

Exploring the Evolution and Characteristics of the iSchool Movement in China

Mingkun Wei, Ismael Mostafavi, Russell Savage, Changyang Feng, and Shima Moradi

This study examines the evolution of current interests and emerging characteristics in library and information science (LIS) from Chinese iSchools, including an analysis of the LIS landscape, space distribution, citation, emerging characteristics, and collaborations. This study considers a non-parametric approach to outline the structure of the iSchool movement in China, while clustering analysis helped us obtain information about the descriptions generated within unsupervised learning groups. It was found that Chinese iSchools play an intermediary role in the international development of Chinese LIS, which further promotes the dissemination and exchange of knowledge and international cooperation in LIS.

Introduction

Information Schools (iSchools) are emerging as one of the most exciting fields in academia, especially with respect to information and computing programs.¹ With rapid development of information technology, the demand for information talents is at the forefront of severe challenges to the field of LIS.^{2,3} In response to the challenge, some of the leading LIS institutions in the USA have launched the information school movement and established a new form of school named iSchools, aimed at guiding the development of LIS into an interdisciplinary domain.⁴ ISchools were founded in 2005 by a group of information schools dedicated to advancing LIS in the twenty-first century (<https://ischools.org/About>). The abovementioned academic model was developed over years to prepare graduates for the information-driven world. The model progressed from “library” to “Library and Information science” in the United States during the 1970s.⁵ The letter *i* in iSchools refers to information or interdisciplinarity, demonstrating the importance of both concepts in the job market as well as the overall recent trends within the field,⁶ the impact of which has been expanding with the rapidly growing popularity of iSchools. These schools are designed to prepare the expert in providing any type of information services needed to boost science, business, education, and culture.⁷

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iSchools are governed by iCaucus (the group of Deans), which addresses the relationship between information, technology, and people. This is required for progress to be made in science, business, education, and culture.⁸ Discipline integration is a major topic of iSchools research, so much so that James Thomas, the dean of the school of Science and Technology at Pennsylvania State University, assumed that the “i” in iSchools was an abbreviation for interdisciplinary.⁹ The iSchools movement advocates the reform of library and information science, which needs to be repositioned and support training while also carrying out reforms and innovation in the curriculum system, faculty construction, and in teaching and scientific research interaction.¹⁰ In order to develop LIS, it must be integrated within the contemporary information environment and cultivate professional talents.¹¹ The rapid development of iSchools has attracted the attention of various Chinese schools of LIS, among them nine of the highest rated Chinese universities in the country. These schools have joined the iSchools union since its founding,^{12,13} including Central China Normal University, Jilin University, Nanjing University, Nanjing University of Science and Technology, Peking University, Renmin University of China, Shanghai University, Sun Yat-sen University, and Wuhan University. However, the status of these universities and the prospects for further development of the field in China are not clear. The objective of this study is to find out the role of iSchools in the development of Chinese LIS by seeking to identify the landscape, emerging trends, and collaboration of LIS in Chinese iSchools.

Literature Review

The ecosystem of information within LIS is dynamic and controversial, and has led to rapid changes.¹⁴ The notion of iSchools was conceived of as far back as 1988, when it was claimed that information science could integrate nature and society.¹⁵ Browsing the literature in this field showed that many studies have taken iSchools into account. A number of studies have analysed various attributes of iSchools, such as intellectual coverage, interdisciplinarity, and research commitment.¹⁶ Wiggins and Sawyer studied the intellectual distribution and faculty composition of academic units involved in the iSchool’s community to better understand its intellectual heritage.¹⁷ They pointed out the interdisciplinary diversity mostly among computing, library, and information sciences. A description of the intellectual landscape of iSchools and investigation of its evolution by Ping Zhang, Jasy Liew Suet Yan, et al. revealed the interdisciplinary nature and multiple dominant themes in iSchools.¹⁸ Moreover, Li Si, Xiaozhe Zhang, et al.’s study of the role and value of iSchools provides some indications of LIS education of scientific data specialists in China.¹⁹ Considering the iSchool structure, Ana Ndumu discussed librarianship as a career option remaining largely out of sight or out of reach for many African Americans.²⁰ The libraries have changed and covered a broader scope of LIS under the development of iSchools.²¹ However, Nathan et al. used social networking tools to explore the differences between iSchools and LIS schools, observing that iSchools are uniquely to design proactive and adaptive policies for social media.²²

As for the capacity of iSchools, Mulder and van Weert focused on informatics curriculums designed to cope with the high diversity demand for informatics education in a controlled way.²³ Moran and Marchionni posit the enhancement of educational pathways and of information specialists and graduates as the reasons for the projected transformation in iSchools by 2050.²⁴ Furthermore, Angel Krystina Washington Durr study of job postings and iSchool

course documentation exploring the intersection of LIS and data science²⁵ demonstrated the techniques related to data science in these schools. This approach has been of interest in other studies: J. Ding, J. Chen, et al. proposed the adoption of research activities, programs, and curriculum that would meet society's need to train student;²⁶ Sam Oh, Song I Y., et al. identified the characteristics of data science education and investigated whether current curricula meet the needs of data science education.²⁷

Addressing the pros and cons of the iSchool movement, Hildreth, Charles R., and Michael Koenig investigated a merging of LIS schools with neighbouring informatics and computing schools in the overall development of LIS schools.²⁸ Sperry DE, Miller PJ, et al. estimated that the achievement of the vision of iSchools was beyond the scope of one single discipline and required interdisciplinary work.²⁹ Their study suggested that iSchool collaboration should be pursued nationally or globally through curricular programs, community outreach, and partnerships with other non-profit and for-profit institutions and organizations. Christopher Cyr and Lynn Silipigni Connaway investigated information and sustainability undertaken at iSchools as well as computer and human-computer interaction (known as HCI) communities by thematic analysis of UN policy documents.³⁰ They found that iSchools have the potential to promote a culture of sustainable information practices essential to prepare society to achieve the UN's sustainable development goals. In contrast, some studies have addressed the side effects of this movement, such as dividing LIS community and isolating small LIS schools.³¹ The aforementioned research has been either limited to theoretical discussions or focused on the characteristics or development of iSchools, and most of it has emphasized multidisciplinary and disciplinary data diversity and argued the undeniable connection between information and computer science. However, this research concentrates on the current landscape of *Chinese* iSchools and their emerging trends, an underresearched area.

