Application of mixed metrics of bibliometric analysis on the journal of the University librarians' association of Sri Lanka (2005 to 2019): with special reference to VOS viewer visualization

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Abstract

This study, using mixed methods of bibliometric analysis, aims to cover the articles published in the Journal of the University Librarians' Association (JULA) of Sri Lanka from 2005 to 2019. Primary goal of the study is to holistically analyze the journal in terms of important bibliometric aspects in light of improving LIS research on open access platforms. Analyses were executed to illustrate authorship impact, citation patterns, subject coverage, and visualization of citations' connections, co-authorship, and co-occurrence network. Among 127 articles authored by 182 librarians/library professionals analyses were performed to find the influential contributors, degree of collaboration, currency of citation, core journals, most preferred topics of research, and outstanding institutions. Single authorship constitutes the majority of the total contribution (62.5%) nevertheless the degree of collaboration steadily increased over time (0.37). Study findings also conform to the application of Lotka's law of author productivity. University of Peradeniya ranks first among outstanding universities that contributed more to the JULA. Application of Bradford's law identified core journals used by the contributors. Authors of this article employed MS Excel and SPSS for carrying out the analyses. They also experimented using VOSviewer for finding the co-occurrence of LIS subjects. Finally, the study intends to find out the areas of improvements needed in library science

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research in Sri Lanka. And, the authors shed their opinions on improving the existing open access journals in light of installing altmetric tools.

Introduction

Bibliometrics emerged a few decades ago to statistically measure the scholarly publications in terms of their extrinsic aspects. Those analyses earlier helped libraries to manage their collections and subscriptions. According to Beck and Manuel (2008) bibliometrics "is one of the oldest research methods in library and information science," and this field of study is now on fast track with the advent of sophisticated computer technology and tools. Wilson (2012) says that "bibliometrics can also be referred to as informetrics, webometrics, scientometrics, and cybermetrics. The different terms basically reflect the types of information to which the analysis is applied." Therefore, these terms, with slightest changes in context or purpose, could represent the same connotation to analyse the metrics of scholarly communications.

Sri Lankan librarianship demonstrates a long history of scholarly publications through its professional bodies. Being a prominent professional body the University Librarians' Association (ULA) of Sri Lanka launched the first volume and issue of the Journal of the University Librarians' Association (JULA) of Sri Lanka in March 1995. It is now a double-blinded, peer-reviewed journal (ISSN: 1391-4081) with two issues per volume. The issues of JULA from volume 9 (2005) are being hosted in the Sri Lankan Journals Online (SLJOL) under open access Creative Commons Attribution Share-alike 4.0 International License. (www.ula.sljol.info).

Its credibility and popularity in the region gave JULA an International recognition to have it indexed on European search engines too. For example, Bielefeld Academic Search Engine (BASE) run by the Bielefeld University Library (Germany) has indexed JULA as one of the open access resources for LIS research (www.base-search.net). Similarly, EBSCO Host has indexed JULA on its open access portal. Since this journal is consistently published with a wider scope in country's librarianship, and the scholarly contributions are made by the academic librarians, it was selected for carrying out this bibliometric study.

For this study, all articles published in 15-year span from volume 09 (2005) to volume 22 (2019) that are made available on Sri Lankan Journals Online

have been subjected to bibliometric analysis in order to present the research trend, citation patterns, and other factors. The purposes of this study are to better understand scholarly communication trends within LIS, to assess the visualization network of citation, and to determine the extent to which the journal has achieved its research communication goals.

Research Objectives
The primary objective of the study is to analyse the JULA of Sri Lanka in terms of its bibliometric qualities in the field of library and information sciences on the scholarly communication platform.

Specific objectives of the study are;
1. To find out authorship pattern and research productivity in university librarians in LIS of Sri Lankan context;
2. To discover the degree of collaboration of university librarians in Sri Lanka;
3. To exhibit the subject spectrum of LIS research within the JULA domain;
4. To investigate the age of citations consulted by JULA authors;
5. To show the visual networks between the authors, subjects and institutions;
6. To propose the measures to bridge the gaps, if there are; and
7. To help university librarians in designing their journal subscription packages.

Literature Review
Bibliometric Studies on Sri Lankan LIS
First known study in this area on JULA was carried out by Gunasekera (2008), who focused on type of research, areas of research, research methodologies employed, authorship pattern and prominent contributors, citation patter, article distribution, and direction of LIS research. Her research, however, looked at bibliometrics of both JULA and Sri Lanka Library Review.

Similar study was conducted by Angammana and Jayatissa in 2016 on master's theses and dissertations in LIS submitted to University of Colombo and University of Kelaniya. In that study the authors extracted the

bibliometric data manually from the reference lists presented in 70 theses or dissertations. And, they identified the leading resource types and names that were consulted by the researchers.

Weerasinghe (2016) studied the LIS research output for collection development to serve the user community. She applied Bradford's Law on JULA for a 5 year period (2010-2015) to find out the core journals, mostly used format of information source, and predominant topic of research. In her study journals were the mostly consulted resources where *the Journal of Academic Librarianship* was ranked atop among 13 core journals. Most frequent research topic was "information seeking."

Other Bibliometric Studies Published in the JULA
The content of JULA includes bibliometric studies that have been carried out by library professionals and researchers on different other disciplines, too. Bibliometric phenomenon was studied by Maheshwaran (2007) on Tamil publications in Sri Lanka in a given period. In 2014, Navaneethakrishnan and Kupesan bibliometrically studied the Sri Lankan Journal of Humanities (published by University of Perdeniya). A scientometric assessment was carried out by Pratheepan and Weerasooriya in 2015 to find out publication output of Sri Lankan universities. Gunasekera (2016) conducted a research on bibliometrics of master's degree theses submitted in sociology and economics in University of Perdeniya. Ceylon Medical Journal was subjected to a bibliometric study by Murugathas and Navaneethakrishnan in 2016. Jayasekara and Abu (2018) conducted a citation analysis of the Internet of Things. Ramanayaka, Chen and Shi (2018) applied webometric techniques on university library websites in Sri Lanka.

