International Journal of Information Science and Management
Vol. 21, No. 4, 2023, 311-329
DOI: https://doi.org/10.22034/ijism.2023.1977944.0 / DOR: https://dorl.net/dor/20.1001.1.20088302.2023.21.4.15.1

Original Research

A Bibliometric Analysis in Web of Science Publications for Obtaining Global Research Trends and Hot Topics in Library and Information Science

Sirous Panahi
Associate Prof. in Librarianship and Medical Information Department, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.
panahi.s@iums.ac.ir
ORCID iD: https://orcid.org/000000017610906x

Somayeh Ghaffari
Ph. D. candidate of Medical Library and Information Science, School of Health Management and Information Science, Iran University of Medical Science, Tehran, Iran.
ghafari.s@iums.ac.ir
ORCID iD: https://orcid.org/0000000192478447

Mahshid Lotfi
Ph.D. candidate of Medical Library and Information Science, School of Health Management and Information Science, Iran University of Medical Science, Tehran, Iran.
Corresponding Author: lotfi.m@iums.ac.ir
ORCID iD: https://orcid.org/0001-7961-5283

Received: 06 September 2022
Accepted: 07 November 2022

Abstract

This research aimed to specify research trends in Library and Information Science (LIS) from 2011 to 2020 and hot papers in this field from July 2020 to July 2021 in the Web of Science (WoS) database. This research was of the type applied, scientometric, and descriptive. The study population was all articles in the field of LIS from 2011 to July 2021. The WoS database was used to collect data. To determine the research trend in the field of LIS, the results were limited to 2011-2020, and to determine the hot papers, this period was limited to July 2020 to July 2021. The data were analyzed using the word co-occurrence technique and social network analysis. UCINET, NetDraw, and VOSviewer software were used to draw scientific maps and identify central subjects and people. "Social media" with 259 and "qualitative" with 53 were the keywords with the highest and lowest frequencies, respectively. Library and emerging technologies (106), citation analysis, scientometrics and webometrics (58), electronic information, information security, and protection (56) were three significant topic clusters in the studied area. The results indicated that the research topics in LIS have changed and evolved in the last ten years despite new and up-to-date topics.

Keywords: Bibliometric Analysis, Web of Science, Library and Information Science, Global Research Trends, Hot Topics.

Introduction

We have transitioned from a conventional two-dimensional world (physical world-society) to a three-dimensional one due to entering the information era (physical world-society-information). The information space enables us to examine society brand-newly and evaluate, mimic, and alter the physical environment. Information has emerged as the fundamental driver of progress in the modern world (Wang, Wang & Huang, 2021). Library and information

science (LIS), which concentrate on the interactions between information, people, and technology, are among the sciences that have been significantly impacted by these changes and the science and technology revolution, and according to several studies, it has found a new direction recently (Araujo & Oliveira, 2017; Järvelin & Vakkari, 2022; Song, Wei, Yang, Shu, & Qiu 2020; Chohdary, Asghar & Alshaheer, 2021).

With the emergence of a journal titled Scientometrics in 1978, the field of scientometrics as one that works with the analysis and graphical depiction of scientific information was formally established (Selvavinayagam, Muthu & Boopalan, 2018). scientometrics encompasses all quantitative components of science, science management, science policy, science communication, etc., progressively making research areas and study issues easier to grasp (Selvavinayagam et al., 2018; Papić & Buhin, 2019). Scientometric studies may be used to design scientific policies in boosting productivity and fostering involvement in the creation of a topic, as well as in the activity of a research group in a field of knowledge to map the expansion of knowledge (Araujo & Oliveira, 2017). This discipline uses data about the network of citations among scientific publications (Papić & Buhin, 2019). Citations let authors locate and recover mentioned works, support and demonstrate their points, authenticate other writers' thoughts, confirm the readers' intellectual background, and justify the authors' moral behavior (Hu & Wu, 2018). Further investigation of referenced publications in a field of study might also turn up hot topics, research trends, top journals, and innovative methodologies (Elia & Sife, 2018; Webster &Watson, 2002).

In general, some reasons have contributed to the enormous expansion of research in the field of LIS during the past forty years in terms of volume, globalization, level of skill, application fields, and interdisciplinary connections. Among these aspects, there are developments in the fundamental technologies of information distribution as well as in allied areas of study such as digital libraries, data mining, machine learning, web science, etc. (Järvelin & Vakkari, 2022), which has created significant difficulties for many fundamental library activities, including gathering, arranging, storing, processing, and utilizing unstructured materials (Song et al. 2020; Chohdary et al. 2021; Bowker, 2018). As a result, researchers focus increasingly on interdisciplinary studies, information behavior and information retrieval analysis, nation rankings analysis, and general content analysis of LIS (Li, Yang & Wang, 2019). This area has expanded and deepened since its inception. The rapid expansion of databases that provide scientific products, such as WOS, ERIC, LISTA, and LISA, further supports this assertion (Figuerola, García Marco & Pinto, 2017). Therefore, the authors want to detail the changes LIS will undergo in the coming century due to technical and social developments.

On the other hand, hot papers, which are defined as publications that acquire more citations than other works on the same topic and publication time (Noruzi, 2017), are ideal possibilities for identifying new trends in a research area that is thought to be specialized (Papić & Buhin, 2019). Researchers have used various methods to review publications in the field of LIS. The research priorities for this topic will be determined by examining the trends and popular publications in LIS, which will significantly advance this discipline (Miyata, Ishita, Yang, Yamamoto, Iwase & Kurata, 2020). Therefore, the present study seeks to analyze the topic, expansion trend, and research process of LIS studies in the previous ten years, from 2011 to 2021, by utilizing the data gathered from the WOS database and applying the proper scientific tools. The ultimate objective is to define LIS's major research areas and limitations in the recent

century.

Scientometrics, officially introduced in 1978 with the publication of a journal named "Scientometrics," is a discipline that analyzes and graphically displays science and technology information (Selvavinayagam et al., 2018). Scientometrics includes all quantitative aspects of science, scientific communication, scientific management, scientific policy, etc., and increasingly plays a role in facilitating the understanding of research fields and research topics within them (Selvavinayagam et al., 2018; Papić & Buhin, 2019). Scientometric studies can be used to develop scientific policies, both in creating participation in the production and increasing the productivity of a subject and in the work of a research group in a field of knowledge, to outline the growth of knowledge (Araujo & Oliveira, 2017). This field provides essential information regarding publications by creating a citation network between scientific publications (Papić & Buhin, 2019). Citations identify and retrieve cited publications, support and prove authors' arguments, validate the ideas of other authors, confirm readers' intellectual background, and confirm authors' ethical behavior (Hu & Wu, 2018). Furthermore, more analysis of papers cited in a research field can indicate current topics of interest, research trends, top journals, and new techniques (Elia & Sife, 2018; Webster & Watson, 2002).