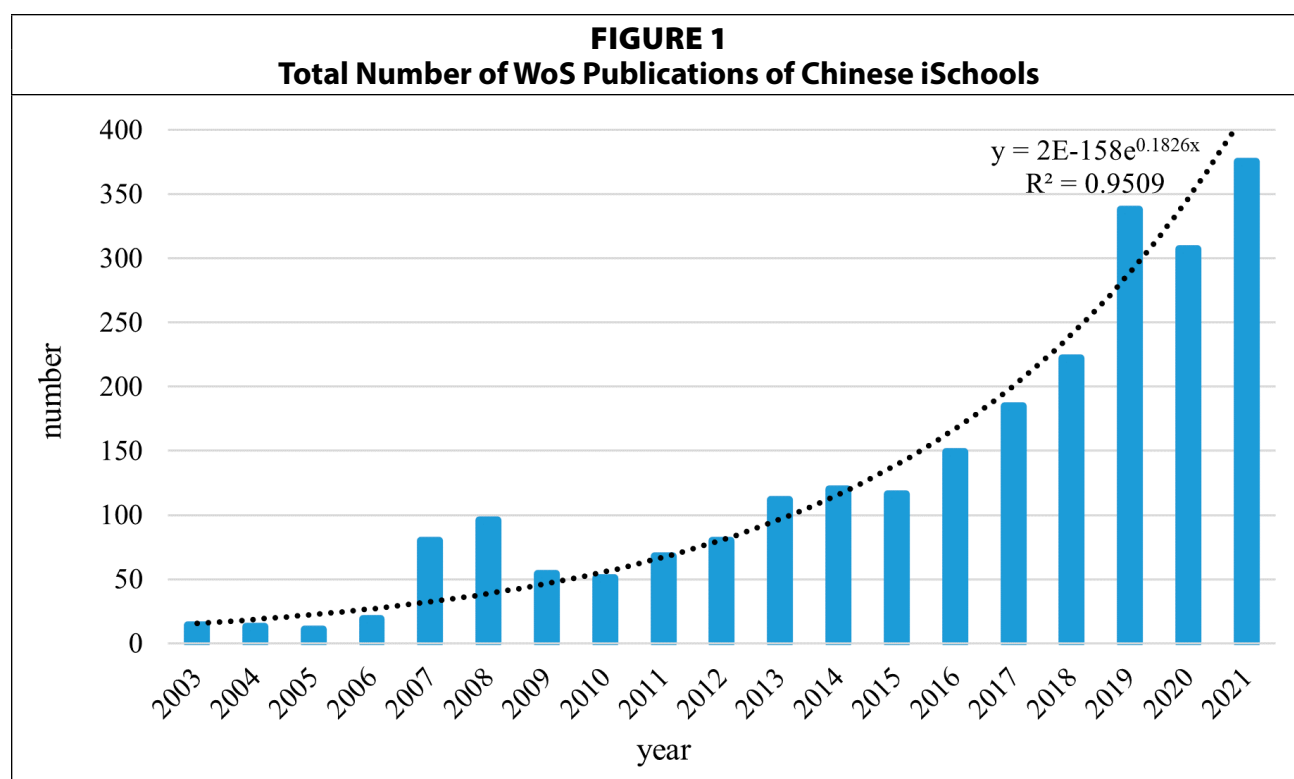
Data and Methodology

To conduct this research comprehensively, the data were retrieved from multiple databases including the China National Knowledge Infrastructure (CNKI) and Web of Science (WoS) Core Collection* on March 31, 2022. WoS is the most comprehensive gateway of knowledge in China; the following publications were retrieved in support of the search strategy:

WoS is OO= ((Central China Normal University) OR (Jilin University) OR (Nanjing University) OR (Nanjing University of Science and Technology) OR (Peking University) OR (Renmin University of China) OR (Shanghai University) OR (Sun Yat-sen University) OR (Wuhan University)) AND SU= Information Science & Library Science.

The dataset demonstrated that 2,588 publications in WoS have been published since 2003, as shown in figure 1, indicating that the first publications for databases appeared in 2003. The figure displays the rapid increase in the number of documents since 2003 over the last eighteen years. The value of the exponential growth fitting curve was 0.9509, which indicated a high degree of fit. To an extent the data reflects increasing internationalization in the achievements of Chinese LIS.

* Core Collection includes all document types in Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index.



The first publication indexed in LIS appeared in 2007. This database was launched in 1996 by Tsinghua University and Tsinghua Holding Group, and was dedicated to the mass digitalization of China's knowledge resources, as well as creating a platform for global dissemination and value-added services. CNKI has developed the most comprehensive system of China's academic knowledge resources, over 90 percent of which it collects, including journals, dissertations, newspapers, proceedings, yearbooks, reference works, encyclopedias, laws, and regulations.

This research was conducted using Scientometrics as the quantitative study of science, focusing on scholarly publication and citation data and providing insight into their value and impact. As for tools, CiteSpace and analytic hierarchy processed by SPSS (Statistical Product Service Solutions) were employed. The top fifty cited references per time slot were selected to visualize the document in co-citation network in both cluster analysis and co-occurrence analysis using CiteSpace, which generates and analyzes networks of co-cited references based on literature records.^{32, 33} The nature of the co-citation network can be identified by algorithmically generated labels of the cluster and representative concepts in the cluster. The analytic hierarchy process (AHP) is essentially the formalization of our intuitive understanding of a complex problem by breaking it down into a hierarchical system. Moreover, AHP is a decision-making method for qualitative and quantitative analysis, which is different from using text mining functionality to construct and visualize co-occurrence networks from important terms in scientific literature.³⁴ After completed the analytic hierarchy process of LIS keywords, the correlated classification of clusters of LIS subjects can be finally obtained.