Bibliometric studies have a range of applications at present. Mabrouk (2015) says that bibliometrics would help bring insights of publication practices, identify influential papers, authors and journals in a domain, and ~~to~~ locate potential collaborators. According to Hoffman and Doucette (2012), citation analysis is a simple methodology that utilizes readily available bibliographic data of references. By doing so researcher is able to understand publication

trends within a given discipline, and measure the accuracy of citation indexes.

Besides, the famous Web of Science (WoS) does not cover equally the disciplines of humanities or social sciences which associate library and information science, thus the citation metrics produced from its data would miss certain components necessary to track LIS research (Moed, 2020). Therefore, citation analytics are important in library science-related disciplines as they become quite cross-disciplinary.

Methodology
Data Collection
Most of the bibliometric studies conducted in Sri Lanka have manually extracted the data from resources and not any automatic citation measurements been involved. For example, print collections such as dissertations/theses, print books, and electronic resources that serve as standalone databases do not have any analytical widgets or tools embedded. In such cases, researchers endeavoured to manually extract the bibliometric data from the articles and references. They completed this extraction of data in 12 months period.

The study included 14 volumes of JULA containing 22 issues published during 2005 to 2019. Data collection was performed at two levels, which included extraction of information such as titles, authors, keywords given by the authors through Sri Lankan Journals Online (ula.sljol.info), and citation related data were gathered manually by pursuing reference lists of each article published in the journal.

Tools of Analysis
There is a range of parameters used by different researchers of bibliometric studies depending on the objectives. However, the general purposes remain the same across various bibliometric studies. In this work, the authors have used Lotka's Law to find out the author productivity in JULA for the given period, Bradford's Law to identify the core resources, and other citation

metrics to analyse authorship pattern, currency of literature used (age of citation), trend in LIS research, and strength of local citations.

In addition, network visualisation analysis was executed on co-authorship and co-occurrence of keywords using VOSviewer (version 1.6.15) software. "VOSviewer is a popular knowledge mapping tool to visualize networks and produce networks consisting of a number of nodes mapped in a two-dimensional space based on the 'visualization of similarities'" (Van Eck & Waltman, 2010). Since the basic bibliometric data of JULA articles could not be directly downloaded from SLJOL, the required data to be analysed on VOSviewer had to be converted to SCOPUS bibliometric format using comma-separated values (CSV) file and run the analysis on VOSviewer. The links between authors, institutions and keywords are shown by different thresholds of documents and connections via different networks. In addition, MS Excel and SPSS were also used to analyse and present the findings.

Results and Discussion
Of the total articles published during the considered period, articles that did not have any citation or research nature have been omitted, such as short communications and essays. Table 1 shows the figures that were derived from the journals included in the study.

From 2009 onwards the journal started publishing two issues per volume. This aspect is appreciated amongst university academics as their promotion criteria mandate publishing in journals having more than one issue per volume. This has been one of the reasons for selecting JULA for this study.

Table 1. Summary of journals analysed for the Study

Year	Volume	No. of Issue/s	No. of Articles
2005	9	1	6
2006	10	1	5
2007	11	1	5
2008	12	1	7
2009	13	2	16

2010	14	1	7
2011	15	1	4
2012	16	2	11
2013	17	2	10
2014	18	2	10
2015	19	1	7
2016	19	1	7
2017	20	2	10
2018	21	2	13
2019	22	2	9
Total	**14**	**22**	**127**

Year-wise Distribution

Throughout the 15-year span, the total number of articles published in JULA is 127 of which 4 are in Sinhala and 123 are in English language. And, 182 authors have contributed in various ways to enhance the quality of publication. Number of articles published from 2005 to 2019 is plotted in Figure 1 below.
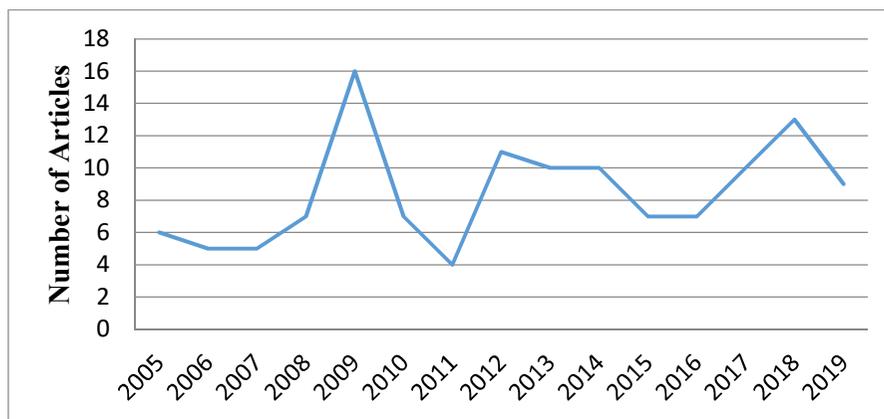

Figure 1. Year-wise distribution of papers

Release of a special issue with more than a dozen contributions in 2009 has rapidly increased the number of articles in that year. With that proliferation the JULA managed to release two issues per volume. The graph shows ups and downs in the number of publications. A good number of articles

published per issue are dependent on contributors, research resources, and in certain times, funds.

Authorship Pattern
During the period from 2005 to 2010, majority of contributors (81.25% and 83.33%) of JULA were single authors, whereas joint authorship slowly increased to maintain 50% at the end of the study (53.13%).

