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Abstract

This bibliometric study set out to evaluate and analyze highly cited papers in Library and Information Science field (LIS) in the Web of Science database from 1983 to 2018. In this bibliometric study, the required data were extracted from the Web of Science database. First, all documents under the rubric of LIS subject area, including 366,756 documents, were retrieved. The search was then limited to the highly cited papers. Of these papers, 433 ones were in the top-1% percentile rank. Finally, after the bibliometric data of the highly cited papers were extracted in plain text format, Excel and VOSviewer software were run to analyze the obtained data. The results showed that the Highly cited papers in LIS (433 ones) were published in the period 2009 to 2018. The highest number of highly cited papers belonged to 2014 (57 articles) and the subject area was Computer Science Information Systems (239 papers). Moreover, Thelwall, the University of Maryland, the United States, and Journal of the American Medical Informatics Association were the top authors, universities, countries, and journals for publishing LIS highly cited articles, respectively. The co-authorship map revealed that Thelwall, M, ranked first with eight co-authorships. In addition, Haustein, S with 6 co-authorships and Lariviere, V with 5 co-authorships were in second and third places, respectively. In addition, the co-authorship map of the countries publishing the Highly cited papers in LIS showed that the most papers were co-authored by the United States and China (link strength = 24). The results of most frequent keyword visualization indicated that in the last five years, concepts such as bibliometrics, altmetrics, social media, information systems, meta-analysis, electronic health record, social networking sites, and big data have been the most important keywords in Highly cited papers in LIS.

Keywords: highly cited papers, Library and Information Science, web of science database, bibliometrics, visualization

Introduction

Citations are the most basic means of communication for scientific research (Shum 1998). They are used to cite information resources, verify previous research, and substantiate claims. Citation plays an essential role in the evolution of knowledge (Hamrick et al. 2010). The modern and official use of citations dates back to the nineteenth century. In this regard, the first systematic attempt to track citations in scientific texts was made by Eugene Garfield, who published the Science Citation Index (Garfield 2006). Highly cited papers play a very important role in maintaining the credibility of scientific institutions (Zhu et al. 2004). Influential papers usually receive more citations (Miyairi and Chang 2012). Today, the interest in using highly cited papers as an important indicator in research evaluation has substantially increased (A. F. Van Raan 2000).

Most highly cited papers are written by a large number of scholars, reflecting international collaborations (Aksnes 2003; Ouchi et al. 2019). The number of citations received varies according to the characteristics of the disciplines. For instance, medical and health science papers often receive more citations (Brace 1992). In addition, hot topics receive more citations. However, the number of citations surges in the first years of publication and then gradually plummets. One possible reason is that information is becoming increasingly obsolete (Dorta-González and Santana-Jiménez 2018). In general, papers that receive more citations enjoy higher scientific quality (Wang et al. 2011). Highly cited papers are much more effective than typical ones (Aksnes 2003). In recent decades, studies on highly cited papers have become popular in most fields, and that countries, financial institutions, and universities strive to evaluate research performance and identify highly cited papers. In this respect, Bibliometrics is one of the most common methods of evaluating and analyzing highly cited papers (Wang et al. 2011). Bibliometric analysis is a technique to evaluate published articles that identifies the impact of articles in a scientific field (Bienert et al. 2015; Moed 2002). Bibliometrics is the use of statistical methods to analyze scientific texts (Tarazona et al. 2018). Bibliometrics is also a method that can be used to assess the status of a particular discipline and examine the structure and process of scientific communication. It is the most important tool for assessing the impact of researchers, institutions and countries as well (N. Zhang et al. 2018).

Web of Science, on the other hands, is the most common database for bibliometric studies (K. Lu et al. 2018). Most bibliometric studies are based on Web of Science citations (Aksnes 2003). Before the Scopus database was launched by Elsevier in 2004, Web of Science was the only database that provided bibliometric data for more than 40 years, and researchers were able to analyze the data on a large scale. Web of Science is still the most important database for bibliometric studies (Archambault et al. 2009). Analyzing the features of popular articles such as year of publication, number of citations received, authors, countries and regions, organizations, journals and other main features of the papers, a comprehensive view of these articles can be obtained which are the most important and effective papers in each field (C . Lu et al. 2019). Accordingly, the present bibliometric study was conducted aiming at evaluating and analyzing the characteristics of Highly cited papers in LIS on the Web of Science database in the period between 1983 and 2018.

Literature review

In their study entitled "Highly Cited Articles in Health Care Sciences and Services Field in Science Citation Index Expanded: A Bibliometric Analysis for 1958 - 2012", Hsu and Ho (2019) investigated magazines, authors, institutions, and countries publishing Health Care Sciences and Services articles that received at least 100 citations. The results revealed that 890 highly cited papers were published between 1977 and 2009. The most widely cited articles were published in the Medical Care and Journal of General Internal Medicine. The United States published 76 percent of the highly cited articles, and the Harvard University had the highest number of articles. Zhang et al (2018) analyzed 2140 highly cited papers in Economics and Business in a bibliometric study entitled "A bibliometric analysis of highly cited papers in the field of Economics and Business based on the Essential Science". The results showed that the United States, with 1517 citations, ranked first in scientific outputs in Economics and Business. There were also 46 top scientists (60.5%) and 37 of the most influential (74%) were from US universities, and that there was a significant positive correlation between authors' citations and the h-index. Ivanović and Ho (2016) in a bibliometric study entitled "Highly cited articles in the Information Science and Library Science category in the Social Science Citation Index: A bibliometric analysis", analyzed the Information and Library Science articles cited at least 100 times in the Social Science Citation Index received by the end of 2012. The results showed that 501 highly cited articles were published in 37 journals from 1956 to 2009. MIS Quarterly Journal had published 26% of the cited articles. Thirteen organizations from the United States and Canada had the most citations. Harvard University had published the most highly cited papers. The University of Maryland in the United States had the largest number of first authors of the highly cited papers. U.S. researchers contributed 67% of the most cited articles. Bauer, Leydesdorff and Bornmann (2016) in a bibliometric analysis entitled "Highly-cited papers in Library and Information Science (LIS): Authors, institutions, and network structures", analyzed top 1% of the Library and Information Science articles on Web of Science database. The study period ranged from 2002 to 2012. The results showed that 798 authors contributed to the publication of 305 articles of the top one percent. The authors worked at 275 institutes. Of the 798 authors, 23 were among the most highly cited authors. Harvard University in the United States had the most contributing authors. Hot topics in the top 1% include "collection and exploitation of information in clinical practices", "use of the Internet in public communication and commerce", and "scientometrics". In a study entitled "The most highly cited Library and Information Science articles: Interdisciplinarity, first authors and citation patterns", Jonathan and Thelwall (2007) extracted 82 top 1% articles cited in the field of Library and Information Science before 2007 from the Web of Science database. The results showed that the highest h-index of the first author was 15 and belonged to Spink A, but the second and third authors of had the h-index less than 8. The largest number of top 1 percent articles in the field of Computer Science Information Systems were 69 articles. S.R. Kolle, T.H. Shankarappa, and Y.-S.Ho (2016) investigated a total of 781 articles in horticultural studies entitled "Highly Cited Articles in Science Citation Index Expanded - Subject Category of Horticulture: A Bibliometric Analysis" with more than one hundred citations out of 33 journals in the Science Citation Index Expanded database between 1961 and 2014. Most of the highly cited publications belonged to The Journal of Theoretical and Applied Genetics and Viticulture and the American Journal of Enology. Most highly cited articles were published in the 1990s and 2000s. Researchers from the USA and the United Kingdom had

