Evolution and Prediction of Hot Keywords in Chinese Information Science Journals

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Abstract

Background: To find the distribution characteristics of research hotspots of periodical papers in the field of Information Science in China, and to explore the basic evolution track of academic research hotspots in the field of Information Science in China.

Methods: The key words of 21 periodical papers in the field of Information Science in China were selected for statistical analysis. The statistical time was from 2000 to 2020, and the statistical data were carried out in Wanfang database. Firstly, select the keywords that are ranked more than 30 times a year as the statistical object of hot research, and then select 60 keywords as the basic hot keywords of information journals. Secondly, the selected 60 keywords are searched in the whole discipline keywords of Wanfang database from 2000 to 2020. Finally, the personalized characteristics and global distribution characteristics of hot keywords of information journals in the whole discipline are compared and analyzed Research. **Conclusion:** The experimental results show that the statistical analysis reveals the evolution track of hot keywords in three stages of Chinese information journal papers in recent 20 years. There are leading and lagging phenomena between the hot keywords of information science and the keywords of the whole discipline, which reflects the development law of mutual learning and mutual promotion between the information discipline and the whole discipline. Based on this law, we can predict the hot spots of Information Science in China in the future, and predict the 72 hot that will continue to appear and may appear in the papers of information journals in China in the future.

Keywords: Hot keywords • Chinese • Library • Journals

Introduction

China's scientific and technological information industry was founded in 1956 and has gone through an extraordinary development process. Chen Chao believes that for more than 60 years, China's scientific and technological information industry has played a role of "booster" and "accelerator" for the national scientific and technological development, reform, and innovation practice, and has made important contributions to promoting the development of science and technology, economy and society [1]. Qiu Junping believes that the information chain, the cornerstone of theoretical research of information science, has developed from fact data information to knowledge wisdom [2]. Chen Fen, et al. believe that information science has made great progress in China since the reform and opening up [3]. The development of informatics needs to comply with the development trend of big data, study the research hotspots and evolution trend in the field of Informatics under the guidance of the new "big information concept" and in combination with the new level, new trends, new technologies and discoveries of social development. Qin Z [4] believes that the research hotspot, knowledge structure, and development trend of the academic field can be identified by counting the frequency of keywords, subject words, article nouns, and other core words in a certain kind of academic literature. Fengmin Y and Yanru L [5] believe that the high-frequency keywords of academic papers in a certain period are the research hotspots in that period. This paper makes a statistical analysis of the keywords of the papers published in China's information science journals, hoping to find the evolution track of the hot spots of information science theoretical research

in China, reveal the interdependence between the development of information science and the development of University Science, and then explore the prediction method of the hot spots of Information Science in the future.

Review of Research Work

Many scholars use different methods such as bibliometrics to make statistical analyses on the hot and frontier fields of information science. Wang Liya, et al. took the research papers published in 38 journals in the field of Library and Information Science in recent 10 years jointly collected by Scopus database and web of science data as the data source [6]. Using the common word cluster analysis method, seven research hotspots in the field of foreign information science are obtained: knowledge management, user technology acceptance behavior, user information behavior in the network environment, library, network information retrieval, information policy, library interlibrary loan. Junping Q and L.V Hong [7] used the papers published in 17 highly influential foreign language journals of Library and information science and their title data collected by SCI and SSCI in recent five years (2008-2012) to carry out visual metrology research. It was concluded that the research hotspots of International Library and Information Science in recent five years were metrology, management, technology, network, retrieval, and medical health. Hongyan Z and Dan Z [8] downloaded the title data of seven representative journals of Informatics from the web of Science in 2014. Taking the data from 2000 to 2010 as an example, they summarized seven main research topics of Informatics since the 21st century: scientific metrology, network resource management and configuration, information retrieval, information system, knowledge management, user interaction and service, and scientific evaluation. In 2017, Xin L, et al. [9] took the "big data" and "Data-Driven" documents of the library and information discipline in the core of web of science as the data source, and adopted the methods of CO word analysis and cluster analysis to obtain eight research hot topics in the field of Library and information. Digital Library Knowledge Organization and semantic interconnection, social network big data, scientific research big data management and sharing Cloud computing and information security, government data opening and sharing, big-data-driven knowledge discovery, e-learning, and higher education, data mining and Digital Humanities. Li Wenjuan, et al. used high-frequency keyword statistics and co-occurrence keyword methods in 2014 to analyze the issuance of documents in China from 2006 to 2010 and summarized four areas of

major concern in the field of Information Science in China during this period: enterprise competitive intelligence, information science theory, knowledge management, and information retrieval [10]. In 2020, Li Shaohui L and Hui H, et al. [11] took 21 core journals of graphic information collected by CNKI from 2011 to 2020 as data sources and revealed 11 hot concerns in the field of graphic information research in China in recent 10 years: a bibliometric analysis based on knowledge map, library and information science driven by data, information service and service quality evaluation, knowledge service and related problems, user information demand and behaviour. The theory and practice of library reading promotion, intelligent library construction and library intelligent service, Digital Humanities, library alliance, competitive intelligence, public cultural service, and public digital cultural service.