Table 2. Authorship Patterns

Authorship	Year					Total	%
	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019		
Single	13	25	12	15	15	80	62.50
2 authors	3	5	12	8	13	41	32.03
3 authors			1	1	3	5	3.91
4 authors					1	1	0.78
Total Articles	**16**	**30**	**25**	**24**	**32**	**127**	
Total Authors	19	36	39	34	54	**182**	
Avg. Authors per article	1.19	1.20	1.56	1.42	1.69		
Single %	81.25	83.33	48.00	62.50	46.88		
Joint %	18.75	16.67	52.00	37.50	53.13		

An increasing series of values represent the joint authorship with successive volumes, nevertheless, the figures are heavily affected by the number of articles published per issue. It is very rarely seen that more than three authors collaborate to produce a published work of research (Table 2).

Degree of Collaboration
Degree of collaboration is calculated as shown below (Subramanyam, 1983 in Abdi et al, 2018):

$$Degree\ of\ Collaboration\ \frac{No.\ of\ Multi\ Authored\ Papers}{No.\ of\ Single\ Authored\ Papers + No.\ of\ Multi\ Authored\ papers}$$

Table 3. Year-wise degree of collaboration

Authorship	Year					No. of Articles
	2005-2007	2008-2010	2011-2013	2014-2016	2017-2019	
Single authored articles	13	25	12	15	15	80
Multi-authored articles	3	5	13	9	17	47
Degree of Collaboration	**0.19**	**0.17**	**0.52**	**0.38**	**0.53**	**0.37**

As seen in Table 3 the degree of collaboration increases over the period considered for the study, however it dropped from 0.52 to 0.38 during 2014 – 2016, and then increased to 0.53 in the later period of the study.

Network Visualization of Authors

The networks between authors who published articles in JULA were visualized and analysed using VOSviewer as shown in Figure 2 below.
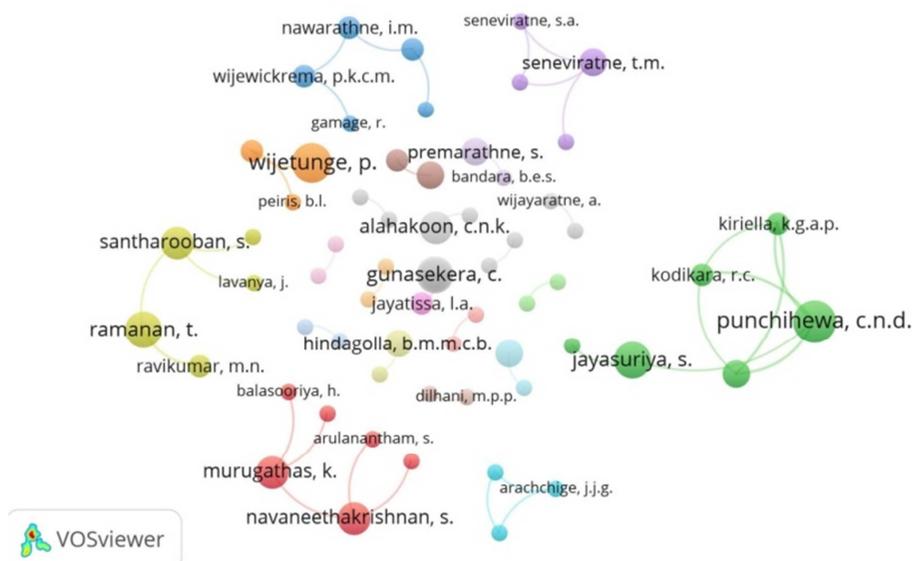

Figure 2. Visualization of Author Collaboration

Figure 2 portrays the links between authors who collaborated with other contributors of JULA. Meanwhile, various sizes of bubbles in the visualization show the strength of authors in terms of the number of publications in JULA during the study period. Weaker contributions are not displayed in the normal view.

Author Productivity

Author productivity was measured using Lotka's Law which is used to investigate contributors' inequality in scientific productivity in a particular discipline during a selected period. Lotka's Law was introduced in 1926 to assess authors' scientific productivity in publications. This factor is influenced by subjectivity of researchers, the field of research, research methods used by authors, and scientific environment conducive for the work (Adigwe, 2016), in other words, resourcefulness of research institutions. In this regard, Sri Lankan universities are not equally resourceful and the subjective aspects of researchers too greatly vary, thus, the author productivity is subject to variations.

$$f(n) = C/n^2$$

$f(n)$ – Number of authors in a domain in a given period contributed to 'n' number of articles
C – Constant (number of authors contributed 1 article each)
n – Number of articles

As shown below in Table 4, the author productivity calculated, and observed values of author productivity for JULA during the study period from 2005 to 2019 have conformed to the Lotka's Law.

Table 4. Author Productivity based on Lotka's Law

No. of Articles (n)	No. of Authors	% of Contribution	$f(n) = C/n^2$	Expected % by Lotka's Law
1	67	65.05	67	65.69
2	17	16.50	17	16.67
3	7	6.80	8	7.84
4	6	5.83	4	3.92
5	4	3.88	3	2.94

6	1	0.97	2	1.96
7	1	0.97	1	0.98
Total	**103**		**102**	

According to Table 4, in JULA 67 authors have contributed only one articles each (65%) during the study period. Likewise, 17 authors published two articles each (16.5%). Authors that produced 3 articles each constitute 6.8% of the total. This goes on for authors contributed 4, 5, 6 and 7 articles each. These figures conform to the Lotka's formula (one article per author is 60%, two articles per author is 15% and 3 articles per author is 7%), thus the author productivity is positively correlated with increasing number of article contribution.

Senior librarians or professors are more likely to have more number of publications therefore these numerical representations do not compare experienced librarians with novice in the profession. The list of top contributors is generated only to enhance the continuity of research and contribution to the knowledge sphere. Moreover, it is an evolving phenomenon in research world.

Prolific Authors of JULA
Productive authors that appeared during the said period of this study are listed below in Table 5. However, names of authors (74 in number) who contributed only once are not displayed due to the length of tabulation.