On the other hand, the information age identifies the information factor as an essential part of today's world. The information space allows us to analyze, simulate, and transform the physical world and explore a society in new ways. Information has become a fundamental factor in development (Wang, Wang & Huang, 2021). Different studies revealed that Library and Information Science (LIS), which focuses on the interaction between information, people, and technology, is one of the sciences firmly influenced by these changes and the science and technology revolution (Araujo & Oliveira, 2017; Järvelin & Vakkari, 2022; Song et al. 2020; Chohdary et al., 2021).

Some authors even believe in the inseparable relationship between information science and technology (Araujo & Oliveira, 2017; Elia & Sife, 2018; Järvelin & Vakkari, 2022). According to Saracevic (2022), information science is a field that uses scientific research and professional performance to deal with the problems of effective communication of knowledge as well as knowledge records between people in different areas and to meet the need for information, in this regard, benefits modern information technology as much as possible (Araujo & Oliveira, 2017).

In general, immense growth in LIS research during the last four decades in terms of volume, international, degree of expertise, areas of application, and interdisciplinary relationships (Li et al., 2019; Figuerola et al., 2017) is due to several reasons. Advances in fundamental technologies of information dissemination as well as in research areas related to this field, such as digital libraries, data mining, machine learning, web sciences, etc., are among these factors (Järvelin & Vakkari, 2022). This issue has created fundamental challenges, such as collecting, organizing, storing, processing, and using unstructured data in many basic libraries (Song et al., 2020; Chohdary et al., 2021; Bowker, 2018). Accordingly, researchers are progressively focusing on LIS's general topic content analysis, interdisciplinary studies, information behavior analysis, information retrieval, etc (Li et al., 2019). In general, the field of LIS is now broader and deeper than it was in the beginning, and the high growth of databases that provide scientific products in this field, including WOS, ERIC, LISTA, and LISA, is also a reason for this claim (Figuerola et al., 2017). Therefore, it seems logical for the authors to study the evolution and development of LIS in recent decades to map its changes in the new century in line with

technological and social changes.

On the other hand, hot papers as papers that receive more than usual citations in a short time compared to other works of the same topic and similar studies in terms of the time of publication (Noruzi, 2017) are good options for discovering emerging trends in a particular field of study (Papić & Buhin, 2019). The WoS citation database defines hot papers as papers published in the last two years that have received many citations in the previous two months, ranking them in the top 0.1% of papers in their field of study (Clarivate, 2022).

Therefore, according to the provided explanations, the present study aims to evaluate LIS studies' subject, evolution, and research trend in the last ten years, from 2011 to 2021, using data obtained from the WoS citation database and employing appropriate scientometric tools. The final objective is identifying the main research areas and LIS boundaries in the last ten years. Moreover, hot papers published from July 2020 to July 2021 will be analyzed to determine the latest study opportunities in the LIS and emerging areas and orientations to inform researchers and policymakers about future research in this field.

Literature Review

Since Kessler's research in the early 1960s, which used the method of bibliographic pairs to analyze the discipline, topic analysis studies of various fields have been conducted. Over time, different techniques have been introduced for this purpose, and the method of analyzing the subject of the discipline has gradually become richer (Li et al., 2019). According to the justifications given, the present study's objectives are to investigate LIS's topic, expansion trend, and research process over the last ten years, from 2011 to 2021, using the data taken from the WOS database and the appropriate scientific tools.

Järvelin and Vakkari (2022) conducted research by analyzing the intellectual content of articles published in 30 scientific journals in the field of LIS, and a part of this research investigated the topical content of articles published in these journals in 50 years from 1965 to 2015. According to the findings, there was a strong emphasis in the field of LIS services in the past, which has diminished significantly over time. However, scientific and professional communication has become the most prevalent topic. In addition, data storage and retrieval issues have lost their powerful position at the end of the studied years. Furthermore, this study provides significant results on the methodology studies and their changes over time (Järvelin & Vakkari, 2022).

In a study conducted by Wang et al. (2021) on research topics in the two disciplines of LIS and computer science to determine the differences and similarities between the research topics of the two disciplines, it was determined that while computer science pays more attention to information technology studies, LIS tends to communicate, organize, access and use information. This study was conducted over five years, from 2014 to 2019, and provided fascinating results on the scope and depth of research topics in the two disciplines. For example, it states that the research concepts of computer science are more centralized, while those of LIS are more extensively used. Moreover, it states that research centers in this field have moved relatively faster, while the continuation rate of research development in computer science is higher. One of the other notable findings in this study is predicting the use of several more advanced computer science technologies in future research on LIS (Wang et al., 2021).

Furthermore, Taskin (2021) aimed to draw a picture of the future of LIS and its sub-disciplines by analyzing the patterns of publications and citations and identified four sub-

disciplines for this field: 1) library and library law, 2) health information in the LIS, 3) scientometrics and information retrieval, and 4) management and information systems. The study of sub-branches in this study indicates that they are entirely different in terms of publication and citation pattern and the level of dynamics. Furthermore, the author concludes that the number of publications, references, and citations will increase significantly, and the amount of collaboration between authors will increase. Future topics predicted in this study for LIS include various areas, from fake news to predatory journals, open government, e-learning, and e-health records (Taşkın, 2021).

The main research areas and boundaries of LIS, two sub-fields of LIS, were explored by Song et al. (2020). In this study, the main areas of LIS science have been compared, and the latest advancements in this field have been addressed. The results indicated three orientations in the development of LIS: 1) Changing from traditional libraries to digital libraries, 2) changing from library services to user behavior, and 3) evolution from library use into databases (Song et al., 2020). In 2019, Li et al. discovered that LIS research from 1989 to 2018 has extended from information to exploration and application of information value, and people and network information resources have become increasingly significant in this process. In this research, it has been determined that in the studied period, research was carried out in the field of LIS, mainly in information retrieval, social media, information systems, information behavior, bibliometrics and webometrics, scientific evaluation, and knowledge management. In addition, researchers predicted that future research in this field would focus on six subject areas: 1) postmodern research, 2) open government, 3) scientific evaluation, 4) big data, 5) social media, and 6) information systems, and all of these areas will be seriously affected by social media (Li et al., 2019).