Results and Discussion

iSchools play an important role in promoting, developing and improving the Chinese system for constructing LIS,³⁵ which guides the cultivation of outstanding scientific talents in

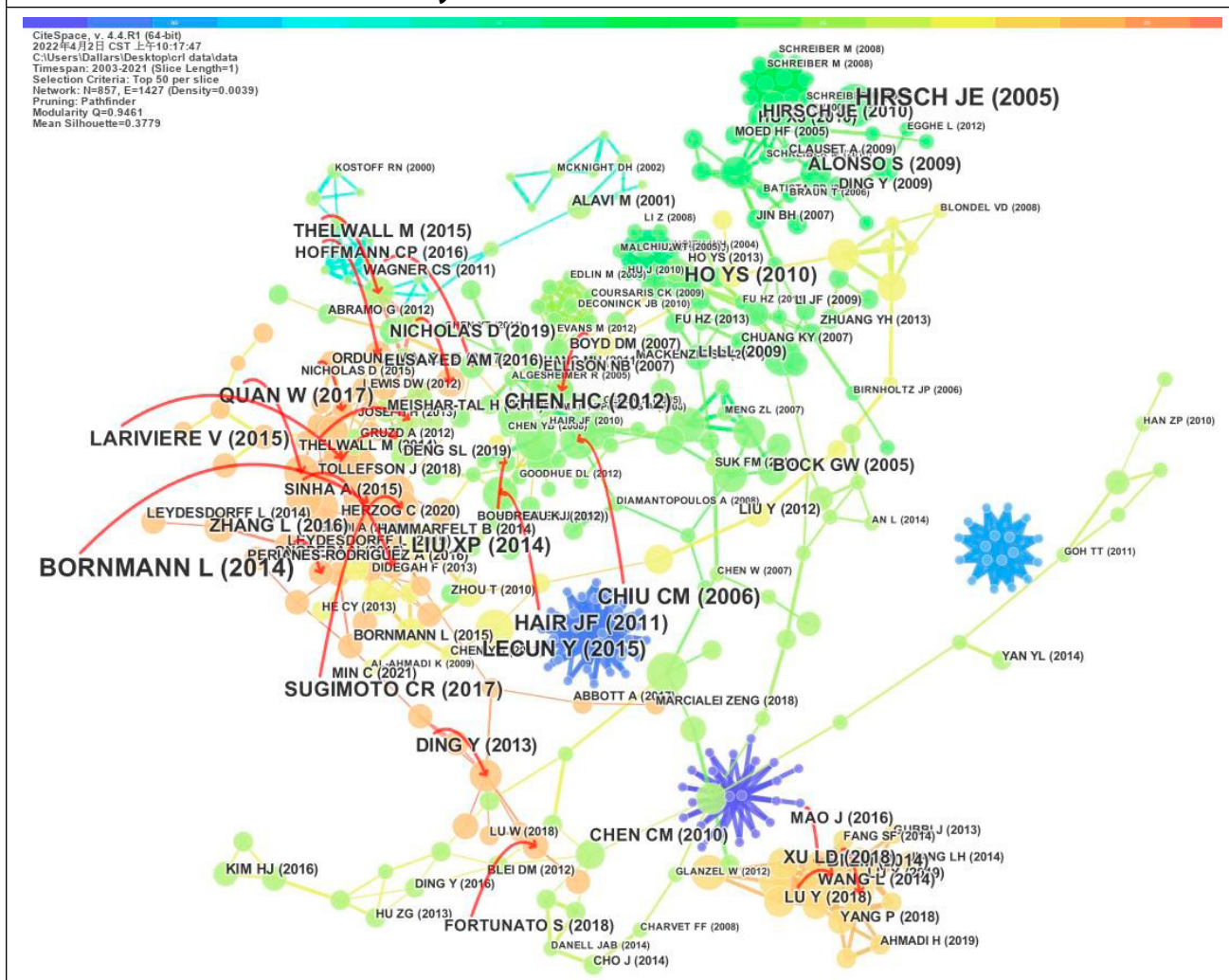
LIS research. This paper employs bibliographic records for exploring the landscape of LIS in Chinese iSchools and detecting the current interest them.

Landscape of Chinese iSchools

The landscape of LIS was represented by a network of cited references, as shown in figure 2. The linking of the network between two nodes represents how frequently two articles are cited together by other articles in a dataset. The blue indicates the earliest connections, with orange showing the most recent connections. The red nodes reflect citation bursts; the purple rims of nodes indicate pivotal points with high betweenness centrality. The quality of the whole division is measured by the modularity (Q), which ranges from 0 to 1. The low value of modularity indicates a network that cannot be reduced to a cluster with clear boundaries; if the value approaches 1, a well-structured network is inferred.

The modularity (Q) was equal to 0.9496 and the mean silhouette was 0.4937, which indicated a good intercluster connection network from a considerable partition of the network. The clusters revealed the specific problems and subfields involved in LIS. The top N indicates that N documents with the highest citations are extracted from each time slice; the larger N is, the more comprehensive the network will be. According to the threshold requirements,³⁶

FIGURE 2
Co-citation Analysis of LIS Publications for Chinese iSchools



the threshold was set to top fifty per year, which generated a co-citation cluster network of LIS for Chinese iSchools. As previously described,³⁷ the findings displayed diversity together with 760 nodes and 623 links, each node standing for a cited literature and the size of nodes representing the number and the importance of the cited literature. The landscape of thematic trends was based on the CiteSpace of burst detection.³⁸ Citation bursts of the literature indicate that highly cited literature provides concrete indicators of emerging themes as well as authors that have been influential. The high-burst cited references were chosen from the document co-citation network to highlight the salient themes and contributors of LIS in Chinese iSchools.