Table 5. Prolific authors with number of papers

No	Authors Name	No of Articles
1	Punchihewa, C.N.D.	7
2	Wijetunge, P.	6
3	Gunasekera, C.	5
4	Jayasuriya, S.	5
5	Perera, P.A.S.H.	5
6	Ramanan, T.	5
7	Alahakoon, C.N.K.	4
8	Gunasekera, D.	4

9	Murugathas, K	4
10	Navaneethakrishnan, S	4
11	Santharooban, S.	4
12	Wijayaratne, A.	4
13	Hindagolla, B.M.M.C.B.	3
14	Jayasundara, C.C.	3
15	Kumara, A.D.B	3
16	Mashroofa, M. M.	3
17	Premarathne, S.	3
18	Seneviratne, T. M.	3
19	Thusithakumari, W. M	3
20	Amarasekera, R.	2
21	Gamage, R.	2
22	Jayatissa, L.A.	2
23	Ketheeswaren, S.	2
24	Kiriella, K.G.A.P.	2
25	Kodikara, R.C.	2
26	Maheshwaran, R.	2
27	Nawarathne, I.M.	2
28	Peiris, N.D.	2
29	Ramanayake, K.H.	2
30	Ranawella, T.C.	2
31	Ravikumar, M. N.	2
32	Samaradiwakera, G.D.M N.	2
33	Weersinghe, S.	2
34	Wijewickrema, P. K. C. M.	2
35	Ratnayake, A.R.M.M	2

The intention of this analysis is to motivate the JULA authors to contribute more in upcoming publications and to set their goals in terms of earning academic merits. Therefore, excellence in academic research helps reinforce the library profession in the university sector in Sri Lanka.

Leading Research University Libraries

Prolific universities in Sri Lanka by publications in JULA are enumerated in Table 6, where University of Peradeniya, University of Colombo, University of Moratuwa, Open University of Sri Lanka, Eastern University, Sri Lanka and University of Jaffna are falling in first 5 places.

Table 6: Outstanding Institutions by Contribution of Papers

Affiliated Institutions of Authors	No. of Articles	%	Cumulative %	Rank
University of Peradeniya (PDN)	32	21.8	21.8	1
University of Colombo (CBO)	21	14.3	36.1	2
University of Moratuwa (MRT)	14	9.5	45.6	3
Open University of SL (OUSL)	14	9.5	55.1	3
Eastern University, SL (EUSL)	10	6.8	61.9	4
University of Jaffna (JFA)	9	6.1	68.1	5
University of Kelaniya (KLN)	7	4.8	72.8	6
University of Sri J'pura (USJP)	6	4.1	76.9	7
University of Ruhuna (RUH)	5	3.4	80.3	8
Sabaragamuwa University (SUSL)	5	3.4	83.7	8
South Eastern University of SL (SEUSL)	4	2.7	86.4	9
Wayamba University of SL (WUSL)	4	2.7	89.1	9
Rajarata University of SL (RUSL)	3	2.0	91.2	10

Uva Wellassa University (UWU)	2	1.4	92.5	11
Kotalawala Defense University (KDU)	2	1.4	93.9	11
Others	9	6.1	100.0	12

It is noteworthy to mention that University of Peradeniya has the highest number of library professionals amongst other universities. Therefore, resourcefulness of an institution is likely to influence author productivity, although other factors too contribute to this variable.

Visualization of Institutional Research Collaboration
Out of 127 research-based articles 47 were jointly produced (See Table 2) and 17 papers are joint ventures, either between Sri Lankan universities or overseas institutions. VOSviewer (Figure 2) displays the linked visualization of collaboration between different institutions. Here, on VOSviewer the threshold was set to two documents to get the visualization network between institutions. It is simply visible that universities that did not liaise with other counterparts for research are seen as single nodes in the figure below.

Figure 3 depicts the visualization of research networks between universities in Sri Lanka formed for publishing articles in JULA from 2005 to 2019. Highest number of collaborations (4) happened with Open University of Sri Lanka. University of Colombo, University of Kelaniya and University of Moratuwa have collaborated with other universities three times each. Peradeniya and Ruhuna universities had liaised with other institutions two times each.
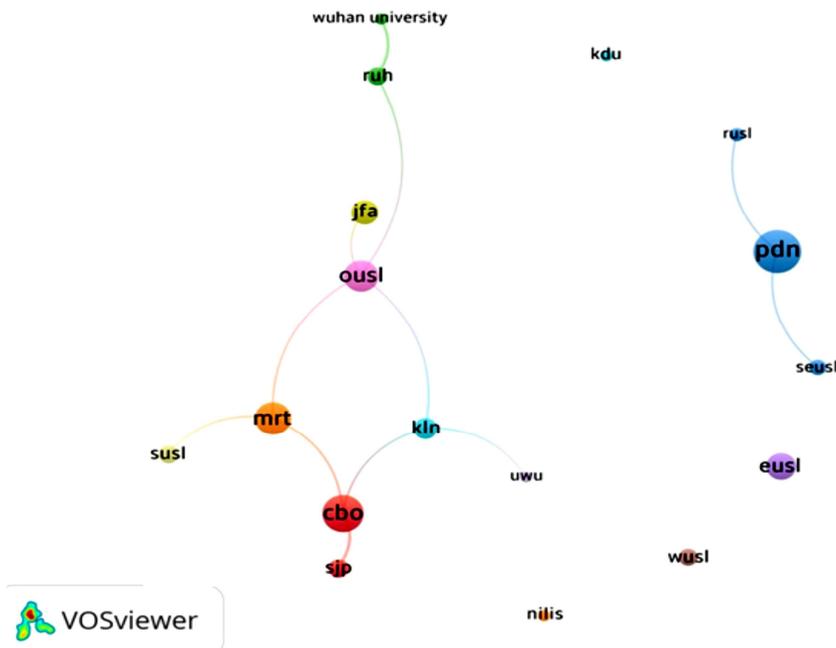
Figure 3. Collaboration between Institutions

Collaboration included foreign universities too (Wuhan University in China, Tsukuba University in Japan, and Bharathithasan University, India).

