors per Paper= Number of authors/ Number of papers.*



It is observed from this table that the average productivity per author ranges from 0.26 to 0.39 during the period under study. Where, the total average productivity per author is 0.34 and the total average number of authors per paper is 2.90.

### 6.1.6 Geographical distribution

Table 6 represents the total contributions of various countries which produces the most number of authors with their respective percentage in the journal D-Lib Magazine during the period under study. There are 537 authors from 185 papers published over a period of 2013 to 2017 in D-Lib Magazine covering 25 countries.

Number	Rank	Country	Total no	Percentage
1	I	USA	143	41.21
2	II	Germany	63	18.15
3	III	UK	39	11.24
4	IV	Australia	18	5.18
5	V	Austria	13	3.75
6	V	France	13	3.75
7	VII	Italy	12	3.46
8	VIII	Netherlands	8	2.30
9	IX	New Zealand	6	1.73
10	IX	Japan	6	1.73
11	XI	India	4	1.15
12	XII	China	3	0.86
13	XII	Poland	3	0.86
14	XII	Norway	3	0.86
15	XII	Finland	3	0.86
16	XVI	Ireland	2	0.58
17	XVII	Greece	1	0.28
18	XVII	Hungary	1	0.28
19	XVII	Doha	1	0.28
20	XVII	Togo	1	0.28
21	XVII	Greece	1	0.28
22	XVII	Singapore	1	0.28
23	XVII	Korea	1	0.28
24	XVII	Brazil	1	0.28

**Table 6: Geographical distribution**

It is revealed from the table 3 that 24 countries have contributed during this period of study. The majority of contributors are from USA 143 (41.21%) followed by Germany with 63 (18.15%) contributors. UK comes next with 11.24% and India comes to the eleventh position contributing 4 (1.15%) articles. It also reveals that only 1.15% authors are from Indian country and rests are from foreign countries.

## 6.2 Citation Analysis

The references provided by the authors at the end of their articles are the basis of citation analysis. Citation traces a connection between two documents, one which cites and the other which is cited. Citation analysis is one of the popular methods applied to derive the following benefits.

### 6.2.1 Distribution of Citations

Over the 23 issues of 185 articles in 5 years, a total of 3271 citations have been appended. The distribution of citations of the said period is shown in Table 7.

<b>Year</b>	<b>Total Articles</b>	<b>Total Citations</b>	<b>Percentage of citations</b>
2013	31	575	17.58
2014	41	508	15.53
2015	48	949	29.01
2016	32	686	20.97
2017	33	553	16.91
<b>Total</b>	<b>185</b>	<b>3271</b>	<b>100</b>

**Table 7: Distribution of Citations**

It is found that the highest numbers of citations are appended only from 48 articles in the year 2015 (949 citations, 29.01%) and a least number of citations are appended from 41 articles in the year 2014 (508 citations, 15.53%).

### 6.2.2 Average no. of citations

Table 8 shows the average number of citations of 185 articles from the period of 2013- 2017.

<b>Year</b>	<b>Total Articles</b>	<b>Total Citations</b>	<b>Average no. of citations</b>
2013	31	575	18.55
2014	41	508	12.39
2015	48	949	19.77
2016	32	686	21.44
2017	33	553	16.76
<b>Total</b>	<b>185</b>	<b>3271</b>	<b>17.68</b>

**Table 8: Average no. of citations**

It is found that the average number of citations per articles is varying from year to year. Average number of citations as a whole is 17.68 and the ranges is 12.39 to 21.44 during the period 2013 to 2017.

### 6.2.3 Ranges of citations

Table 9 shows the total number of citations used by all 185 articles under study. All the articles have been arranged according to the total number of citations used.

Year	Volume	0-10	11-20	21-30	31-40	41-50	Above 50	Total
2013	19	10	12	2	5	1	1	31
2014	20	20	11	7	2	1	0	41
2015	21	17	12	10	6	2	2	48
2016	22	8	11	7	1	2	2	32
2017	23	12	10	4	3	2	2	33
<b>Total articles</b>		<b>67</b> (36.22)	<b>56</b> (30.27)	<b>30</b> (16.22)	<b>17</b> (9.19)	<b>8</b> (4.32)	<b>7</b> (3.78)	<b>185</b>

**Table 9: Ranges of citations**

According to the analysis of ranges of citations, most of the articles belong to 0-10 ranges of citations (36.22%), followed by 11-20 citations (30.27%). And, only 7 (3.78%) articles have used more than 50 citations.