the most scientific contributions. Examination of the citations revealed that the highly cited articles received more citations in the second decade of their publication compared to the first decade of publication.

Methodology

In this study, Bibliometrics and Visualization techniques were used. The research population consisted of all highly cited articles in the field of Library and Information Science indexed in the Web of Science database from the onset of 1983 to the outset of 2018. In March 2020, the Web of Science database was used to collect data. Conducting a preliminary search in the Web of Science database and setting the time limited to 1983 and 2018, a total of 366,756 papers in the field of Library and Information Science were retrieved. Of these, 433 papers were highly cited papers. Sampling was not performed in this stage, and all highly cited papers in Library and Information Science, which were 433 papers, were included in the study using census sampling technique. In order to collect the required data, first, in the Advanced Search section of the Web of Science database, the search was limited to the research area of Information Science and Library Science, and the highly cited papers in the field of Library and Science Information between 1983 and the end of 2018 were retrieved. Then, in the results analysis section, the required data were collected with respect to the research objectives and by entering the data in Excel and VOSviewer software, the required scientific tables and maps were drawn. Figure 1 shows the flowchart for searching and extracting Highly cited papers in LIS

Advanced search in the Web of Science in the field of "Information Science & Library Science" and limiting the year of publication to 1983-2018

Retrieving 366756 articles in the subject area of "Information & Library Science"

Filtering the search results by highly cited papers

Retrieving 433 highly cited papers in the subject area of Information & Library Science

Collecting the data using Analysis Results and visualizing the scientific maps
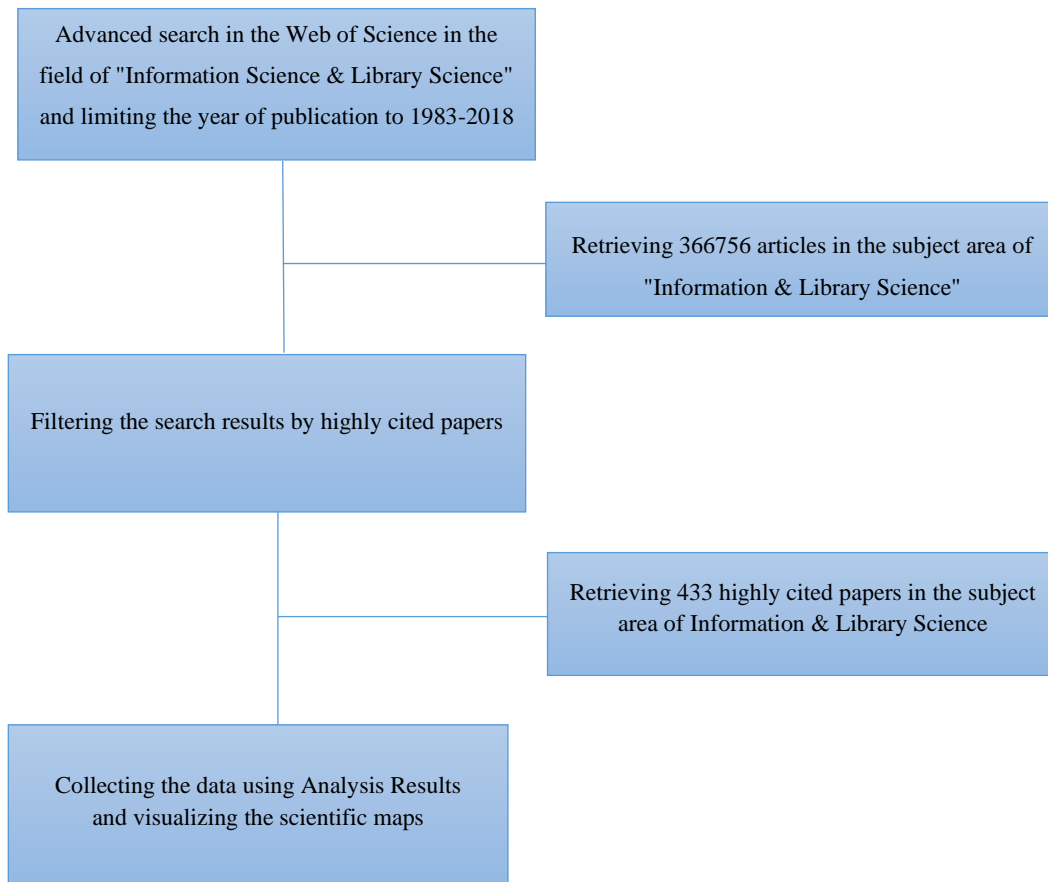
Fig1. Schematic for searching the highly cited articles

Results

Web of Science Subject Categories

Table 1 presents the frequency distribution of highly cited papers in LIS based on Web of Science Subject Categories. As can be seen in Table 1, the highest number of highly cited articles (239 articles) was in the subject area of Computer Science Information Systems, followed by Computer Science Interdisciplinary Applications (126), and Management (122) respectively. This result suggests that LIS citations to information systems and computer science as an interdisciplinary science. It is noteworthy that some of the articles were placed in several subject areas due to their interdisciplinary topics.

Table 1: Subject area of highly cited papers in Library and Information Science

Rank	WC	TP	Pct
1	Computer Science Information Systems	239	34.19
2	Computer Science Interdisciplinary Applications	126	18.03
3	Management	122	17.45
4	Health Care Sciences Services	63	9.01
5	Medical Informatics	63	9.01
6	Communication	31	4.43
7	Geography	24	3.43
8	Geography Physical	24	3.43
9	Social Sciences Interdisciplinary	10	1.43
10	Social Sciences Biomedical	6	0.86
11	Telecommunications	1	0.14

WC: Web of Science Subject Categories; **TP:** total number of included highly cited articles; **Pct:** percent

Publication Year

The frequency distribution of highly cited papers in LIS by year of publication is shown in Table 2, below. The results of Table 2 show that all highly cited articles in LIS (433 articles) were published between 2009 and 2018. The highest number of highly cited articles belongs to 2014 (57 articles), followed by 2016 (53), and 2017 (48) respectively.