Distribution of Citations

Although citation counts generally depend on the number of articles, there are variations when scope of the research expands and deepens in literature. In this study, the average citation distribution is 16 per article. Table 7 shows that 127 articles consulted 2069 citations in total, nevertheless there is no relationship between the number of articles and their corresponding citations.

Table 7. Citation Distribution (Year wise)

Year	No. of Articles	No. of Citations	ACPA
2005	6	38	6.33
2006	5	48	9.60
2007	5	67	13.40
2008	7	89	12.71

2009	16	171	10.69
2010	7	100	14.29
2011	4	150	37.50
2012	11	121	11.00
2013	10	201	20.10
2014	10	140	14.00
2015	7	191	27.29
2016	7	141	20.14
2017	10	226	22.60
2018	13	258	19.85
2019	9	128	14.22
Total	**127**	**2069**	**16.29**

The purpose of analyzing citation distribution is to provide a complete degree of popularity of scholarly journals than the average or total number of citations (Redner, 1998).

In this regard, articles are strengthened by the number of associated citations, thus would make the JULA a popular carrier of LIS research in Sri Lanka.
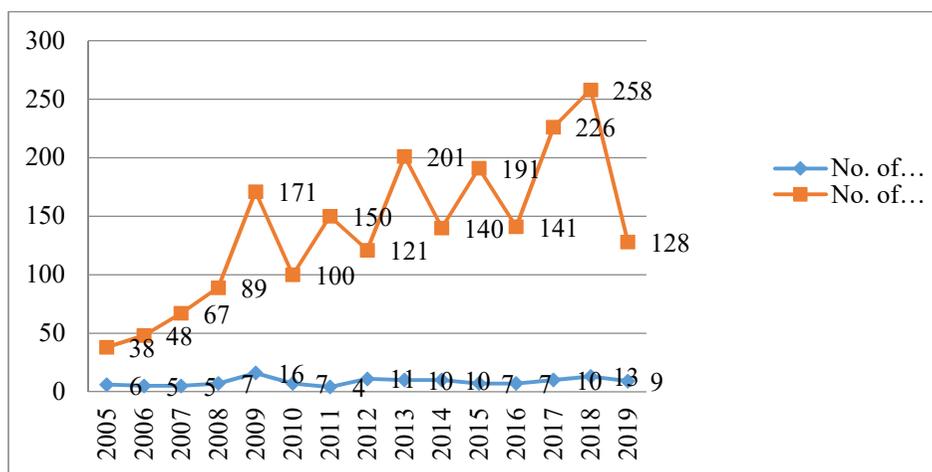

Figure 4. Distribution of Citations

Age of Citation

Year of sources used in an article is called age of citation. Figure 5 shows the relationship between the chronology and number of citations. Citations from immediate preceding year are higher in number compared with current year citations. Number of older citations decreases with age.
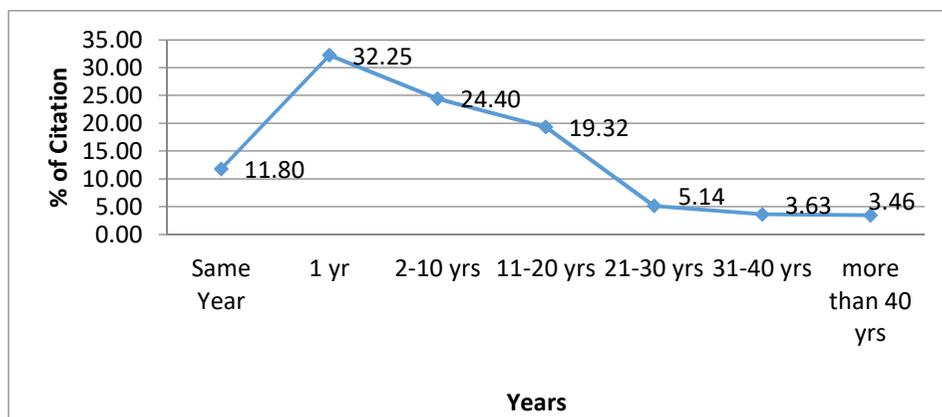

Figure 5: Age of Citation in JULA

This finding shows that the references conferred on for JULA articles are more or less latest in chronology, thus it raises the credibility and quality of the journal.

Distribution of Type of Resources

It is obvious that the JULA authors consult a vast range of information resources for accomplishing their research. Journals, books and website resources stand on top of the list of types of references used.

Journals are the primary media of scientific communication and are subject to bibliometric analyses. However, at present scholarly communication is permeating across social media where general public reflect on research values (Thelwall, 2017). Therefore, it is important to share and consult related information on non-academic channels in addition to scholarly journals.
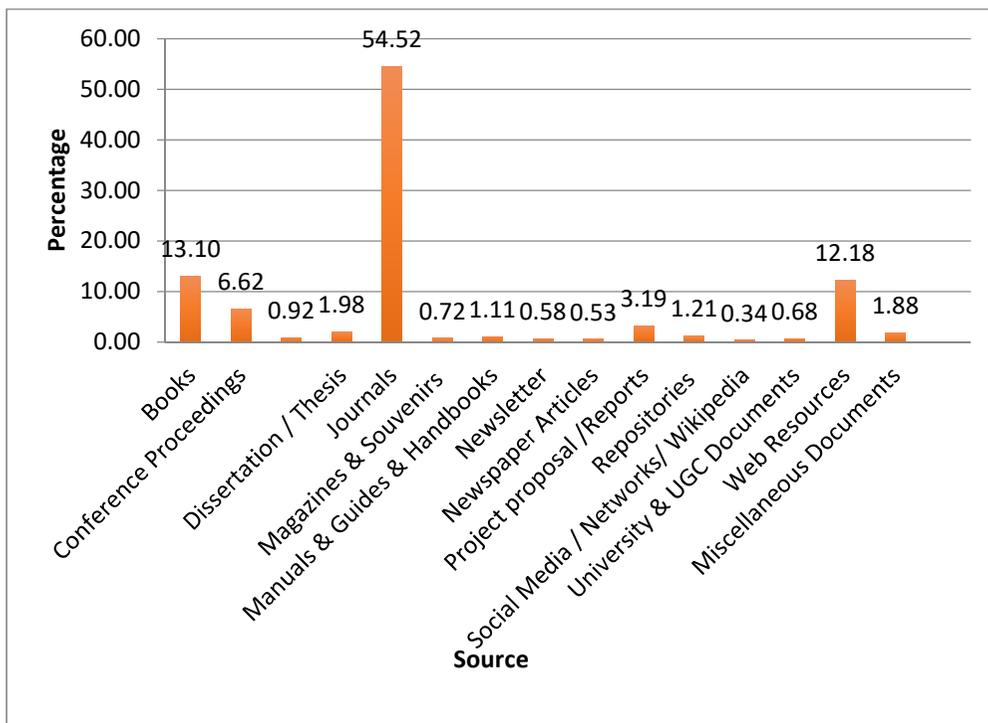
Figure 6. Types of Resources