Papić and Buhin, in a study in 2019 on 21 LIS journals from 2015 to 2018 in the first quarter of the WoS database, analyzed quantitatively and qualitatively highly cited documents and categorized them into ten groups based on hot topics. These ten categories comprise scientific communications, social media, information security and privacy, IoT, big data analytics, e-health/mobile, e-government, knowledge management, information retrieval, and information behavior (Papić & Buhin, 2019). Moreover, Elia and Sife (2018) analyzed ten papers with the most citations extracted 2018 from Google Scholar Metrics and found nine were citation analyses. The results indicated that LIS research has turned towards examining scientific publications and their influence through citation analysis, bibliometrics, and scientometrics (Elia & Sife, 2018). Araujo & Oliveira (2017) studied technology in the LIS and revealed that information, systems, and technology are the most common phrases in this area.

Furthermore, they introduced seven topic groups as the main topics in this area. Information systems were ranked as the most fundamental topic group, followed by the digital and virtual libraries. Internet and networking, computer training in the library, automated indexing, knowledge management, and electronic publishing are other specified topic groups (Araujo & Oliveira, 2017). The difference between the present investigation and previous studies can be explained in several aspects. First, in terms of time, ten years was considered, which seems proper to study new evolutions in LIS given recent changes in the world of new technology and innovations. Second, using the WoS as a criterion source for data mining has the advantage of providing the standards needed to conduct a perfect scientometric study in terms of the scope of the study, interdisciplinary research requirements, and review of citations and hot papers. Third, given recent evolutions in the health area and the emergence of the COVID-19 virus, the

present study is expected to cover possible developments related to field research, especially in the hot paper area affected by this main change in terms of time.

Objectives

The objectives of the present investigation were as follows:

1) Determining the most frequent keywords used in scientific productions related to LIS in the world during 2011-2021 in the WOS database.

2) Determining the active countries in LIS research in the world during 2011-2021 in the WOS database.

3) Determining active authors in LIS research during 2011-2021 in the WOS database.

4) Determining active institutes in LIS research worldwide during 2011-2022 in the WOS database.

5. Determining the hot topics of LIS papers from July 2020 to July 2021 in the WOS database.

Materials and Methods

The present research is an applied and descriptive study with a scientometric approach that describes the LIS area using scientometric software and the word co-occurrence technique. The research population was all papers in the field of LIS in the WoS database during 2011-2020. Therefore, sampling was not performed, and the census method included all articles in the study. The required research data were collected by visiting the WOS website on August 1, 2020 (*www.webofscience.com*). The specifications of all scientific products in the field of LIS were extracted using Advanced Search and the Core Collection section in the database. This information contained the paper's title, the journal's name, the impact factor, the number of citations received, the corresponding author, the partner country, the institutional affiliation of the corresponding author, and the number of keywords.

The final search strategy was as follows:

WOS: WC = (Information Science & Library Science)

16,636 records were obtained from the WOS database to determine the topic trend. First, the database data, stored in text format, was entered into textbook software, and the AU, AD, DP, and KW tags were each held separately for extraction processing. The keywords were examined and refined using Rover Prime software. Moreover, Ravar PreMap software has been designed to prepare data and create word co-occurrence matrices.

The papers in the field of LIS in the WOS core collection were searched and analyzed to specify the hot topics. Usage Count in the WOS database indicates the amount of application of the article by users in the last 180 days and demonstrates the number of clicks of users to access the paper. In this study, paper usage was determined and recorded for each paper. As a result, the use of each paper was assigned to the keywords determined by the author. On the other hand, highly cited articles published in the field of LIS from July 2020 to July 2021 were also selected in the WOS database. The number of citations to each article is the number of citations to the keywords of each article. As a result, the number of citations to articles in the WOS database was given to keywords. Moreover, the keywords were sorted based on the number of citations and usage count. The citation and usage rates for each keyword were summed, and the keywords were sorted based on the highest rates of citation and usage.

The search strategy for hot papers was as follows:

TITLE-ABS-KEY ("library and information science") AND (LIMIT TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR 2020) OR LIMIT-TO (PUBYEAR 2019) OR LIMIT-TO (PUBYEAR 2018))

Steps of Keyword Homogenization and Normalization

At this stage, 21,821 keywords were obtained out of 16,636 retrieved records from the WOS database. Since each article presented the keywords in different writing, spelling, abbreviations, and complete phrases, it was necessary to use Raver PreMap to normalize the keywords and the other items. In the following steps, the keywords were homogenized and normalized. In the second step, the country, organization, and place names were removed from the keywords. Then, the keywords with synonymous expressions were normalized, and the frequently used keywords were selected from various synonyms. Moreover, abbreviations were converted to complete phrases. Meaningless words were removed, and plural words were converted to singular or vice versa if they had high frequencies. After normalization, 12,384 keywords were obtained from the WOS database. The keywords with the most repetitions were selected for homogenizing from those with different versions.

This study analyzed the data using Excel, Bibexcel, and Ravar PreMap software, accessible on the web for free. In addition, a designed data collection form was used to collect data. Article specifications, including article title, journal name, journal impact factor, the number of citations received, corresponding author, partner country, the corresponding author's institutional affiliation, and the number of keywords, were collected using a data collection form designed by the researchers. Data were analyzed using word co-occurrence and social network analysis techniques, and Usenet, NETDRAW, and VOSviewer software were used to draw scientific maps and identify central topics and individuals.

Results

The data obtained from the research community were analyzed, and the findings related to each objective were reported.

The research objectives include:

1) Specifying the most frequent keywords used in scientific productions in the field of LIS to determine the topic trend of papers in this field worldwide during 2011-2020 on the WOS website

In total, 21,821 keywords were obtained out of 16,636 records retrieved from the WOS database to respond to this question, and after normalization, 17,123 keywords remained. The keywords were analyzed using VOSviewer software, and the frequency of 398 keywords was determined. A total of 30 keywords with the highest frequency were categorized in Table 1. As shown in this table, the keywords "social media," "academic librarian," and "social network" with frequencies of 259, 220, and 193, respectively, were identified as the most frequent keywords. The keyword "qualitative," with a frequency of 53, was identified as the lowest frequent keyword.