Table 2: Year of publication of highly cited papers in library and information

Rank	PY	TP	Pct
1	2018	31	7.159
2	2017	48	11.085
3	2016	53	12.240
4	2015	48	11.085
5	2014	57	13.164
6	2013	40	9.238
7	2012	42	9.700
8	2011	38	8.776
9	2010	45	10.393
10	2009	31	7.159

PY: Year Published; **TP:** total number of included highly cited articles; **Pct:** percent

Authors of highly cited papers in Library and Information Science

Table 3 shows the specifications of authors with 5 or more highly cited articles. As can be seen in Table 3, Thelwall has the highest number of LIS citations in the Web of Science database with 16 highly cited papers from the University of Wolverhampton (England). Waltman of Leiden University (Netherlands) is the second highly cited author in LIS with 11 papers. Dwivedi of Swansea University (Wales) and Van Eck of Leiden University (Netherlands) jointly rank third with nine highly cited papers.

Table 3: Authors of highly cited papers in Library and Information Science

Rank	Authors	Organization	Country	TP	h-index	Sum of Times Cited	Average citations per item	Co-Authors Count
1	Thelwall M	University of Wolverhampton	England	16	51	10,186	31.63	20
2	Waltman L	Leiden University	Netherlands	11	34	4,874	62.49	13
3	Dwivedi YK	Swansea University	Wales	9	36	3,474	27.35	16
4	Van Eck NJ	Leiden University	Netherlands	9	29	3,809	68.02	12
5	Bornmann L	Max Planck Society	Germany	7	42	7,406	25.28	5
6	Denny JC	Vanderbilt University	United States	7	53	10,729	35.88	24
7	Sugimoto CR	Indiana University	United States	7	24	2,540	34.32	22
8	Xu H	Penn State University	United States	7	26	2,703	30.72	24
9	Haustein S	University of Ottawa	Canada	6	25	2,417	27.16	13
10	LariviereV	University of Montreal	Canada	6	34	4,292	37.65	11
11	Bates DW	University of East Anglia	England	5	113	53,819	59.01	24
12	Liu XP	Sun Yat Sen University	China	5	21	1,221	33	16
13	Rafols I	Universitat Politecnica de Valencia	Spain	5	26	3,447	70.35	10
14	Rana NP	Swansea University	Wales	5	19	1,270	25.4	7
15	Siponen M	University of Jyvaskyla	Finland	5	28	2,370	30	6
16	Venkatesh V	University of Arkansas System	United States	5	57	34,058	85.15	8
17	Zhang H	University of California Davis	United States	5	17	1,227	19.79	11
18	Boyack KW	SciTech Strategies Inc	United States	4	25	2,889	57.78	11

Institutions publishing the highly cited papers in Library and Information Science

Data in Table 4 shows that the University of Maryland has published the most numerous articles in Library and Information Science publishing with 18 articles. Wolverhampton University with 16 publications and Leiden University with 15 published articles are ranked second and third, respectively. As can be seen in Table 6, most of the publishers of highly cited papers in LIS belong to the U.S.

Table 4: Institutions publishing the highly cited papers in LIS

Rank	Organizations	Country	TP	Pct
1	Univ Maryland	USA	18	4.157
2	Wolverhampton Univ	England	16	3.695
3	Leiden Univ	Netherlands	15	3.464
4	Vanderbilt Univ	USA	13	3.002
5	Indiana Univ	USA	12	2.771
6	Univ Montreal	Canada	10	2.309
7	Harvad Univ	USA	9	2.079
8	Northwestern Univ	USA	9	2.079
9	Swansea Univ	Wales	9	2.079
10	Temple Univ	USA	9	2.079
11	Univ Washington	USA	9	2.079
12	Univ Wisconsin	USA	9	2.079
13	Wuhan Univ	China	9	2.079
14	Brigham Women Hosp	USA	8	1.848
15	Univ Arizona	USA	8	1.848
16	Univ Michigan	USA	8	1.848
17	City Univ Hong Kong	China	7	1.617
18	Columbia Univ	USA	7	1.617
19	Georgia Inst Technol	USA	7	1.617
20	Mayo Clin	USA	7	1.617
21	Mcgill Univ	Canada	7	1.617
22	Univ Amsterdam	Netherlands	7	1.617
23	Korea Adv Inst Sci Technol	South Korea	6	1.386
24	Penn State Univ	USA	6	1.386
25	Suny Buffalo	USA	6	1.386

TP: total number of included highly cited articles; **Pct:** percent

Countries publishing highly cited papers in LIS

The results of Table 5 show that the United States, with 237 articles, has published about 55% of the highly cited papers in LIS. China with 53 highly cited papers (12.24 percent) and England with 49 highly cited papers (11.31 percent) rank second and third, respectively.

Table 5: Countries publishing highly cited papers in LIS

Rank	Countries/Regions	TP	Pct
1	United States	237	54.734
2	China	53	12.240
3	England	49	11.316
4	Canada	38	8.776
5	Netherlands	35	8.083
6	Germany	26	6.005
7	South Korea	25	5.774
8	Spain	18	4.157
9	Taiwan	17	3.926
10	Australia	14	3.233
11	Finland	13	3.002
12	Switzerland	11	2.540
13	Wales	10	2.309
14	Singapore	9	2.079
15	Italy	8	1.848
16	India	7	1.617
17	Belgium	6	1.386
18	Denmark	5	1.155
19	France	5	1.155
20	Malaysia	5	1.155
21	Portugal	5	1.155
22	Sweden	5	1.155
23	Iran	4	0.924
24	Scotland	4	0.924
25	Austria	3	0.693

TP: total number of included highly cited articles; **Pct:** percent

Top journals publishing highly cited papers

As can be seen in Table 6, Journal of the American Medical Informatics Association has published the most widely cited papers in LIS with 74 articles. The MIS Quarterly and the International Journal of Information Management rank second and third publishing 62 and 37 articles, respectively. In addition, the results in Table 6 indicate that most journals publishing highly cited articles belong to the United States, England, and the Netherlands. Also, most articles in terms of Quartile are Q1.