Identification of Core Journals using Bradford's Law

This law is employed to find out the number of core journals within a given discipline. According to Bradford's law, "if the journals containing articles on a given subject are arranged in descending order of the number of articles they carried on the subject, then successive zones of periodicals containing the same number of articles on the subject form the simple geometric series $1:n:n^2$." It is therefore determined that the first zone is the nucleus of journals which are mostly consulted for the given subject (Alabi, 1979).

In this study, 13 journals fall in the first zone, which are devoted for majority of research work in LIS published in JULA. Second zone contains 70 journals and third zone has 317 journals (Table 8).

Table 8. Distribution of cited journals based on the Bradford's law

Zone	No. of Journals	No. of Citations	Journal %	Observed ratio
1	13	376	3.26	1
2	70	381	17.54	5
3	317	371	79.45	24
Total	399	1128		

Table 9 lists down the journal titles in the nucleus of Bradford's scattered distribution of journals used in JULA during the study period.

Table 9: Core Journals in the Nucleus (first zone)

No	Journal Title	No. of Citations	%	Cumulative %	Rank
1	Journal of Academic Librarianship	67	5.94	5.94	1
2	Journal of the University Librarians' Association of SL (JULA)	60	5.32	11.26	2
3	Library Philosophy and Practices	38	3.37	14.63	3
4	Electronic Library	32	2.84	17.46	4
5	Scientometrics	26	2.30	19.77	5
6	College and Research Libraries	22	1.95	21.72	6
7	Journal of Documentation	22	1.95	23.67	6
8	Journal of the American Society for Information Science and Technology	21	1.86	25.53	7
9	Library review	21	1.86	27.39	7
10	Information Research	18	1.60	28.99	8

11	Library Trends	18	1.60	30.59	8
12	Reference Services Review	16	1.42	32.00	9
13	Collection Building	15	1.33	33.33	10

The core journals identified here (Table 9) are the most frequently conferred resources by JULA authors; however, it does not devalue the journals fall into the second and third zones. Besides, core journals are determined by the access to leading journals and their relevance to research problems taken into authors' consideration. It is evident that not all contributors were at the luxury of using subscribed journals thus open access journals are the panacea to most of the research problems. Surprisingly, *the Journal of Academic Librarianship* has still been the top ranking journal amongst university librarians and their research (*See* Weerasinghe, 2016).

Visualization of Co-occurrence network
The keywords given by authors in each article were used to identify the research spectrum using VOSviewer. The co-occurrence network of author-given keywords is visualized in Figure 7.

The keywords displayed in Figure 7 are those with minimum of two occurrences. The links among keywords indicate their co-occurrence in the JULA publication. This unveils that most of the papers are published in information literacy; user education; online databases; electronic journals; electronic information resources related to university libraries in Sri Lanka and bibliometric studies.
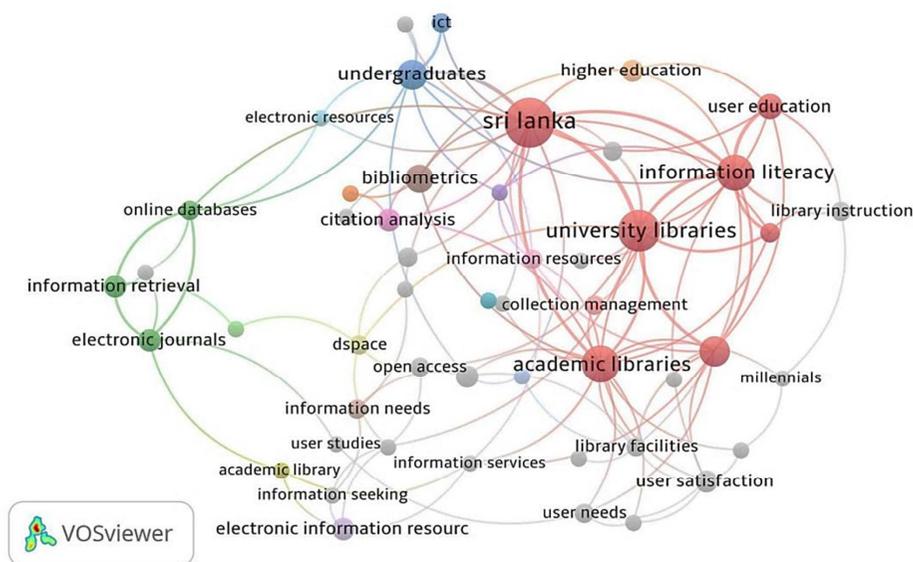
Figure 7. Co-occurrence of Keywords

Also it shows the gaps and least touched LIS research topics in the JULA from 2005 to 2019. This study has proven that the trend of research has changed from "information seeking" as found in Weerasinghe (2016) to "information literacy."