Table 1
Identification of the 30 Most Frequent Keywords in the LIS Research in Iran and the World During the Years 2011-2020 on the WOS Website

No.	Words	Frequency
1	Social Media	259
2	Academic Librarian	220
3	Social Network	193
4	Information Literacy	158
5	Bibliometrics	145
6	Knowledge Management	124
7	Electronic Health Record	100
8	Collaboration	93
9	Innovation	90
10	Twitter	80
11	Libraries	76
12	Privacy	71
13	Citation Analysis	69
14	Evaluation	69
15	Classification	68
16	Knowledge Sharing	66
17	Information Retrieval	65
18	Public Libraries	64
19	Cloud Computing	63
20	Education	60
21	E-Government	59
22	Scientometrics	59
23	Health Care	58
24	Internet	57
25	Literature Review	56
26	Research	56
27	Facebook	55
28	Machine Learning	55
29	Information Science	54
30	Qualitative	53

Topic Clusters in the field of LIS Worldwide During 2011-2020 on the WOS Website

Topic clusters of scientific outputs in LIS were depicted using the word co-occurrence method through Raver PreMap software. Since this software cannot be used to analyze 17,123 keywords and it is the only software available in Iran to depict topic clusters to draw a topic map, keywords with a frequency of 10 or higher (i.e., 97 keywords) were selected and entered into the software. In addition, topic clusters were formed into eight general categories. Figure 1 shows different clusters with different colors. These clusters are 1) library and emerging technologies (106 members), 2) citation analysis, scientometrics, and webometrics (58 members), 3) electronic information, security, and information protection (56 members), 4) social media (49 members), 5) metadata and data mining (48 members), 6) data management, information, and knowledge (41 members), 7) research method (7 members), and 8)

information retrieval (8 members).

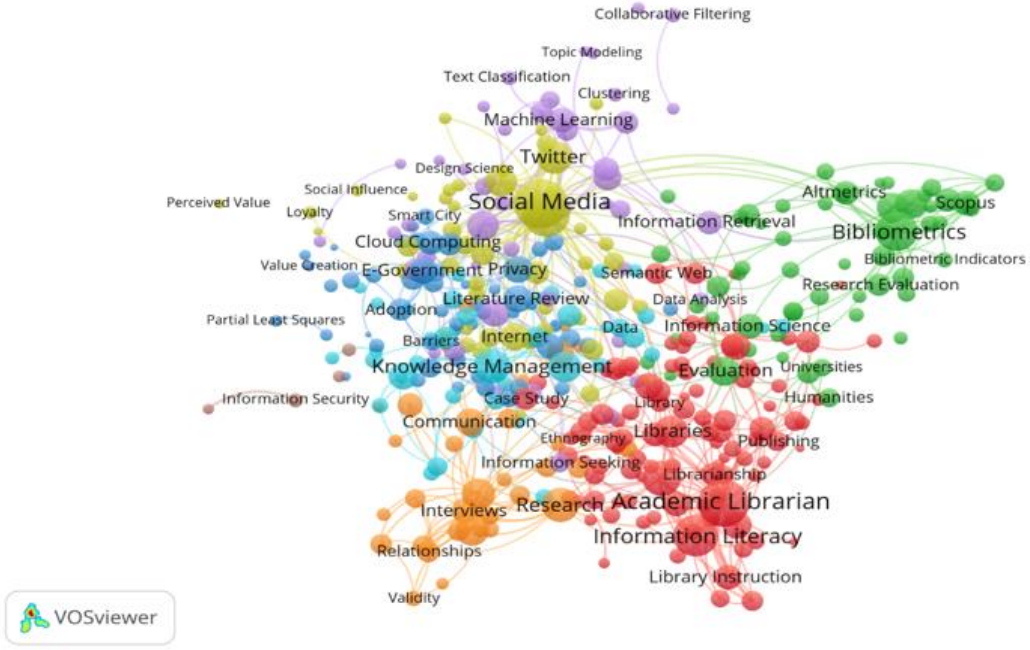

Figure 1: Topic Clusters of the Most Frequent Keywords in the LIS Research in Iran and the World During 2011-2020 on the WOS Website

As indicated in Figure 1, the largest topic cluster libraries and emerging technologies with 106 members represent topics that have received the most attention in this area. The members of the topic cluster "libraries and emerging technologies" were categorized in Table 2. The keywords university library, information literacy, and collaboration were the most frequent.

Table 2
Thirty Most Frequent Keywords of the Largest Topic Cluster of Lis Research in Iran and the World on the Wos Database During 2011-2020

No.	Words	Frequency
1	Academic Librarian	2
2	Information Literacy	4
3	Collaboration	8
4	Libraries	11
5	Public Libraries	18
6	Education	20
7	Digital Humanities	33
8	Metadata	34
9	Assessment	35
10	Higher Education	37
11	Case Study	38
12	Sustainability	43
13	Library	50
14	Ethics	55
15	Scholarly Communication	59
16	Technology	60

No.	Words	Frequency
17	Digital Libraries	63
18	Archives	67
19	Library Instruction	71
20	Semantic Web	72
21	Library	77
22	Leadership	82
23	Linked Data	83
24	Publishing	85
25	Library Services	89
26	Cataloging	91
27	Collection Development	93
28	Public Library	95
29	Copyright	97
30	Training	104

Active Countries in the field of LIS Research in Iran and the World During 2011-2020 on the WOS Website

According to the results, 129 countries were active in the field of LIS from 2011 to 2020. Among these, 30 countries had products with frequencies higher than 100. The United States, China, and the United Kingdom were the most active, and Papua New Guinea was the least active. Table 3 indicates the top ten active countries in this field.

Table 3
Active Countries in the Field of LIS in Iran and the World During 2011-2020 on the WOS Website

No.	Item	Count	Contribution (%)
1	USA	6802	40.89%
2	Peoples R China	1144	6.88%
3	UK	922	5.54%
4	Canada	632	3.80%
5	Australia	523	3.14%
6	Spain	505	3.04%
7	Germany	456	2.74%
8	India	414	2.49%
9	Italy	384	2.31%
10	Brazil	361	2.17%

As demonstrated in Figure 2 and Table 4, the United States is at the center of this network. In addition to the United States, the United Kingdom, Australia, and Spain are also active and influential countries in this area. Furthermore, Papua New Guinea has the minimum collaboration in the field of LIS.