Table 6: The journals publishing highly cited papers in LIS in the Web of Science database from 1983 to 2018

Rank	Journal Title	County	TP	Quartile	IF	H-Index	CiteScore
1	Journal of the American Medical Informatics Association	England	74	Q1	4.292	129	4.43
2	MIS Quarterly	United States	62	Q1	4.373	191	4.18
3	International Journal of Information Management	England	37	Q1	5.063	78	8.81
4	Scientometrics	Netherlands	30	Q1	2.867	106	5.6
5	International Journal of Geographical Information Science	England	27	Q1	3.545	87	3.87
6	Information Management	Netherlands	22	Q1	4.12	123	-
7	Journal of the Association for Information Science and Technology	United States	22	Q1	2.452	100	-
8	Journal of Informetrics	Netherlands	20	Q1	3.879	58	-
9	Journal of the Association for Information Science and Technology	United States	20	Q1	2.738	37	3.68
10	Telematics and Informatics	Netherlands	19	Q1	3.714	3.714	4.94
11	Information Systems Research	United States	18	Q2	2.457	129	6.33
12	Journal of Computer Mediated Communication	United States	18	Q1	4.896	67	7.41
13	Journal of Health Communication	United States	12	Q2	1.773	73	2.37
14	Government Information Quarterly	United States	9	Q1	4.311	72	7.10
15	Information Systems Journal	United States	6	Q1	3.286	65	6.17
16	Social Science Computer Review	United States	6	Q1	2.922	56	4.21
17	Journal of Knowledge Management	England	5	Q1	4.604	51	5.63
18	Qualitative Health Research	United States	5	Q1	3.03	94	3.48
19	Information Processing & Management	England	4	Q1	3.892	83	5.51

20	Journal of Management Information Systems	England	3	Q1	3.013	98	5.04
21	Learned Publishing	United States	3	Q2	2.2	28	1.89
22	Annual Review of Information Science and Technology	United States	2	Q1	1.727	52	-
23	European Journal of Information Systems	England	2	Q1	2.603	80	6.58
24	Journal of Enterprise Information Managemen	England	2	Q2	2.126	15	3.83
25	Journal of Information Science	England	2	Q2	2.327	57	2.97

TP: total number of included highly cited articles

Co-authorship map of highly cited papers in LIS

The co-authorship map of the highly cited papers in LIS is shown in Figure 2, below. A total of 1382 authors participated in the publication of 433 highly cited articles. To draw the map, we entered the top 50 authors. Of the 50 authors, 10 were co-authors and appeared on the map. Thelwall. M was in first place with 8 first co-authors. Haustein (S) with 6 co-authors and Lariviere (V) with 5 co-authors were in the second and third ranks, respectively.
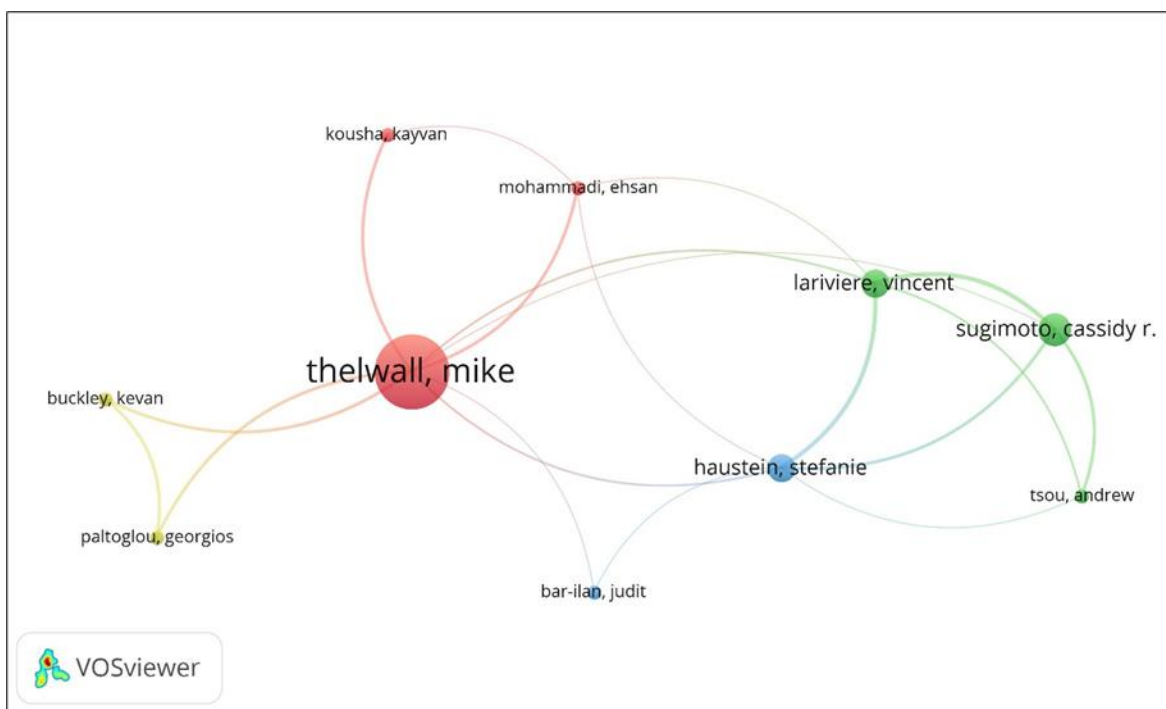

Figure 2: Co-authorship map of highly cited papers in LIS

Figure 3 shows the cluster density of co-authorship map of highly cited articles in LIS. As shown in Figure 3, this map consists of four clusters. The first cluster is marked in red. Authors such as Thelwall, M, Mohammadi, E, and Kousha. K are present in this cluster. The second green cluster consists of authors such as Lariviere, V, Sugimoto