CiteSpace allows researchers to detect burst literature with red. Citation bursts may indicate the degree of attention from the scientific community to a published article. Burst detection can also identify burst literatures as indicators of emerging trends.³⁹ These burst literatures reflect the focus of LIS for Chinese iSchools and predict future trends. According to figure 2, burst literatures include a burst value that reflects the different impact in the development of iSchools. These burst literatures indicate the research hotspots to a better answer to society in line with Andrew Dillon⁴⁰ and Moran B. and Marchionini G.⁴¹ This claim is reaffirmed when such a finding is observed in the time cluster analysis, namely, the analysis of cited references from the time line view. It was found that the quality of scientific research output has become the theme of research in LIS. Moreover, highly cited and influential research references in a specific research domain can be found through document co-citation analysis,⁴² particularly in detection of important literature. The frequency of cited references shown in Table 1 could reflect the classicality and importance of references in LIS, which become the knowledge base of this field. The highest burst value was 8.65, which was cited nineteen times. The cited literature published by Hirsch JE had a high impact on the development of LIS in Chinese iSchools.⁴³ The second most highly cited literature

TABLE 1
The Top 10 Cited Literatures in Co-citation Frequency Related to LIS

Frequency	Burst Value	Author	Cited Reference
19	8.65	Hirsch, JE	An index to quantify an individual's scientific research output
18	6.57	Liang, HG	Understanding and mitigating uncertainty in online exchange relationships: A principal-agent perspective
13	5.89	Chiu, CM	Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories
14	5.63	Liu, Y	Social sensing: A new approach to understanding our socioeconomic environments
13	5.59	Chiu, WT	Bibliometric analysis of tsunami research
10	5.47	Kankanhalli, A	Contributing knowledge to electronic knowledge repositories: An empirical investigation.
9	4.63	Ross, L	The library is dead, long live the library! The practice of academic librarianship and the digital revolution
10	4.4	Arms, WY	The 1990s: the formative years of digital libraries
13	4.25	Chen, HC	Business intelligence and analytics: From big data to big impact.
8	4.19	Pei, T	A new insight into land use classification based on aggregated mobile phone data

was published by Liang HG with 18 citations. These most cited references, to some extent, were regarded as the knowledge base of LIS, which would promote future research. It is worth mentioning that the most highly cited references address digitization, which reflects the tangible and intangible changes in academia to continue technological improvements.

There is extensive literature about trend analysis using CiteSpace,^{44, 45} highlighting the developing nature of LIS.⁴⁶ However, little research has been done regarding the hot topics of iSchools using bibliometric methods. In this paper, LIS literature was analysed using CiteSpace to discover the main trends and current topics of Chinese iSchools. The high-burst cited references among document co-citation networks were traced to highlight the salient themes and contributors of the iSchools research field and domains. The perspective of iSchools, along with the clustering analysis, was also identified.

Space Distribution of Collaboration for Chinese iSchools

The co-country analysis was carried out to clarify the distribution of countries involved in LIS for Chinese iSchools. It was found that the USA, Taiwan, England, Australia, Singapore, and Pakistan played key roles in the collaboration of LIS in Chinese iSchools. China's cooperation in LIS is expanding from the degree of cooperation already given. Figure 3 shows that countries acted as the node type, with the size of the node reflecting the frequency of cooperation between China and other countries. With the development of iSchools, the cooperating countries changed from 2003 to 2021; in recent years, the collaboration with Malaysia, Poland, Denmark, and Scotland increased gradually.

In constitution analysis, the institution acted as the node type, and the cooperation network among institutions involved thirty-six nodes and thirty-seven links after 3.502s, as shown in figure 3. The centrality of an institution reflected its role in cooperation, as well as its weight in Chinese iSchools. The highest centrality was observed in Wuhan University, followed by Peking University with centrality of 0.55 and 0.49 respectively. From the analysis of cooperation frequency, the highest institution was Wuhan University, followed by Nanjing University with respective frequency of 1205 and 384. Science expands along with communication and scholarly communication is hence of high importance, as it can be used to interpret the network mapping of aforementioned iSchools, which generally is associated with the exchange of experience and knowledge, as supported in research conducted by Nathan, Lisa P., Alice MacGougan et al.⁴⁷

Table 2 lists the top five co-institutions in terms of frequency and centrality, with most co-institutions being domestic institutions in China. From the analysis of co-institution distribution, the cooperation between domestic institutions such as Wuhan University, Nanjing University, and Peking University was not balanced. The cooperation between these universities was fairly close given that they were important partners and members of iSchools, which demonstrates that this cooperation between iSchools members is associated with obvious advantages. However, the cooperation with other international iSchools members was still negligible. Gobinda Chowdhury and Kushwanth Koya referred to the proximity of LIS and computer science, arguing that cooperation and collaboration among iSchools can promote a culture of sustainable information practices among university graduates and researchers in different disciplines, which will pave the way for achieving seventeen Sustainable Development Goals (SDGs). Therefore, the weak connection can be interpreted as a lack of strong communication or differences in curriculum content.