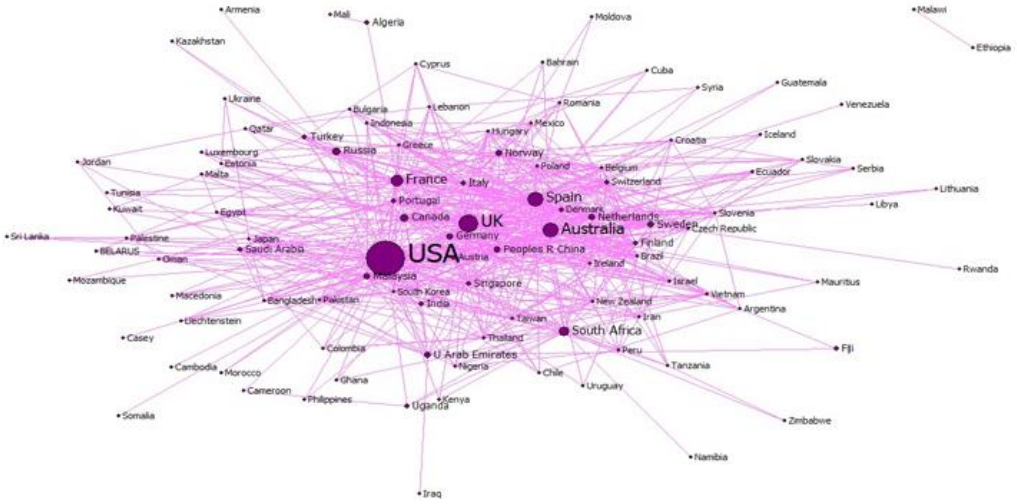

Figure 2: Co-authorship Network of Countries in the WOS Database in Iran and the World from 2011 to 2020

Table 4
Ranks Of Significant Countries in the Co-Authorship Network Based on the Centrality Index in Iran and the World From 2011 To 2020 in the WOS Database

No.	Item	Degree of Centrality	Closeness	Betweenness
1	USA	68.519	75	27.122
2	UK	55.556	67.925	12.244
3	Australia	42.593	62.791	9.569
4	Spain	47.222	63.905	8.89
5	France	37.963	60	6.758
6	Canada	37.037	60.335	4.18
7	Sweden	25.926	55.67	3.368
8	Peoples R China	36.111	59.669	2.957
9	Netherlands	34.259	58.696	2.866
10	Germany	37.037	59.341	2.338

Active Institutes in the LIS Research in Iran and the World During 2011-2020 in the WOS Website

All the institutional affiliations of the authors were examined to answer this question. According to findings, 7105 universities and research departments have contributed to the paper products in this field (Table 5). Among them, the University of Illinois, with 0.75%, and the University of Carolina, with 0.58%, had the most significant shares in the publication of research pieces.

Table 5
Ten active institutes in the LIS research in Iran and the world from 2011 to 2020 on the WOS website

No.	Item	Count	Contribution (%)
1	University Illinois	125	0.75%
2	University N Carolina	97	0.58%
3	Harvard University	88	0.53%
4	Champaign Publ Lib	85	0.51%
5	Wuhan University	84	0.50%
6	University Michigan Lib	82	0.49%
7	University Michigan	80	0.48%
8	Indiana University	80	0.48%
9	University Wisconsin	78	0.47%
10	Chinese Acad Sci	73	0.44%

To map the collaboration network between institutions and universities, due to the high volume of data, institutions with some papers higher than 15 (i.e., 263 cases) were identified as the most productive institutions and entered into the map (Figure 2).

As indicated in Figure 3, the University of Illinois is at the center of this network. It has shaped the connections and scientific flow of the field between various institutions and universities. Indiana University and Chinese Acad Sci are also active and influential universities that, in collaboration with the University of Illinois, have been able to form and lead the main body of the collaboration network between institutions and universities around the world.

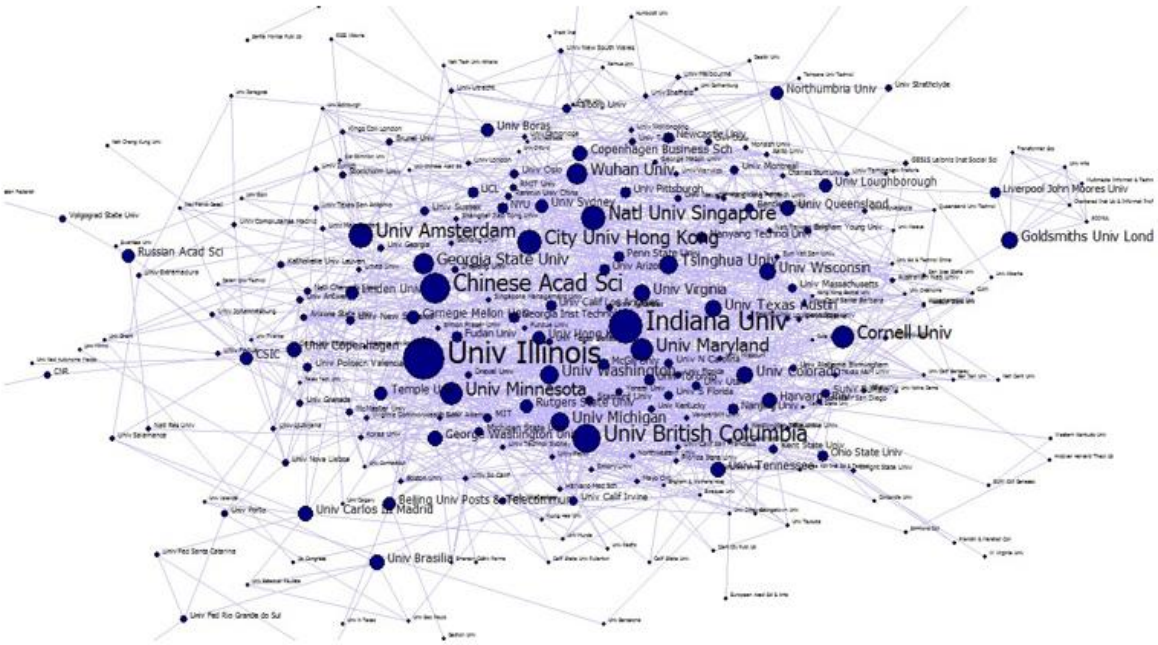

Figure 3: Collaboration (Co-Authorship) Network of Institutions From 2011 To 2020 on the WOS Website

The central and significant institutions in shaping the collaboration network in the field of LIS based on centrality indicators are presented in Table 6.