Cassidy, R, and Tsou, A. Haustein, S and Bar-ilan, J are present in the third cluster, which is blue. The fourth yellow cluster includes Buckley, K and Paltoglou, G.
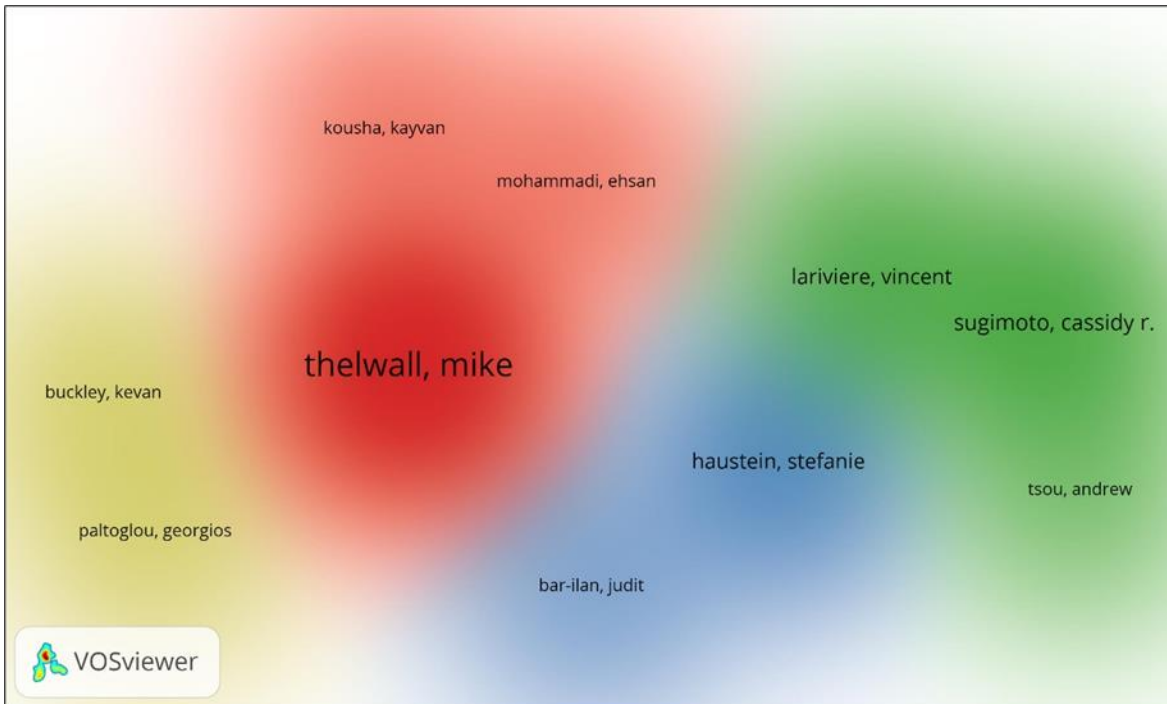

Figure 3: Cluster density of co-authorship map of highly cited papers in LIS

Co-authorship map of countries with highly cited papers in LIS

The scientific co-authorship map of countries of the highly cited papers in LIS lib is shown in Figure 4. A total of 52 countries participated in the publication of 433 highly cited articles. To map, we entered the top 20 countries. The size of the circles indicates the number of papers in the countries, whereas the thickness of the lines indicates the amount of co-authorship among the countries. The most co-authorship was between the United States and China (link strength = 24). The United States and the United Kingdom (Link strength = 16), the United States and Canada (link strength 16) were in second place. The third co-authorship was between the United States and North Korea (link strength = 11). In addition, the results show that the United States ranks first with 18 co-authorships. The UK is ranked second with 16 co-authorships, followed by China with 14 co-authorships.
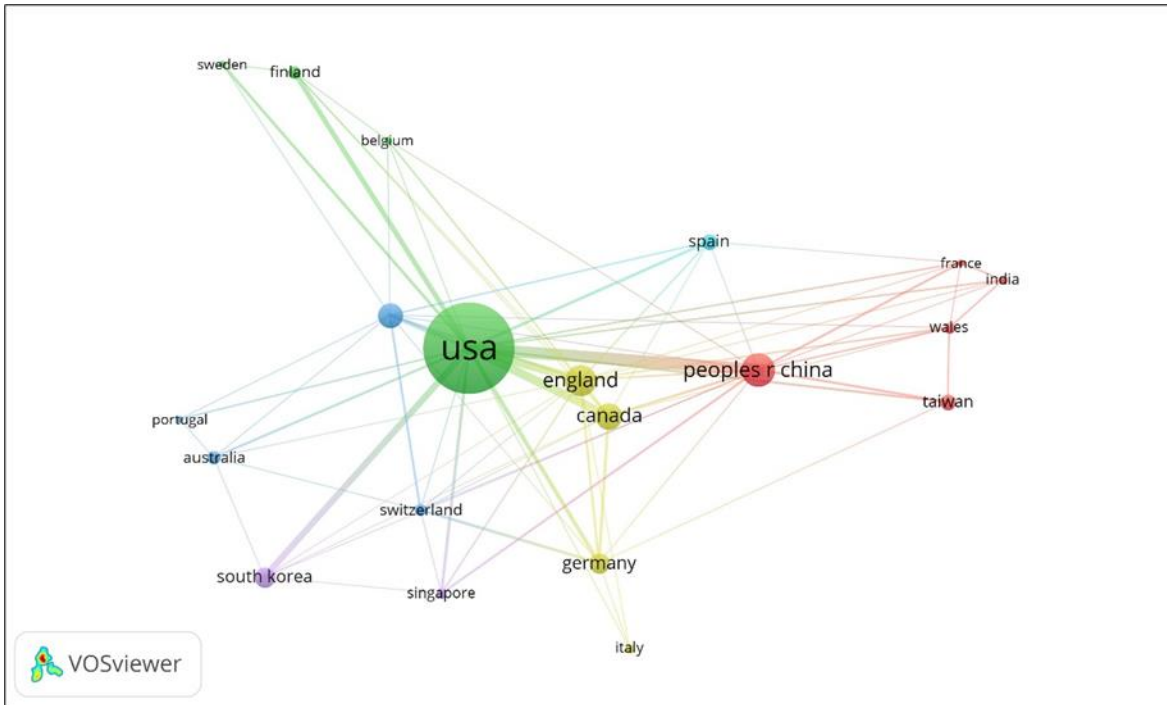
Figure 4: Co-authorship map of countries participating in highly cited papers in LIS