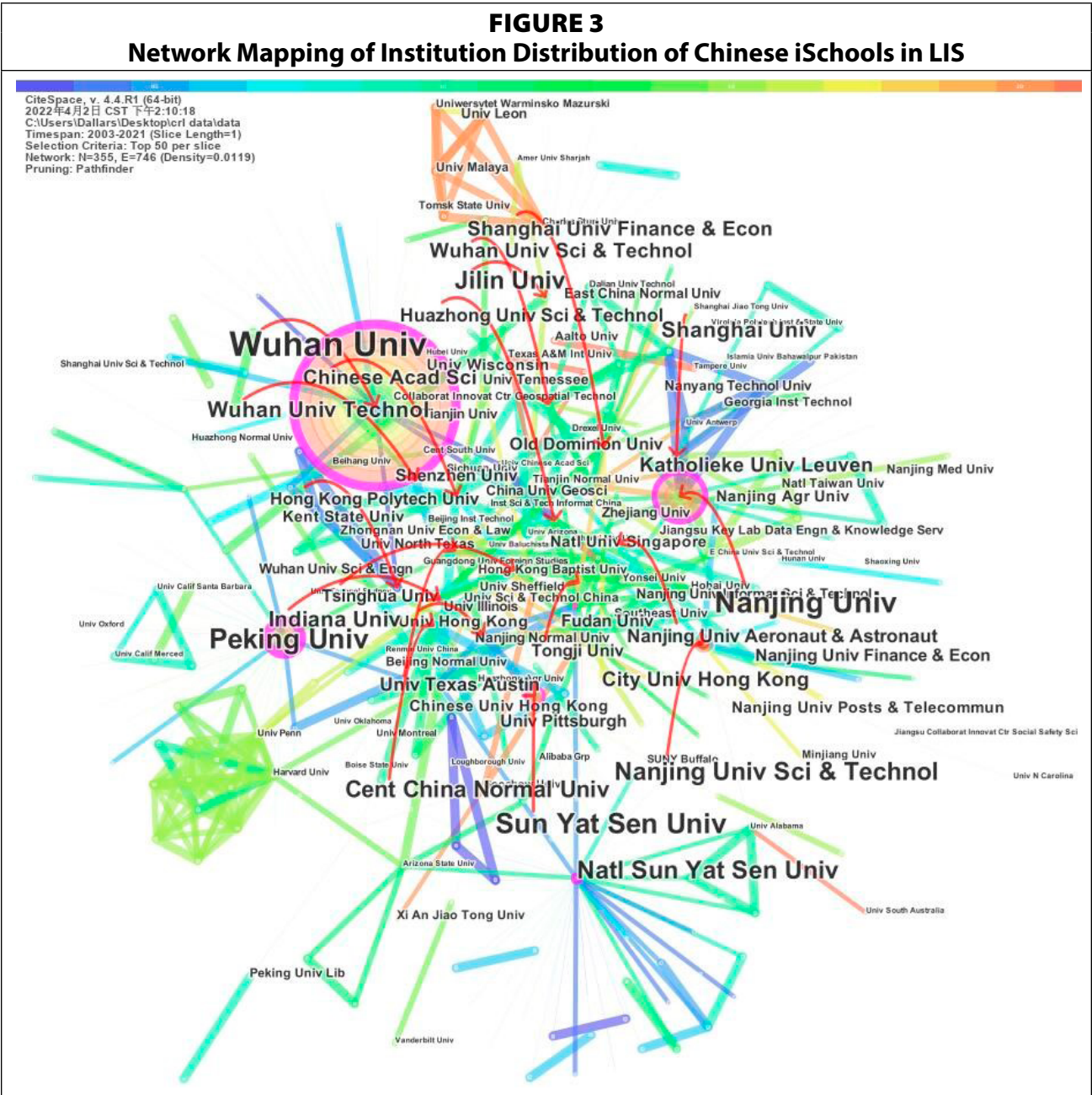


TABLE 2				
The Top 5 Co-institution Distribution in the LIS				
NO.	Frequency	Institution	Centrality	Institution
1	1205	Wuhan Uni	0.55	Wuhan Uni
2	384	Nanjing Uni	0.49	Peking Uni
3	324	Peking Uni	0.37	Natl Sun Yat Sen Uni
4	263	Sun Yat Sen Uni	0.24	Nanjing Uni
5	161	Nanjing Uni Sci & Tech	0.16	Sun Yat Sen Uni

Co-occurrence Analysis of Research Interest from the Viewpoint of Chinese iSchools

The keyword is the extraction of a document that automates the extraction of representative and characteristic words from a document that expresses all the key aspects of its content.⁴⁸ Table 3 shows the facet of iSchools research in China, highlighting the top twenty keywords with the highest occurrence, such as impact, model, information, and science, in iSchool publications. These keywords help indicate significant themes in the current interest in the development of Chinese iSchools. In relation to these top twenty keywords, further analysis was done by dividing keywords into groups, including information, technology, and human being; discipline integration, teaching system, and curriculum; scientific research and cooperation communication; and the development of LIS. There was an overlap within these groups, which indicated the close association among research groups. Through further analysis of these groups of high-frequency keywords, LIS research could be indicated in the discussion on the concept of discipline integration, curriculum design, scientific research, and reform of LIS education. These categories demonstrated the transformation mentioned by M. Brunet,⁴⁹ as well as the multidisciplinary nature of LIS context, as previously referred to by L. Lyon and A. Brenner,⁵⁰ and by F. Mulder and T.J.V. Weert.⁵¹

The development of iSchools engaged in various research content is the foundation for an emerging research field.⁵² The history of the i-movement has been associated with attempts by some previous programs to distinguish themselves from the traditional library programs. There is a large degree of variability in the levels of interdisciplinarity, the structure of academic units, and faculty composition in the iCaucus movement.⁵³ Moreover, one of the research goals of iSchools is to discover multidisciplinary areas and promote cross-domain integration and cooperation,⁵⁴ which meets the development needs of talents, exploring the role of information in human activities where information, technology, and human relations are the focus for research and practice. Human-computer interaction (HCI) has been referred to as one of the most crucial topics to be included in LIS curriculum.⁵⁵ Course content of this scientific field is rooted in the multifaceted attention of iSchools' students and scholars to topics including information, technology, networking, and collaboration, as well as public aspects leading to a variety of keywords in research.

TABLE 3
The Top 20 Keywords in the Field of LIS

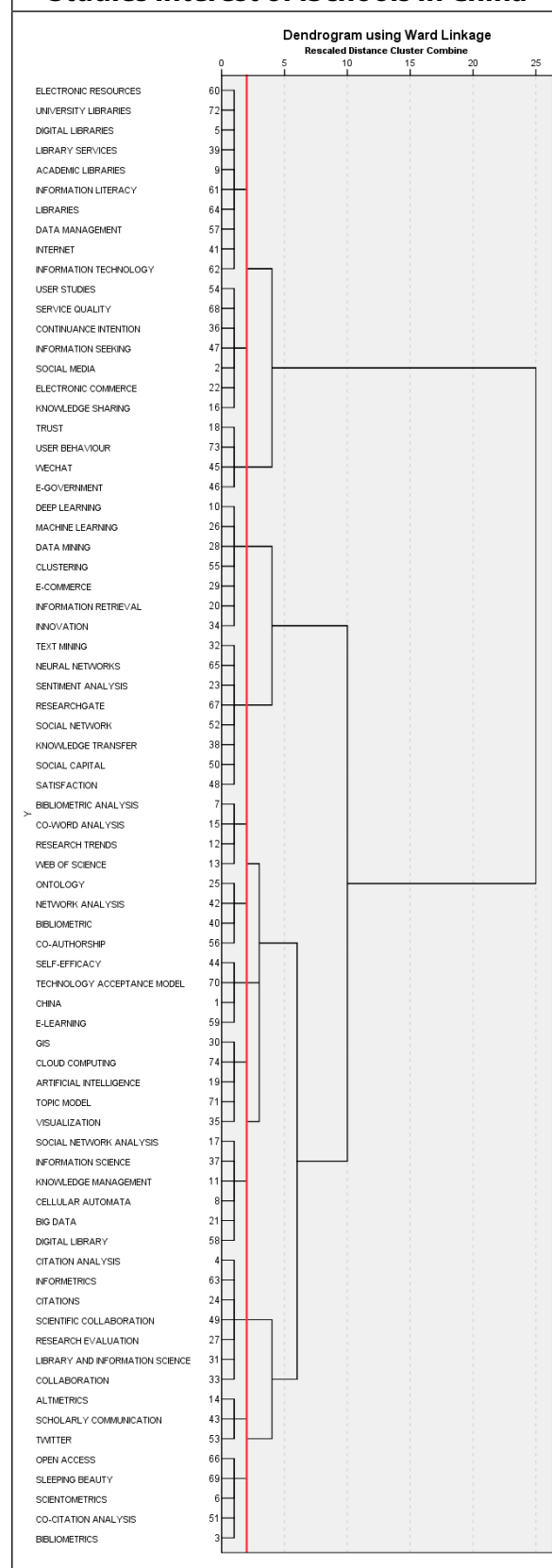
No.	Keywords	Frequency	No.	Keywords	Frequency
1	impact	238	11	citation	87
2	model	219	12	knowledge	82
3	information	148	13	pattern	80
4	science	140	14	web	80
5	system	131	15	quality	73
6	behaviour	120	16	management	72
7	network	115	17	collaboration	66
8	performance	115	18	trust	63
9	technology	114	19	adoption	59
10	social media	105	20	information technology	53