Table 6
Ranks of Significant Institutions in the Co-Authorship Network Based on the Centrality Indicators in the WOS Database From 2011 to 2020

No.	Item	Degree of Centrality	Closeness	Betweenness
1	University Illinois	17.51	24.291	6.731
2	Indiana University	17.51	24.546	5.456
3	Chinese Acad Sci	13.23	23.621	4.557
4	University British Columbia	10.506	23.492	4.388
5	University Amsterdam	7.004	22.003	3.818
6	City University Hong Kong	14.397	23.708	3.646
7	Natl University Singapore	12.451	23.84	3.552
8	University Minnesota	12.451	23.752	3.404
9	Cornell University	5.058	22.213	3.398
10	University Maryland	17.121	24.177	3.311

As can be seen in Table 6, the University of Illinois is the leading and most significant institution in the studied area because it alone has the most scientific products in this field. It also has the highest score regarding the degree of centrality, betweenness, and closeness.

Active Authors in the Field of LIS in Iran and the World During 2011-2020 in the WOS Website

A review of articles published in the subject area revealed that 21,673 authors contributed to the authorship of these papers. The ten authors with the highest contributions (i.e., the number of published papers higher than 50) are presented in Table 7. To map the network, 191 authors with ten or more articles were entered into the map. According to the results, Anon, Maria C, McCardle Megan M, and Hoffert Barbara were three active authors in the field of LIS in the WOS database.

Table 7
Ten Active Authors in the Field of LIS on the WOS Website From 2011 To 2020

No.	Item	Count	Contribution (%)
1	Anon, Maria C.	136	0.82%
2	Mcardle, Megan M.	111	0.67%
3	Hoffert, Barbara	106	0.64%
4	Donohue, Nanette	103	0.62%
5	Ramsdell, Kirstin	86	0.52%
6	Campbell, Lyndsay	84	0.50%
7	Wyatt, Neal	81	0.49%
8	Sharbrough, Christine	67	0.40%
9	Jacobsen, Teresa	66	0.40%
10	Cassada, Jackie	57	0.34%

According to Figure 4, the network of authors' collaboration in the field of LIS on the WOS website is not well-formed in the global dimension. Most collaborations have occurred between several authors, Chen Xi, Zhang Jiong, Liu Yan, and Xu Xm. In addition, most papers are

single-authored, which indicates that authors in this field are less willing to collaborate. Notably, most collaborations have been formed between several authors, i.e., Chen, Zhang, Liu, and Xu.

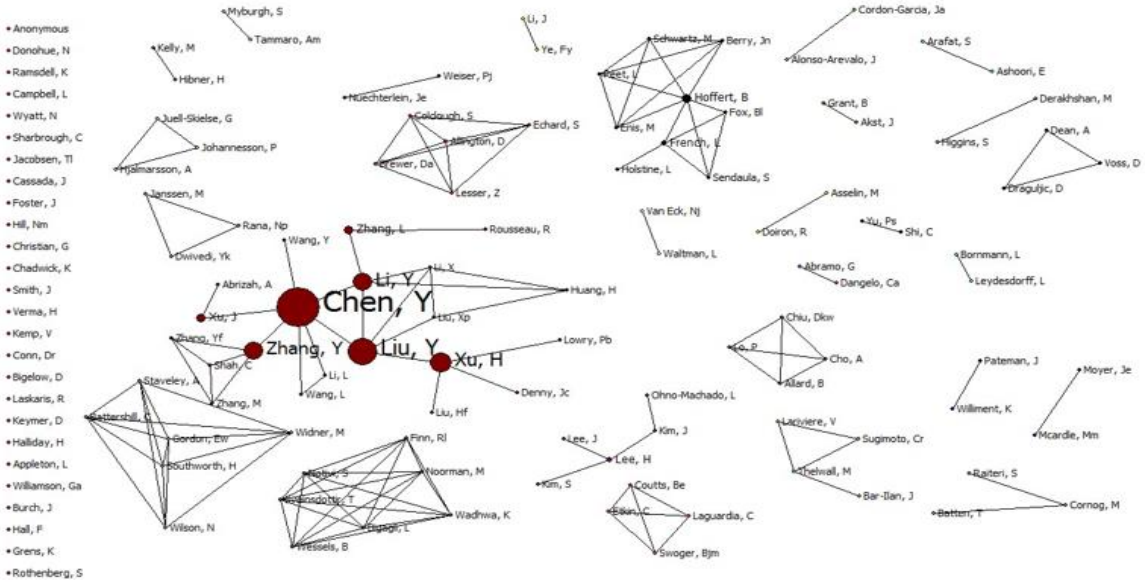

Figure 4: Collaboration (Co-Authorship) Network of Authors in the Field of LIS From 2011 to 2020 on the WOS Website

Hot Topics of LIS Papers from July 2020 to July 2021 on the WOS Website

A total of 587 records were obtained for identifying hot topics in the field of LIS based on a search of the WOS database and a written strategy. A data collection form and paper keywords were employed for analyzing records. The papers with the highest usage and citation rates were specified, and 1568 keywords with the highest citation and usage rates were specified. Moreover, the keywords were given citation and usage scores specified in the designed collection form. After normalizing and removing duplicate keywords, 121 keywords were obtained. The keywords with the most citations and usage rates were diffusion patterns, disinformation, and misinformation. Table 8 presents the 30 most frequently used keywords.

Table 8
Thirty Keywords with the Most Citations and Usage Rates in the WOS Database From 2020 To 2021

No.	Keywords	Sum of Citations and Usage Rates
1	Diffusion patterns	211
2	Disinformation	203
3	Misinformation	201
4	Fake news	181
5	Information literacy	132
6	Social network	132
7	Citation analysis	119
8	Data science	117
9	Intelligent libraries	116
10	Knowledge pattern	114

No.	Keywords	Sum of Citations and Usage Rates
11	Research method	112
12	Information service	111
13	Documentation	109
14	Content analysis	108
15	LIS education	107
16	Academic libraries	97
17	Bibliometric analysis	95
18	Data literacy	94
19	Topic analysis	92
20	Online health information	91
21	Systematic review	86
22	COVID-19	85
23	Seeking behavior	83
24	Content analysis	82
25	Digital libraries	81
26	Social justice	76
27	Information seeking	75
28	Academic libraries	74
29	knowledge	69
30	Research productivity	67

Discussion

The primary purpose of the LIS is to facilitate access to information the user needs (Vakkari, 1994; Borgman, 2003; Oltmann, 2009). This science area has expanded, and the information facilitation fields have been developed into other fields besides libraries (Vakkari, 1994). This development has led to the emergence of new concepts and terms in the field of LIS, which has resulted in novel studies in this area in recent years. This study examined the output of LIS studies published over a decade from 2011 to 2021 and hot papers published from 2020 to 2021.