Most Cited JULA Authors

Citations attributed to JULA authors by other JULA authors reflect the development of an LIS topic over a period in Sri Lanka. The more an author does research in a particular area the more he or she gets cited by others who research in that area of LIS realm. There is an important requirement to trace research findings discovered by local contributors in LIS in order to avoid reinventing the wheel. Moreover, local citations will strengthen the academic and research network among library professionals in Sri Lanka.

Table 10: Local Citations in JULA

Name of Author	No. of Citations in JULA	%	Rank
Wijetunge, P.	17	7.00	1
Punchihewa, C.N.D.	11	4.53	2
Gunasekera, C.	9	3.70	3
Jayatissa, L.A.	8	3.29	4
Hindagolla, B.M.M.C.B. Seneviretne, T. M.	7	2.88	5
Gunasekera, H.P.S.D., Jayasuriya, S., & Perera, P.A.S.H.	6	2.47	6
Jeyasundra, C.C., Rathnayakae, A.R.M.M., & Yapa, N.U.	5	2.06	7
Alahakoon, C.N.K., Amarasekara, R., Mashroofa, M.M., Peiris, N.D., Ranaweera, P.,Wickramanayke, L., & Wijeretna, A.	4	1.65	8
Dharmarathne, W. G. A., Gamage, R., Goonetileke, H.A.I., Karunarathna, H. M. P. P., Millawithanachchi, U. S., Mudannayake, I., Senadeera, N.T.S.A., Seneviretne, D.C., Wickramasinghe, V.M., & Seneviratne, W.	3	1.23	9
11 authors	2	0.82	10
71 authors	1	0.41	11
Total	**243**		

Of 243 local citations 28 are self-citations. Observations show variations of author self-citation depending on different scientific disciplines (Aksnes, 2003), and it could be recognized that author self-citations are more likely to occur when the researcher continues a project in succeeding levels. Wolfgang, Bart and Balazs (2004) record that self-citation indicators are supplementary to traditional tools and having potentiality in informetrics and research evaluation although they present reliability issues and bias.

Experiments with Altmetrics

Altmetrics are nothing but alternative to conventional bibliometrics where data are gathered not only from journals and books but also from social media, government documents, mass media, and software (Adie & Roe, 2013). Sri Lankan Journals Online has not yet installed with bibliometric tools let alone altmetric widgets.

Therefore, the researchers of this study experimented with the Altmetric bookmarklet, which is free for individual academic researchers, and enables an instant display of altmetric data for any scientific article with a DOI. However, they could not harvest the metrics on SLJOL.

According to Warren, Raison and Dasgupta (2017), research output is exponentially increasing every 9 years at a rate of 2.5 million articles per year. While older versions of bibliometrics assess the citation, altmetrics analyse the real-time influence and real world impact of an article across "non-academic" platforms. Since altmetrics are exclusively concerned with the real-time impact of academic research it is harvesting scientometric information from the social web. In other words, posts and comments are placed on social websites by general public and it is believed to have the reflection of research value to society rather than to future academia (Thelwall, 2017).

Conclusion and Recommendations

Bibliometric studies or its branches like scientometrics, informetrics, webometrics or altmetric analyses are important for developing and managing library collections, deciding on journal/databases subscriptions, designing information literacy programs in a given discipline, contributing to the knowledge corpus, and increasing the author and journal impacts. Sri Lankan university library professionals and other academics in LIS field are quite contributing to the research in library services and technology although author productivity, citation metrics and keyword analysis have revealed the areas to be improved.

Authorship pattern is promisingly increasing along with single authorship (63%) and joint authorship (37%). Degree of collaboration has also increased over the study period (0.37). It is evinced that certain universities often carried out collaborative research, *viz.* University of Colombo, Moratuwa University and the Open University of Sri Lanka. If this type of collaboration expands, the research output will be more profound and current. It will also save the resources of the institutions. Most preferred resource types are journals, books and websites, where journals predominate by 54.5%. It is encouraging to see that *the JULA* is also coming under the first zone of core journals found in the study, where *the Journal of Academic Librarianship* ranks in top. However, it ~~is~~ was found that many high impact journals in the field fall in second and third zones of Bradford's scattering law. VOSviewer visualization exhibits the commonly researched topics in LIS studies. In this regard, compared to the earlier bibliometric studies, the co-occurrence has changed to trendy fields in LIS such as information literacy, digital librarianship, and bibliometric studies. Yet, the contribution to the JULA needs to touch upon topics such as cutting-edge technologies in LIS.

When DOI resource locator is not mentioned in citations it is near impossible to harvest any altmetrics for the citations. Therefore, the authors should give the DOI resource locators when applicable. This practice will help future citation analyses on JULA. Moreover, the visibility of JULA has to be further expanded to develop and increase the journal impact and the scientometric recognitions of Sri Lankan authors on International platforms especially the open access resources.

At present, the JULA portal on SLJOL does not have any bibliometric / altmetric widgets or tools for measuring the citation traffic (eg. PlumX Metrics). Fortunately, there is a number of free analytical plug-ins made available by external parties. For example, Altmetrics.com team provides free resources for measuring alternative metrics of authors and articles across all sorts of information resources that include social networks, mass media and software.

In addition, developing a hub or portal with altmetrics / bibliometric tools that enables searching across all institutional repositories managed by state-owned universities in Sri Lanka will give the researchers a bird's view on a topic. There is a potentiality for a holistic bibliometric research on all LIS publications covering the entire discipline in Sri Lanka. This will dissect the research impact on the field in Sri Lanka so that further developments in publication, dissemination and quality of writings in LIS domain would be increased.

References

Abdi, A., Idris, N., Alguliyev, R. M., & Aliguliyev, R. M. (2018). Bibliometric Analysis of IP&M Journal. Journal of Scientometric Research, 7(1), 54-62.