### 6.2.4 Forms of Documents Cited

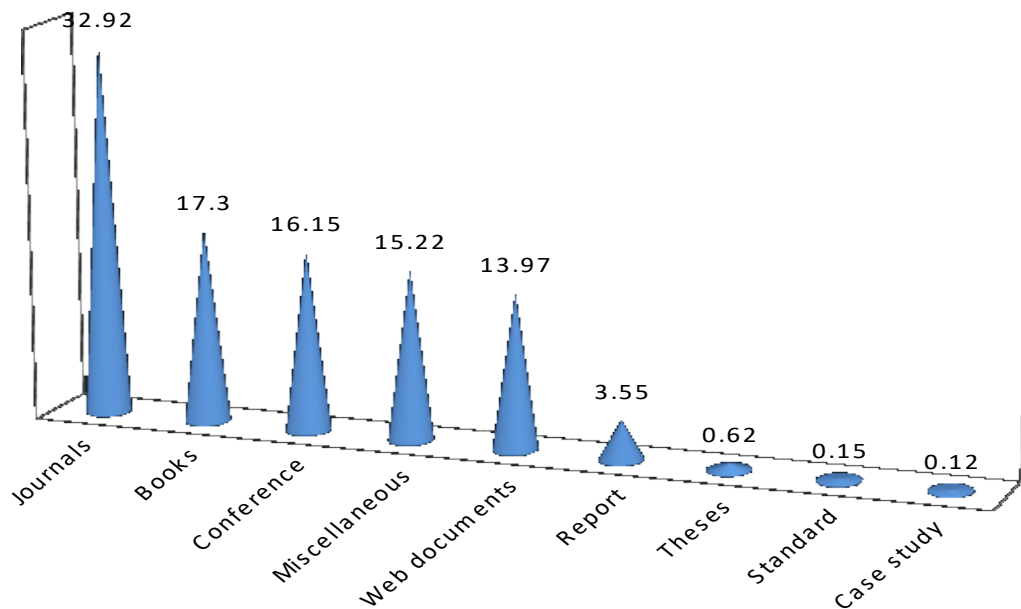
Table 10 represents the overall year wise distribution of literature appeared in research articles published in the journal D-Lib Magazine. There are a total of 3271 citations received from 185 research articles published in the journal during study period (Fig.3).

Forms	Year-wise distribution					Total	%	Rank
	2013	2014	2015	2016	2017			
Journals	131	142	313	294	197	1077	32.92	I
Books	115	35	187	131	98	566	17.30	II
Conference	108	117	156	75	72	528	16.15	III
Miscellaneous	123	108	170	68	29	498	15.22	IV
Web documents	49	84	95	89	140	457	13.97	V
Report	34	21	23	22	16	116	3.55	VI
Theses	6	1	5	7	1	20	0.62	VII
Standard	5	0	0	0	0	5	0.15	VIII
Case study	4	0	0	0	0	4	0.12	IX
<b>Total</b>	<b>575</b> (17.58%)	<b>508</b> (15.53%)	<b>949</b> (29.01%)	<b>686</b> (20.97%)	<b>553</b> (16.90%)	<b>3271</b> (100%)	100	

**Table 10: Forms of Documents Cited**

From the analysis of table 10, it is observed that out of 3271 citations, the highest numbers of citations are appeared in 2015 (29.01% citations). It is also observed that more than 30% citations are belonging to Journal Articles and ranked 1<sup>st</sup> position where as, Books having 2<sup>nd</sup> position (17.30% citations) and conference proceedings having 3<sup>rd</sup> positions (16.15% citations). It is also found that 13.97% citations are accounted from Web documents and it goes to 5<sup>th</sup> position. So it may be concluded that journal articles are the popular form of literature in this area compared to other literature.

Fig. 3 shows the graphical representation of Forms of Documents cited.



**Fig. 3: Forms of Documents Cited**

## Research Findings

The findings of the study are summarized as follows;

- The number of articles in each volume of D-Lib magazine is not consistent. They are varied from volume to volume. The highest number of articles are in 2015 (vol. 21) with 48 (25.94%) articles and lowest in 2013 with 31 (16.75%) articles.
- Maximum 86 articles are published within the page range of 6-10 and it is 46.49% of total contributions. So the page length is considerable for a research paper.
- Single author contribution is 44 (23.78%) and multiple author contribution is 141(76.22%). Multi-authored articles are dominant in the journal. There is trend towards author collaboration.
- The Degree of Collaboration for the journal has been calculated for the year 2013-2017. The Degree of Collaboration for the journal is 0.76 which indicates the significant amount of collaborative research among authors of the journal.

- The average productivity per author is 0.34 and the total average number of authors per paper is 2.90 during the said period.
- A total of 24 countries over the globe have contributed papers in this journal. United States of America (USA) has ranked top position contributing maximum 143 articles at a rate of 41.21%. Germany is in second position with 63 articles at 18.15% and India in the eleventh position with 4 articles at 1.15%.
- Most of the articles belong to 0-10 ranges of citations (36.22%), followed by 11-20 citations (30.27%).
- It is also observed that more than 40% citations belong to Journal Articles and ranked 1<sup>st</sup> where as 10.45% citations are accounted from Books and it goes to 4<sup>th</sup> position which indicates that journal articles are the popular form of literature in this area.

## Conclusion

It could be concluded that due to the negative growth of publication, *D-lib Magazine* has suspended its publication from July 2017. But during the said period, D-Lib Magazine has shown remarkable growth in all aspects. This study shows the majority of the authors have preferred journals as the source of information providing the highest number of citations. Most of the articles have produced outside of India. Although multi-authorship is leading authorship trend but also single authored articles have shown good number of contribution with the 0.76 rate of degree of collaboration. This type of study is helpful for librarians, researchers, readers for scholarly communication to choose right journal for research study. In addition, it may be helpful to the publishers as well as editors of the journals to improve the status, quality of the journal, so that they can stand before their competitors.

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