According to the results, the most frequently used keyword in the studies related to LIS during the studied period was "social media," followed by the keywords "academic librarian," "social network," "information literacy," and "bibliometrics," respectively. In a study by Chang, Huang and Lin (2015) the main keywords used during the four 5-year periods from 1995 to 2014 in the leading journals were "bibliometrics" and "citation analysis," which were among the most frequent keywords in all four periods. Additionally, in Onyancha's study (2018), the keywords "bibliometrics," "knowledge management," and "social media" were the most frequently used keywords in the reviewed papers published between 2011 and 2015. In addition, the other high-frequent keywords extracted in the studied period are significantly similar to the findings of the present investigation. In a study by Song et al. (2020), the keywords "document delivery," "inter lending," and "world wide web" were introduced as the most used keywords between 2000 and 2019. According to the results of the present study and by reviewing other similar studies, it can be concluded that some keywords, such as bibliometrics, are among the leading topics in the field of LIS, which have maintained their continuity over time. The same is true of the Internet and related topics, which have entered the field of LIS as newer topics since the advent of the World Wide Web. According to the results

of the present study, one can reflect on the issues related to networks and social media in the process of keywords entering the LIS area. Regarding the increasing popularity of social media in terms of diversity and usage in recent years, including these topics in the LIS papers seems a reasonable issue. Moreover, the significant interest of authors can be seen in academic libraries and information literacy during the years under study.

Among the eight topic clusters identified in the present study, the largest and most prevalent area in the LIS research is the libraries and emerging technologies, which have been addressed by more than 100 articles in the studied collection. Moreover, the scientometrics and webometrics area is in second place, and the electronic information and data preservation areas are in third place. To Chang et al. (2015), the predominant subject areas in the four five-year periods from 1995 to 2014 were "information seeking and information retrieval," "user-based information behavior," "H-index," and "Bibliometrics". In Han's study in 2020, the predominant subject area in the field of LIS published in several credible journals was "bibliometric analysis" between 2011 and 2015 and "citation analysis and impact factor" between 2016 and 2019. In a study by Hou, Yang and Chen (2018), "scientific collaboration" has been identified as the largest field in information science, the dominant cluster for 16 years from 2000 to 2015. In Ma and Lund (2020), "information systems and retrieval" was the predominant topic of LIS papers published between 2006 and 2018.

Tuomaala, Järvelin and Vakkari, (2014) determined that in 2005, the topic of "interactive information retrieval" was the most popular in the field of LIS. Moreover, Li et al. (2019) indicated that from 1981 to 2016, the LIS studies focused on some topics such as "information retrieval," "social media," "information systems," "information behavior," "bibliometrics," "webometrics," "scientific evaluation," and "knowledge management." According to review studies, the focus of research in the field of LIS depends on some factors, including the scope of the study, the publisher's journals, and especially the studied period. Some study areas, such as "information retrieval," "bibliometrics," and "webometrics," have always maintained their dominance over the research timespan. The present study is the most recent and covers a larger area than most studies due to the lack of restrictions imposed by publishing journals. Therefore, in this study, the areas related to technology and its increasing development, such as "emerging technologies in libraries," "social media," and "electronic information," are predominant, which seems justifiable and logical in terms of time.

According to the findings, the United States is the most productive country in this area, publishing approximately 41% of papers in the field of LIS, with a significant difference from other countries. In respective order, China and the United Kingdom are the following places. In the present investigation, the Illinois, Carolina, and Harvard universities were identified as the most productive institutions in the field of LIS, respectively. Furthermore, among the authors who publish papers, the first four authors, with a minimum of 0.62% and a maximum of 0.82% of documents, are the most productive researchers in this area. The results of Chohdary et al. (2021) on the most productive countries align with the results of the present investigation; however, the most productive institution in this study is the Wuhan University of China. In addition, regarding the production of papers in the mentioned study, each of the top four authors published more than 1% of the papers in the studied collection. In general, the findings indicate that the most productive countries, institutions, and writers in the field of LIS are from developed countries.

Regarding hot topics published in the field of LIS, the 30 most used keywords were

identified over the studied period, ranging from 211 in diffusion patterns to 67 in research productivity. The keywords "disinformation," "misinformation," and "fake news" are ranked second to fourth, respectively. Moreover, the keyword "COVID-19" ranks 22nd with a frequency of 85. These keywords in hot papers in the field of LIS can indicate the arrival of newer subject areas and following current issues in this area. Due to the COVID-19 pandemic that occurred in the studied period and the publication of numerous studies in this field as an emerging research field (Coccia, 2021), the footprint of this area can be seen in the LIS research.

Additionally, the topics related to false and unreliable information and fake news are among the topics raised, especially in the health area, which has been included in various studies abundantly with the expansion of the usage of social media and networks. All these features can be related to LIS's interdisciplinary nature and its footprint's emergence among various disciplines. The ten hot topics identified by Papić and Buhin (2019) were "scientific communication," "social media," "information security and privacy," "IoT," "big data analysis," "e-health," "e-government," "knowledge management," "retrieval of information," and "information behavior." Comparing the findings of this study with the present investigation, it can be seen that there are apparent differences between the hot topics in the field of LIS in a short period. Taşkın (2021) identified an extensive range of topics from fake news to predatory journals, open government, e-learning, and e-health records as future topics in the field of LIS and introduced COVID-19 as a new cluster in the introduced texts in this area that is in line with the current research in the topics "fake news," "COVID-19," "E-learning."

Conclusion

In conclusion, the results of the present study indicate the dynamic and evolutionary nature of LIS. This investigation proves the incredible and time-dependent diversity and technological and social developments of research topics in this field. This indicates the lack of a clear boundary and scope for investigations in this field, which can be observed in the extensive range of studies from computer science to medical and social sciences. Therefore, because of alterations in various areas and disciplines over time and due to the effectiveness of LIS research on significant developments in different fields, it is expected that researchers in this area constantly update their knowledge in line with these changes so that they can remain in the competition to advance future studies and research in the field of LIS.

Ethical Approval

This study was conducted with the approval of the ethics committee of Iran University of Medical Sciences, Iran (IR.IUMS.REC.1398.1302).

Availability of Supporting Data

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare that they have no conflict of interest.

Funding

This study was supported as a research project with grant number (IR.IUMS.REC.1398.1302) from the Research Deputy of Iran University of Medical Sciences.