Adie, E. and Roe, W. (2013), Altmetric: enriching scholarly content with article-level discussion and metrics. *Learned Publishing*, 26, 11-17. doi :10.1087/20130103

Adigwe, I. (2016). Lotka's Law and productivity patterns of authors in biomedical science in Nigeria on HIV/AIDS: A bibliometric approach, *The Electronic Library*, 34(5), 789-807. doi: https://doi.org/10.1108/EL-02-2014-0024

Aksnes, D.W. (2003). A macro study of self-citation. *Scientometrics*, 56, 235–246. doi: https://doi.org/10.1023/A:1021919228368

Alabi, G. (1979). Bradford's law and its application, *International Library Review*, 11, 151-158. doi: https://doi.org/10.1016/0020-7837 (79) 90044-X

Angammana, A.M.S. & Jayatissa, L.A. (2016). A Bibliometric Study of Postgraduate Theses in Library and Information Science: with special reference to University of Kelaniya and University of Colombo, Sri Lanka. *Journal of the University Librarians Association of Sri Lanka*, 19(1), 2–53. doi: http://doi.org/10.4038/jula.v19i1.7874

Beck, S. E., & Manuel, K. (2008). *Practical research methods for librarians and information professionals.* New York, NY: Neal-Schuman, p. 166.

Gunasekera, C. (2016). Characteristics of citations in postgraduate theses of sociology and economics: a comparative study. *Journal of the University Librarians Association of Sri Lanka*, 19(2), 82–99. DOI: http://doi.org/10.4038/ jula.v19i2.7888

Gunasekera, C. (2008). Library and Information Sciences Research Literature in Sri Lanka: A Bibliometric Study. *Journal of the University Librarians Association of Sri Lanka*, 12, 17–46. doi: http: //doi.org/10.4038/jula.v12i0.327

Hoffmann, K., & Doucette, L. (2012). A Review of Citation Analysis Methodologies for Collection Management. *College & Research Libraries, 73*(4), 321-335. DOI : https://doi.org/10.5860/crl-254

Jayasekara, P.K., & Abu, K.S. (2018). Top Fifty Highly Cited Publications on the Internet of Things. *Journal of the University Librarians Association of Sri Lanka*, 21(2), 40–156. doi: http: //doi.org/10.4038/jula.v21i2.7922

Mabrouk, Patricia (2015 Dec 15). *An introduction to bibliometrics* [Video File] Retrieved from https://www.youtube.com/watch?v =c8N4rE70kJI

Maheshwaran, R. (2007). Bibliometric phenomenon of Tamil Publications in Sri Lanka in 2005. *Journal of the University Librarians Association of Sri Lanka*, 11, 2–36. doi: http://doi.org/10.4038/ jula.v11i0.321

Moed, H.F. (2020). Appropriate Use of Metrics in Research Assessment of Autonomous Academic Institutions. *Scholarly Assessment Reports*, 2(1), 1. DOI: http://doi.org/10.29024/sar.8

Murugathas, K. & Navaneethakrishnan, S. (2016). Bibliometric analysis of Ceylon Medical Journal during the period from 2003 – 2012. *Journal of the University Librarians Association of Sri Lanka*, 19(2), 67–81. doi: http://doi.org/10.4038/jula.v19i2.7887

Navaneethakrishnan, S. & Kupesan, R. (2015). Bibliometric analysis of Sri Lanka Journal of the Humanities. *Journal of the University Librarians Association of Sri Lanka*, 18(1), 51–71. doi: http://doi. org/10.4038/jula. v18i1.7861

Pratheepan, T. & Weerasooriya, W.A. (2016). The Publication Output and Impact of various Faculties in Sri Lankan Universities: a Scientometric Assessment and Policy Implications. *Journal of the University Librarians Association of Sri Lanka*, 19(1), 54–70. doi: http://doi.org/ 10.4038/jula. v19i1.7875

Thelwall, Mike, (2017). Data science altmetrics, *Journal of Data and Information Science*, 1(2), 7–12, doi: https://doi.org/ 10.20309 /jdis.201610.

Ramanayaka, K.H., Chen, X. & Shi, B. (2018). Application of Webometrics Techniques for Measuring and Evaluating Visibility of University Library Websites in Sri Lanka. *Journal of the University Librarians Association of Sri Lanka*, 21(1), 1–17. doi: http://doi.org/10.4038/jula.v21i1.7908

Redner, S. (1998). How popular is your paper? an empirical study of the citation distribution. *The European Physical Journal B - Condensed Matter and Complex Systems*, 4, 131–134. doi: https:// doi.org/10.1007 /s100510050359

Subramanyam, K. (1983). Bibliometric studies of research collaboration: A review. *Journal of Information Science*, 6(1), 33–38. doi: https:// doi.org/10.1177/016555158300600105

Van Eck, N.J., & Waltman, L. (2010) Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 84, 523–538. doi: https://doi.org/10.1007/s11192-009-0146-3

Warren, H.R., Raison, N., & Dasgupta, P. (2017). The Rise of Altmetrics. *Journal of American Medical Association (JAMA)*. 317(2), 131–132. doi: 10.1001/jama.2016.18346

Weerasinghe, S. (2016). A review of the possibility in applying game theory to libraries. *Journal of the University Librarians Association of Sri Lanka*, 19(2), 100–115. doi: http://doi.org/10.4038/jula.v19i2.7889

Wilson, Virginia, (2012). Research methods: bibliometrics, *Evidence Based Library and Information Practice*, 7(3), 121–123. doi: https://ejournals.library.ualberta.ca/index.php/EBLIP/article/view/17975/14278

Wolfgang, Glänzel, Bart, Thijs, & Balázs, Schlemmer. (2004). A bibliometric approach to the role of author self-citations in scientific communication, *Scientometrics*, 59(1), doi: 10.1023/B:SCIE.0000 013299.38210.74