Identifying Different Concepts of iSchools from Hierarchical Cluster Analysis

Hierarchical cluster analysis can identify groups of samples that behave similarly or show similar characteristics, and thus quantify the structural characteristics of the samples or variables. The procedure of the hierarchical clustering involves the construction of a tiered, treelike structure. There are two kinds of procedures used to produce a structure, namely agglomerative and divisive. In the agglomerative method, each observation starts in a cluster of its own and then continuously joins clusters together until there is only one cluster consisting of all the observations. The divisive method proceeds in the opposite direction to the agglomerative method. The main objective of hierarchical cluster analysis of sample data is to classify the data into different groups by structuring it. This would then help in identifying the relationship among observations. LIS and related research have been a hot topic both at home and abroad; LIS is interdisciplinary due to the advanced nature and creativity of the discipline.⁵⁶ The rapid development of information technology and the continuous progress of emerging disciplines are injecting more vitality into the field, together with new tools and methods.⁵⁷ After the integration of library science and information science, several scholarly studies in the field are still based on specific content and form a theoretical and practical system. At the iConference in 2019, scholars from around the world gathered at the University of Maryland to talk about the education for the information professions, domain-centric and cross-disciplinary educational opportunities in iSchools, and other matters. The meeting consisted of a focused discussion on education for the information professions to identify areas of common challenges and issues, and to generate ideas and creative approaches to teaching and learning in the information fields.⁵⁸

The keyword is the core and essence of literature, which is a high-level summary of the content of literature. Clustering of keywords of

FIGURE 4
The Hierarchical Clustering of LIS Studies Interest of iSchools in China



Chinese iSchools studies in LIS can be seen in figure 4. Hierarchical cluster analysis is helpful in grouping sets of objects that share similar characteristics, which builds a diversified portfolio of similarity. The similarity between objects was measured by squared Euclidean distances, and Ward's method of divisive hierarchical clustering for the cluster analysis.⁵⁹ The figure characterizes a dendrogram based on the cluster analysis of the LIS studies interest of iSchools in China. Cluster analysis combined samples of the interest of iSchool study areas into eight cluster groups. Group I consisted of electronic resources, university libraries, digital libraries, library services, information literacy, academic libraries, data management electronic commerce, social media, internet, information technology, knowledge sharing, service quality, user studies, information seeking, and continuance intention; Group II consisted of informetrics, citation analysis, citations, research evaluation, scientific collaboration, library and information science, and collaboration; Group III consisted of WeChat, trust, user behaviour, and e-government; Group IV consisted of self-efficacy, technology acceptance model, China, and e-learning; Group V consisted of deep learning, data mining, machine learning, e-commerce, clustering, information retrieval, innovation, knowledge transfer, social capital, satisfaction, neural networks, text mining, ResearchGate, sentiment analysis, and social network; Group VI consisted of GIS, cloud computing, artificial intelligence, topic model, visualization, social network analysis, information science, knowledge management, cellular automata, and big data; Group VII consisted of bibliometric analysis, research trends, co-word analysis, web of science, network analysis, ontology, bibliometrics, and coauthorship; group VIII consisted of twitter, altmetrics, scholarly communication, open access, sleeping beauty, scientometrics, and co-citation analysis. The cluster analysis groups are mainly derived from the different concepts of iSchools research.

This research has employed hierarchical clustering to present the different research interests of iSchools in China. The eight clusters of LIS subjects in Chinese iSchools are presented in Table 4. There are eight groups of hierarchical clusters across different interests. It was found that many keywords appeared in the hierarchical cluster. In addition, information technology and knowledge management are one of the representative concepts, and data science is the larger cluster that occurred in other studies.⁶⁰⁻⁶² A good clustering should generate a high-quality cluster with similar observations in some clusters and dissimilar observations in other clusters. Hierarchical cluster analysis is an iterative process to form various clusters.

There is a strong relationship between computing and iSchools, which support similar results found by I. Song and Y. Zhu.⁶³ In preparation for the future, many iSchools such as Wuhan University or Central China Normal University have added computing content mostly in big data to the curriculum, including an introduction to data science theory. The content covers discussion on data management, social media, and other issues arising from data collection, storage, analysis, and usage. Data science mainly trains students to scientifically collect, store, process, analyse, and use data in legal policy as well as ethical issues throughout the data lifecycle. Big data resources, key technologies of big data, and the application of big data have become important contents of Chinese iSchools. As a derivative of the internet in the internet era, big data permeates people's life and research as a way of thinking and a method of research. The combination of LIS and data science was a valuable step toward sustainable development⁶⁴ to meet society's needs,⁶⁵ which created a new opportunity for the development of LIS.