Authors' Contributions

Mahshid Lotfi: Data collection, Somayeh Ghaffari: Data analysis, Sirous Panahi: Manuscript Drafting.

References

Araujo, R. F. & Oliveira, M. (2017). Technological basis for information science in Brazil: A scientometric study. *Qualitative and Quantitative Methods in Libraries*, 231-241. Retrieved from http://www.qqml.net/index.php/qqml/article/view/377

Borgman, C. L. (2003). *From gutenberg to the global information infrastructure: Access to information in the networked world*. Mit Press.

Bowker, L. (2018). Corpus linguistics is not just for linguists: Considering the potential of computerbased corpus methods for library and information science research. *Library Hi Tech*, 36(2), 358-371. https://doi.org/10.1108/LHT-12-2017-0271

Chang, Y. W., Huang, M. H. & Lin, C. W. (2015). Evolution of research subjects in library and information science based on keyword, bibliographical coupling, and co-citation analyses. *Scientometrics*, 105(3), 2071-2087. https://doi.org/10.1007/s11192-015-1762-8

Chohdary, I. N., Asghar, M. B. & Alshaheer, M. A. (2021). Predicting LIS scholarly research directions in the era of data science. *Library Philosophy and Practice (e-journal)*. 6328. https://digitalcommons.unl.edu/libphilprac/6328

Clarivate (2022). Essential science indicators help. Clarivate Analytics. Retrieved from http://esi.help.clarivate.com/Content/hot-paper-thresholds.htm

Coccia, M. (2021). Evolution and structure of research fields driven by crises and environmental threats: The COVID-19 research. *Scientometrics*, 126(12), 9405-9429. https://doi.org/10.1007/s11192-021-04172-x

Elia, E. F. & Sife, A. S. (2018). Analysis of top cited papers in library and information science that have stood the test of time. *University of Dar es Salaam Library Journal*, 13(1), 54-68. Retrieved from file:///C:/Users/Reza/Downloads/ajol-file-journals_164_articles_184589_submission_proof_184589-1957-469662-1-10-20190314.pdf

Figuerola, C. G., García Marco, F. J. & Pinto, M. (2017). Mapping the evolution of library and information science (1978–2014) using topic modeling on LISA. *Scientometrics*, 112(3), 1507-1535. https://doi.org/10.1007/s11192-017-2432-9

Hou, J., Yang, X. & Chen, C. (2018). Emerging trends and new developments in information science: A document co-citation analysis (2009-2016). *Scientometrics*, 115(2), 869-892. https://doi.org/10.1007/s11192-018-2695-9

Hu, Z. & Wu, Y. (2018). A probe into causes of non-citation based on survey data. *Social Science Information*, 57(1), 139-151. https://doi.org/10.1177/0539018417742537

Järvelin, K. & Vakkari, P. (2022). LIS research across 50 years: Content analysis of journal articles. *Journal of Documentation*, 78(2), 65-88. https://doi.org/10.1108/JD-03-2021-0062

Li, P., Yang, G. & Wang, C. (2019). Visual topical analysis of library and information science. *Scientometrics*, 121(3), 1753-1791. https://doi.org/10.1007/s11192-019-03239-0

Ma, J. & Lund, B. (2020). The evolution of LIS research topics and methods from 2006 to 2018: A content analysis. *Proceedings of the Association for Information Science and Technology*, 57(1), e241. https://doi.org/10.1002/pra2.241

Miyata, Y., Ishita, E., Yang, F., Yamamoto, M., Iwase, A. & Kurata, K. (2020). Knowledge structure transition in library and information science: Topic modeling and visualization. Scientometrics, 125(1), 665-687. https://doi.org/10.1007/s11192-020-03657-5

Noruzi, A. (2017). Hot papers in library and information science from the point of view of research methods. *Webology*, 14(2), 1-5. Retrieved from https://www.webology.org/data-cms/articles/20200515031920pmeditorial24.pdf

Oltmann, S. M. (2009). Information access: Toward a more robust conceptualization. *Proceedings of the American Society for Information Science and Technology*, 46(1), 1-17. https://doi.org/10.1002/meet.2009.1450460274

Onyancha, O. B. (2018). Forty-five years of LIS research evolution, 1971-2015: An informetrics study of the author-supplied keywords. *Publishing Research Quarterly*, 34(3), 456-470. https://doi.org/10.1007/s12109-018-9590-3

Papić, A. & Buhin, M. (2019, May). Mapping the hot topics in library and information science field in period 2015-2018 Year. In *2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)* (pp. 508-513). IEEE.

Saracevic, T. (2000). Digital library evaluation: Toward evolution of concepts. *Library Trends*, 49(2), 350-369. Retrieved from https://tefkos.comminfo.rutgers.edu/Courses/Zadar/Readings/Saracevic%20eval%20LibraryTrends%202000.pdf

Selvavinayagam, A., Muthu, M. & Boopalan, E. (2018). Scientometrics, techniques, sources and their key points to analysis of LIS research: An overview. *International Journal of Science and Technology*, 8(1), 10-19. Retrieved from http://ijst.co.in/papers/vol8issue1/ijst_180303.pdf

Song, Y., Wei, K., Yang, S., Shu, F. & Qiu, J. (2020). Analysis on the research progress of library and information science since the new century. *Library Hi Tech*, 41(4), 1145-1157. https://doi.org/10.1108/LHT-06-2020-0126

Taşkın, Z. (2021). Forecasting the future of library and information science and its sub-fields. *Scientometrics*, 126(2), 1527-1551. https://doi.org/10.1007/s11192-020-03800-2

Tuomaala, O., Järvelin, K. & Vakkari, P. (2014). Evolution of library and information science, 1965–2005: Content analysis of journal articles. *Journal of the Association for Information Science and Technology*, 65(7), 1446-1462. https://doi.org/10.1002/asi.23034

Vakkari, P. (1994). Library and information science: Its content and scope. In *Advances in librarianship*, Vol. 18 (pp. 1-55). Emerald Group Publishing Limited. https://doi.org/10.1108/S0065-2830(1994)0000018003

Wang, X., Wang, H. & Huang, H. (2021). Evolutionary exploration and comparative analysis of the research topic networks in information disciplines. *Scientometrics*, 126(6), 4991-5017. https://doi.org/10.1007/s11192-021-03963-6

Webster, J. & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, 26(2), xiii-xxiii. Retrieved from https://web.njit.edu/~egan/Writing_A_Literature_Review.pdf