Figure 5 shows the cluster density of co-authorship map of countries participating in highly cited papers in LIS. This map consists of 6 clusters. In the first cluster with red color are countries such as China, Taiwan, Wales, India and France. The second green cluster consists of the United States, Finland, Belgium and Sweden. The third cluster, which is blue, encompasses the Netherlands, Australia, Switzerland and Portugal. The fourth cluster, which is yellow, includes countries such as England, Canada, Germany and Italy. The fifth purple cluster includes South Korea and Singapore. In the last cluster with the turquoise blue color is Spain.
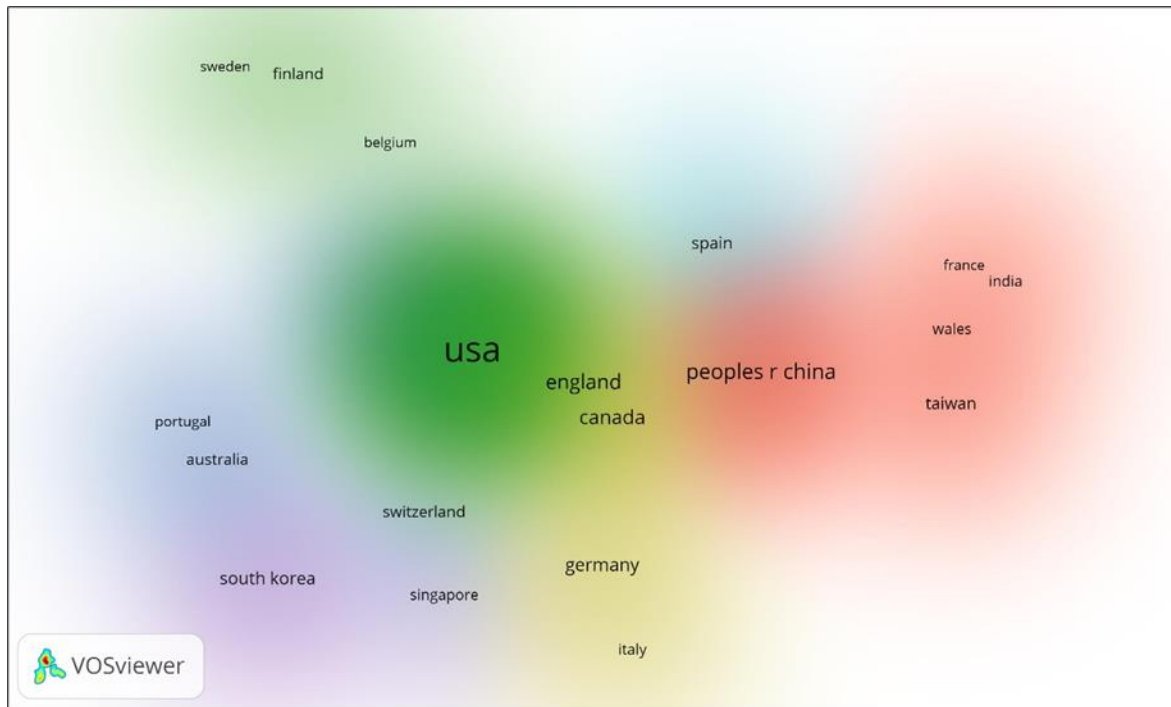
Figure 5: Cluster density of co-authorship map of countries participating in highly cited papers in LIS

Map of frequent keywords of highly cited papers in LIS

Authors' keywords are very important because they are the main concepts that the authors have used to communicate with the audience. A total of 1,449 unique keywords were found in 433 articles. Threshold 5 was considered for drawing the map and keywords that were repeated 5 times and more than 5 times were entered into the map. The most common keywords were assigned to 4 clusters in red, green, blue, and yellow in terms of co-occurrence. The following are the keywords of each cluster:

Red cluster: Bibliometrics, Altmetrics, Citation Analysis, Meta-Analysis, Literature Review, Research Evaluation,

Green cluster: Social media, Twitter, Social networks Sites, Social networks, Facebook

Blue cluster: E-Government, Mobile Banking, Technology Adoption

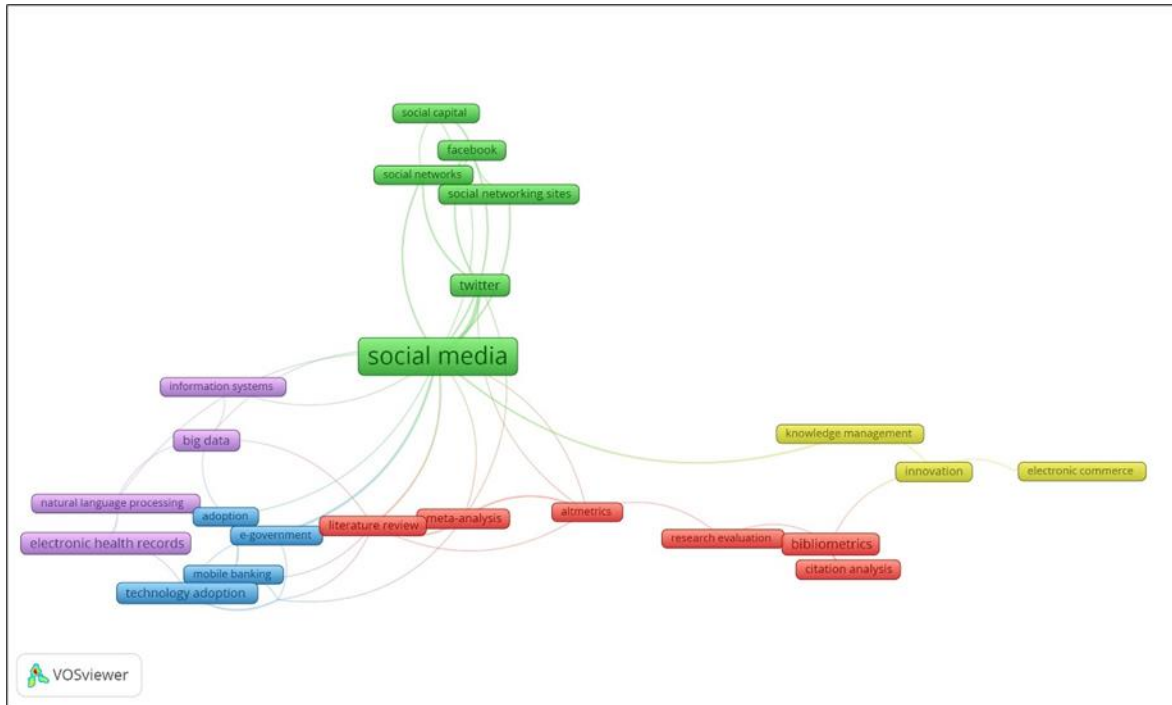*Yellow cluster*: Knowledge Management, Innovation, Electronic Commerce