With the development of modern information technology and so called "soft sciences," the collection, selection, evaluation, and analysis of social information require data science and

TABLE 4
The 8 Clusters and Subjects of Current Research Interest in iSchools in China

clusters	concepts	clusters	concepts
electronic resources; university libraries; digital libraries; libraries library services; information literacy; academic libraries; data management; e-commerce; social media; internet information technology; knowledge sharing; service quality; user studies; information seeking; continuance intention	Libraries; information technology and knowledge management	Informetrics; citation analysis; citations; research evaluation; scientific collaboration; library and information science; collaboration;	Scientific collaboration; and citation analysis
WeChat trust user behaviour e-government	E-government trust	self-efficacy; technology acceptance model; China; e-learning	Electronic learning in China
deep learning; data mining; machine learning; e-commerce; clustering; information retrieval; innovation; knowledge transfer; social capital; satisfaction; neural networks; text mining; ResearchGate; sentiment analysis; social network;	Social networks; deep learnings and information sharing and information	GIS; cloud computing; artificial; intelligence; topic model; visualization; social network; analysis; information science; knowledge management; cellular automata; big data;	Artificial intelligence; Social network analysis; cloud computing
bibliometric analysis; research trends; cword analysis; web of science; network analysis; ontology; bibliometrics; coauthorship	Bibliometrics; Ontology and Network analysis	Twitter; Altmetrics; Scholarly; communication; open access; sleeping beauty; scientometrics; co-citation analysis	Scientometrics and Altmetrics

big data to be the basis to achieve scientific decision-making services at different levels. Data analysis is the process of taking information and data as basic resources and research objects, and organizing and managing information and data effectively by analysing and mining big data in order to provide relevant services for users. Quantitative analysis is a crucial part of LIS, and data is an important resource. The collection and analysis of big data has become an important opportunity for the development of LIS. More and more researchers also fully realize that further value can be realized with the help of data science. Data is a gold mine,⁶⁶ and the development of an LIS relationship to data science has been found in this study for China as well as for other countries also.^{67, 68}

According to the top ten keywords, big data was the main research field within iSchools investigations. S.J. Walker, Viktor Mayer-Schönberger, and Kenneth Cukier regarded the concept of big data as no longer only sampling data but all data; not precise data but fuzzy data focusing on correlation rather than causality.⁶⁹ Big data mainly refers to a new concept and thinking, and people should have a sense of the data surrounding their environment. LIS is the pioneer of information processing and application, and big data on the cultivation of

thinking should be an essential component in the curriculum system. The goal of big data is not only to enhance the professional competitiveness of graduates in the field of LIS but also to lay the foundation for big data literacy. From the perspective of curriculum training objectives, the major goal of big data is to train students in big data thinking and critical thinking in order to improve students' data literacy, enabling them to understand the basic concepts related to big data and put big data technology into practice.

In the era of big data, the scale of data resources presents an explosive and exponential trend, and the sources and types of data are highly complicated. As a center of information resource, libraries face great challenges in the construction, organization, and provision of big data resources due to the rapid growth of the digital and virtual collection of papers, collection of resources, and the assortment and preservation of various web-based resources and scientific research data. Therefore, LIS must cultivate students' awareness of basic concepts of big data and various sources of data, including sensors and social media, as well as the ability of data generation principle, data types of different genres, data collection and fusion, and data quality discrimination. It is worth noting that the information science is without boundary; therefore, it may affect other related fields like computer science and turn it into "iField," as coined by Bonnici, Subramaniam, and Burnett,⁷⁰ and by D. Wu. et al.⁷¹

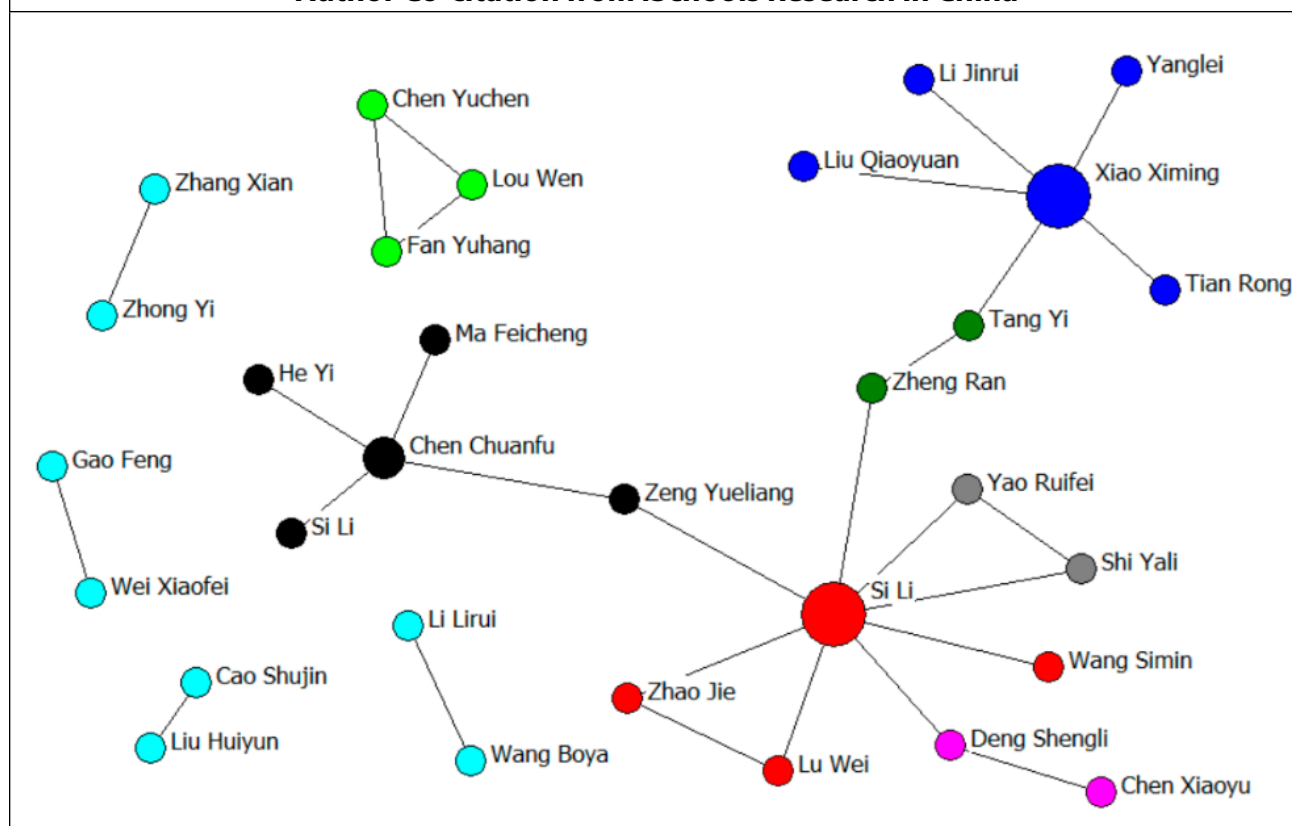
Authorship and Collaboration in Research of iSchools