Figure 6: Frequent keyword co-occurrence map of highly cited map in LIS

A time-based co-occurrence map was used to identify the evolution of the concepts of highly cited papers in LIS. The evolution trend is shown in Figure 7. The color guide for the highly cited papers at the bottom of the map is marked as a color bar. As shown in Figure 7, in the last five years, i.e. since 2015, concepts and subject areas such as bibliometrics, altmetrics, social media, information systems, meta-analysis, electronic health record, social networking sites, and big data have been the most important areas in highly cited papers in LIS.
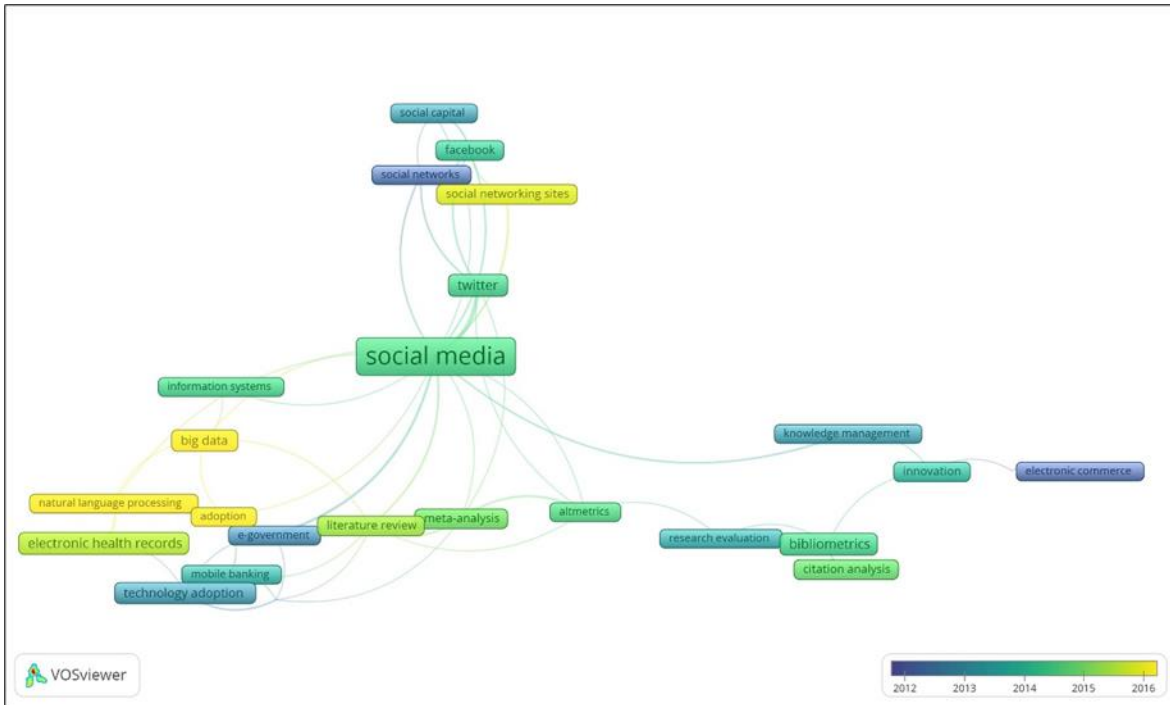
Figure 7: The time-based co-occurrence map of frequent keywords of highly cited papers in LIS

Figure 8 shows the density map of keywords of highly cited library and information articles. The yellow color and size of the keywords indicate the density and importance of the keywords. As can be seen in the map, *social media* is the hottest area in the highly cited papers in LIS.
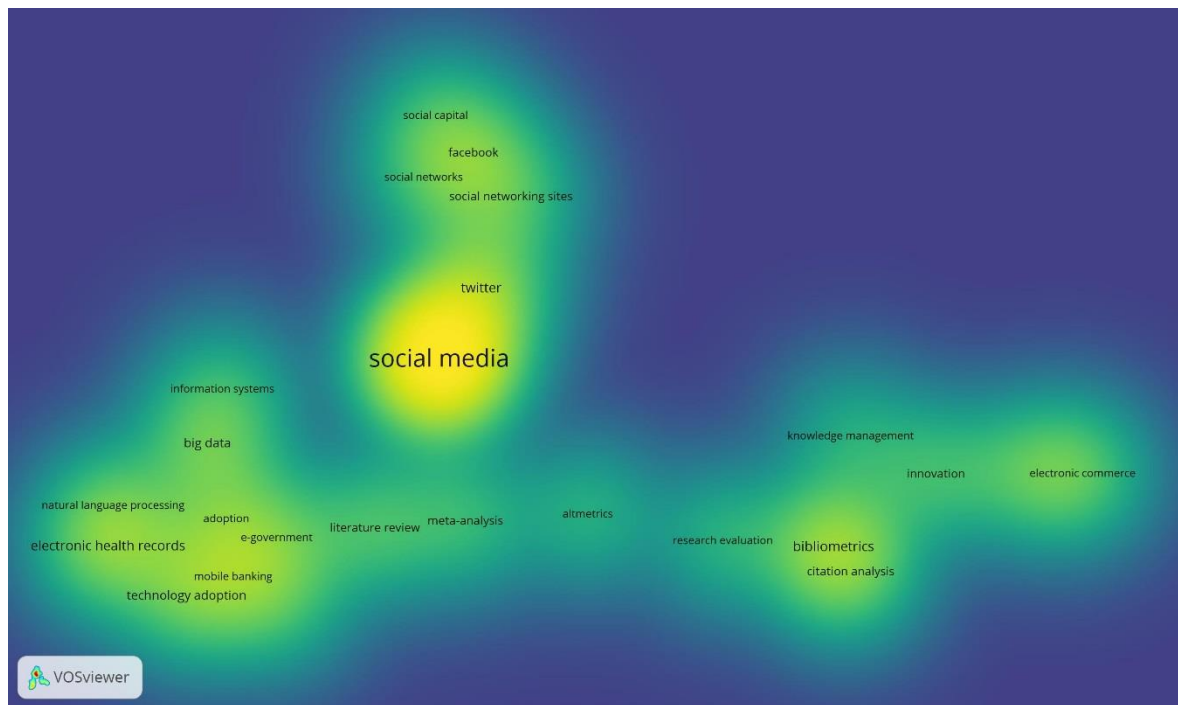

Figure 7: Density map of keywords of the highly cited papers in LIS

Map of important terms in the titles and abstracts of highly cited papers in LIS

Figure 9 shows a map of important and frequently used terms in the titles and abstracts of the highly cited papers in LIS.
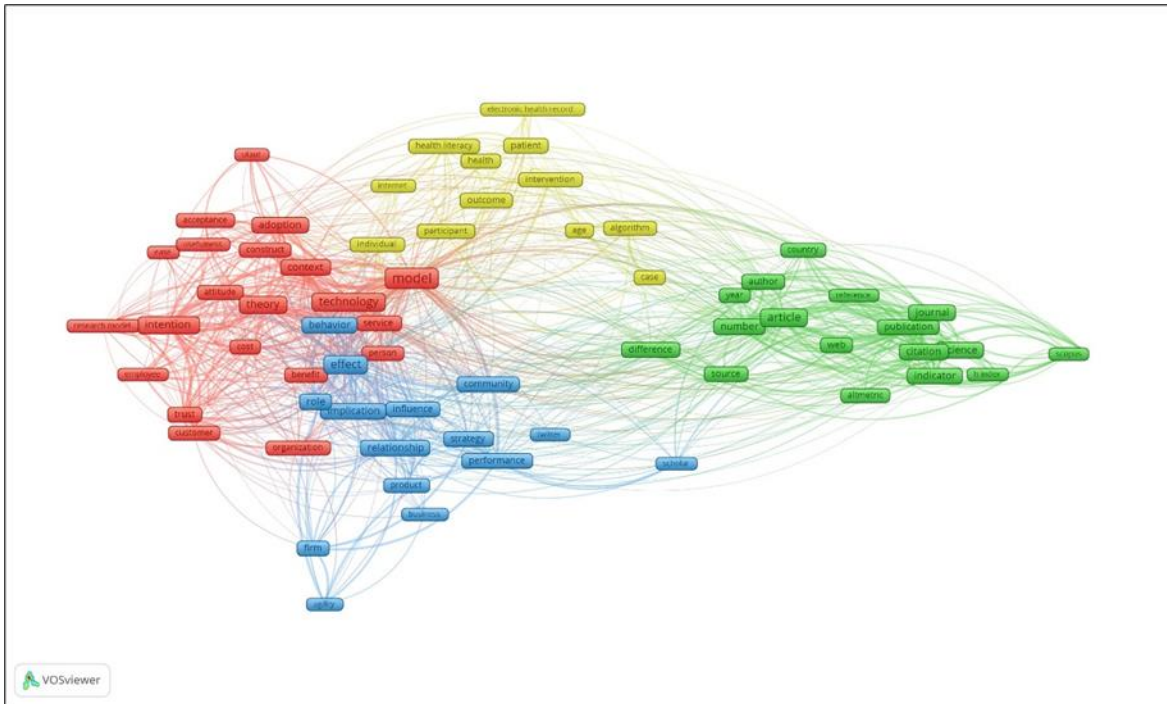