Co-citation analysis not only includes literature co-citation but also author co-citation, which can be used to evaluate the relationship of authors to LIS, revealing clusters with similar interests, perspectives, patterns, and backgrounds.⁷² Author co-citation analysis establishes the citation relationship, with the author of the documents as the basic unit. When the documents of two authors are cited by a third document at the same time, a co-citation relationship is established. The frequently cited authors are closely related to the relevant research topic. Therefore, author co-citation analysis demonstrates that many authors can be gathered through the cited relationship to form a discipline group network. The impact of an author can be found in terms of citations and can be used to evaluate the contribution of an author to a specific field, which is why it exposes the intellectual structure of a subject.⁷³ The authors with the highest number of citations can be considered to play a significant and basic role in the development and evolution of LIS for Chinese iSchools.

Compared with the development of iSchools, the research on iSchools in China was considered at a later time. Many schools have joined iSchools, and a large number of them have been considered the diversified theme of iSchools.⁷⁴ The co-citation network refers to the citing authors (figure 5). Authors with a higher rate of co-citation trend were found to be closer to each other. From the co-citation view, Ximing Xiao, Li Si, and Chuanfu Chen were the most active scholars in iSchools who played a leading role in promoting the development of iSchools in China.

The selection of high-impact authors is the first step of the co-citation analysis. Since the contribution rate of the first author to academic achievement is the largest, this paper selected the first authors. At present, there are several studies on the selection of high-impact authors in the field of LIS. In this paper, high-impact authors were identified according to their citation frequency. These influential authors promoted the interdisciplinary development of LIS, which had a profound impact on the promotion of Chinese iSchools. Network density was a commonly used indicator in network analysis; it reflected the degree of close relationships between nodes.

FIGURE 5
Author Co-citation from iSchools Research in China



In a co-cited network, the smaller the value of network density and the relationship between scholars, the lesser the cooperation, citation, and other relations, and the slower the knowledge exchange between academic networks. In contrast, the higher the value of network density, the closer the relationship between researchers, frequent cooperation, citation, and other behaviours promoting information exchange and scientific research cooperation. From figure 5, it was easy to discover that the author co-citation network displayed the density of information exchange and scientific cooperation by Chinese iSchools. As indicated earlier, iSchools seek experts from a variety of disciplines to cover multiple themes and bridge gaps; therefore, the displayed density of authors in figure 5 may be a reason for the interdisciplinary environment.⁷⁵ Researchers have contributed to various relevant researches requiring scholarly communication to advance, which is why iSchools are important to sustainability goals as “they develop the culture of sustainable data and information practices across different disciplines and businesses.”⁷⁶

Conclusion

The findings suggest that LIS related research is evolving and that this is still an emerging trend, as the analysis of iSchools publications demonstrates. Therefore, the five conclusions are as follows.

(1) iSchools are deemed to represent interdisciplinary characteristics of schools, which are involved with the development and usage of technology to manipulate information and data. Our results revealed that Chinese iSchools play an important role in LIS. The main scope of iSchools’ publications is related to LIS, and their research interests are focused on topics such as big data, curriculum, health informatics, cultivating talents, etc.

(2) The study demonstrated that there are more opportunities for international cooperation among iSchools, as well as further research collaboration with China on iSchools. Moreover, the scholarly communication capacities in iSchools are increasingly diverse and different, especially concerning data, information, and knowledge.

(3) In the thematic review of publications, large-scale research with educational themes and social media were identified, which revealed their strong connection as well as the use of these networks to develop LIS education. This means that education development is an undeniable trend, especially in LIS. Talent development, on the other hand, was another highlighted theme in iSchools publications. The development of LIS requires modernization; therefore, recruiting more capable scholars and admitting good students will enhance the quality of publications as well as the scientific weight of the school. If the admission process considers graduates of other universities in China as well as in other countries, it would bring new ideas and new perspectives to the research. Although enrolment and career choices vary from student to student, designing a unified curriculum can draw the attention of high-potential students in order to educate and train them for the future “information society.” Finally, the dramatic development of information demands specific attention to acquisition, analysis, and archiving, all related to management as a highlighted topic in our findings, as well as being highly regarded in LIS and LIS training.

(4) iSchools attach great importance to the integration and development of data in the field of LIS. From the perspective of frequency words, the frequency ranking of data in iSchools research is very high. The frequency of the word “data” is generally in the top ranking, which indicates that data occupies a high proportion of iSchools research. The terms “data,” “data management,” “data storage,” “open data,” and so on are seen throughout. From the perspective of literature clustering, the literature related to data is closely associated with other research topics, indicating that data and the existing research themes in the field of LIS are blending. Strengthening the exploration of data will have great significance in the development of Chinese iSchools.

(5) With respect to the future of LIS, human-computer interaction is an essential scientific context to be considered; therefore, the iSchool curriculum should cover it to familiarize future users in the information society with related approaches, solutions, and tools with which to face new challenges.

For future work, it is recommended that those who join the iSchools consider the training goals of LIS, and especially that they analyze the landscape, research interests, and emerging trends not only within but also outside iSchools. Finally, it is suggested that the current approach be conducted in different countries in order to achieve a more global understanding of iSchools.

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