Figure 9: The co-occurrence map of the terms extracted from the titles and abstracts of highly cited papers in LIS

As can be seen in Figure 9, the map of the most frequent terms is made up of 4 clusters. The first cluster is marked in red. In this cluster there are terms such as technology, model, theory, adoption, and acceptance. Accordingly, this cluster can be called "technology acceptance studies". The second cluster in green consists of terms such as citation, h-index, indicator, journal, publication, scopus and altmetrics. The best title for this cluster is "Science Assessment Studies". The third cluster is blue and includes terms such as Business, product, performance and firm. "Managerial Studies" is a good title for this cluster. In the fourth cluster, which is yellow, there are terms such as electronic health record, health, health literacy, intervention and patient. Based on this, this cluster can be called "health information management studies". Figure 10 demonstrates the density map of clusters of important and frequently used terms in the titles and abstracts of highly cited papers in LIS.

Figure 10: Density map of the terms extracted from the titles and abstracts of highly cited papers in LIS

Discussion and Conclusion

Today, due to the availability of electronic formats for scientific journals, researchers can easily access the full text format of articles and cite articles related to their research topic (Gondivkar et al. 2019). The history of citation analysis by Eugene Garfield dates back to before 1955 (An et al. 2017). The quality of scientific publications in each country is determined by the number of highly cited papers (Noorhidawati et al. 2017). Citations play an essential role in the evolution of knowledge (Aksnes 2003). The review of the highly cited papers is attractive because of the potential link between the high number of citations and the quality of the papers (Levitt and Thelwall 2009). One way to evaluate highly cited papers is to conduct a bibliometric analysis. The term bibiliometrics was coined in 1969 by Alan Pritchard to mean the application of mathematics and statistical methods to assess books and other communication media (23). Bibliometrics is a method in Library and Information Science and is a quantitative scale for examining various aspects of a scientific field and determines the growth and dynamism of knowledge in that field (Udo-Anyanwu 2018). Bibliometrics is the statistical analysis of academic publications used by researchers to discover their impact in a particular scientific field (Mohammed et al. 2017). Citation rate is widely used as an indicator of the impact of papers and journals on science (Hutchins et al. 2016). Authors of highly cited papers tend to attract citations for a long time through international collaborations (Miyairi and Chang 2012). In the present study, a total of 1382 authors had participated in the publication of 433 highly cited papers, with an average of at least 3 or more authors per paper. This was consistent with the results of the study carried out by Barbosa et al. (2019). The results of the present study showed that highly cited papers have been published in the core journals of Library and Information Science and the top ten highly cited journals have published at least 20 articles or more of

the highly cited articles in Library and Information Science. The results was in line with that of the research conducted by Kolle et al. 2019.

In our study, 433 highly cited papers in LIS in the Web of Science database from 1983 to 2018 were reviewed using bibliometric method, which is a performance analysis and visualizing a scientific map to evaluate a scientific field (Noyons et al. 1999; A . Van Raan 2004). The results showed that the papers in the field of "Computer Science Information Systems" with 239 papers were the highly cited papers in LIS, which was completely consistent with the research by Thawwal and Levitt, 2009. Thelwall, with 16 papers, from the University of Wolverhampton published the most articles in the field of LIS in the Web of Science database. The United States had the most co-authorships in the highly cited papers in the Web of Science database. The result was in line with the findings of Zhai and Di, 2019). Most of the co-authorships were done between the United States and China, the United States and the United Kingdom, and the United States and Canada, respectively. This result was also in line with that by Ivanović and Ho 2016. The hottest articles in LIS were in the field of "social media" which was consistent with the results of the research performed by GALVEZ (2018). The most common terms were related to the emergence and application of technology. This was in line with the results of the study by Blessinger and Hrycaj 2010). The most frequently used keywords were categorized into four clusters based on co-occurrence: the first cluster was "scientometrics", the second cluster was "social networks", the third cluster was "e-government" and the fourth cluster was "knowledge management and e-commerce", which showed LIS is an interdisciplinary science, and is more related to the fields of information technology. This result was relatively consistent with the findings of a study by Bauer et al. (2016). Mike Thelwall of the University of Wolverhampton in the UK had the most cited papers in LIS and the most co-authored works. Furthermore, the University of Maryland in the United States, with 18 articles, had the highly cited papers in LIS in the Web of Science database. A total of 52 countries participated in the publication of 433 papers, of which the United States, with 237 articles, alone published 54.73 percent of the highly cited papers in LIS in the Web of Science database. It should be noted that this result is consistent with a bulk of recent bibliometric studies (Lu et al. 2018; C. Lu et al. 2019; Kolle et al. 2019; Zhai and Di 2019; X. Zhang et al. 2019; Dorta-González and Santana-Jiménez 2018; Bauer et al. 2016; Ivanović and Ho 2016; and Blessinger and Hrycaj 2010, to name a few). In addition, Journal of the American Medical Informatics Association, with an impact factor of 4,292 and an h-index of 129, had the highest number of highly cited papers (74 ones) in LIS in the Web of Science database. This result was to some extent consistent with the findings by Ivanović and Ho (2016). Most of the highly cited papers in LIS were published in journals with an impact factor of 2 to 4. This was also in line with the results of the study by colleagues Kolle et al. (2019). The authors hope that the results of this study, which analyzed the characteristics of highly cited papers in LIS, be useful for researchers in the field.

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