The above research uses a variety of research methods to analyse the research hotspots in the field of information science at different stages, but the research time interval for the research hotspots of Information Science in China is relatively short, the obtained research hotspots are still relatively macro, and it fails to show the evolution track of research hotspots and the mutual development relationship of the whole discipline, and the prediction method for future research hotspots. To further understand the research hotspots of China's information science journals, this paper expands the actual research range to 20 years, expands the research scope to the scope related to China's information science journals, compares the research of information discipline with the whole discipline, analyzes the interactive relationship between the development of information discipline and the development of the whole discipline, and looks for the characteristics and development power of information discipline.

Analysis on the Evolution Track of Hot Keywords in Domestic Information Science Journals

Annual distribution statistics of hot keywords in domestic information science journals

The purpose of this paper is to reveal the evolution track of hot keywords in journal papers in the field of Information Science in China in recent 20 years. According to this purpose, the statistical work consists of three stages.

The first stage is the selection of journals in the field of information. According to the document classification method of Wanfang database, "the classification code of information science is N07", there are 14 journals: competitive intelligence, information engineering, information science, information theory and practice, information exploration, information journal, information magazine, information work, library and information work, library and information knowledge, library and information, modern information, Chinese traditional medicine library and information magazine Chinese Journal of Medical Library and information. Based on the N07 classification code, seven other journals with "information" are added, namely "University Library and Information Science Journal and Agricultural Library and Information Science Journal" with "Library Science and Philology classification code N06"; "Journal of aquatic science and technology information and preventive medical information" with "comprehensive code of preventive medicine and public health d31"; "Land and resources information" with "geographical classification code B10"; "Geological science and technology information" with "geological classification code B11"; "Forestry science and technology information" with "forestry classification code C07"; Finally, a total of 21 domestic information science journals were selected.

The second stage is the selection of statistical time. The statistical data comes from Wanfang database. The starting time of 21 journals in the field of Information Science in Wanfang database is different, and most of them were collected around 1989. For example, the Journal of information science was founded in 1982, and Wanfang database was included in 1989. There is also the Journal of Library and information of Chinese traditional medicine, which was founded in 1960, and Wanfang database was included in 2013. Therefore, the statistical time is from 2000 to August 21, 2020.

The third stage is the selection of hot keywords. There are two conditions for the selection principle of hot keywords. First, take the top 30 keywords in the annual ranking as the statistical object of hot keyword research. Secondly, according to the annual duration of keywords is greater than a reasonable value, that is, the duration of keywords appearing before 2017 is maintained at more than 4 years, and the duration of keywords appearing in 2018 is maintained at more than 2 years.

According to the above three statistical conditions, 60 keywords were selected as the basic hot keywords of journal papers in the field of information science, and these 60 hot keywords appeared 43204 times. Select 60 hot keywords, as shown in Table 1.

The annual distribution of 60 hot keywords of journals in the field of information science from 2000 to 2020 is shown in Figure 1. It can be seen that the number of these 60 hot keywords remains between 24-30 times a year.

Track evolution analysis of hot keywords in papers of Information Science Journals

To analyze the chronological distribution and quantitative characteristics of 60 hot keywords, the 60 hot keywords are divided into three stages according to the starting time. The first stage is 2000, including 24 keywords, which is shown in Figure 2. The second stage is 2001-2009, including 21 keywords, represented by Figure 3. The third stage is 2011-2019, including 15 keywords, as shown in Figure 4. Among the 60 hot keywords, most of them appear about hundreds of times, and the number of two hot keywords is too large, several times higher than that of other hot keywords, such as 7809 times for "library" and 6184 times for "University Library". To make the data details displayed by graphics clearer, these two keywords are deleted, Therefore, only 22 hot keywords are reserved in Figure 2 in the first stage. In Figure 2, the ordinate is the number of keyword occurrences, and the abscissa is the year.

As can be seen from Figure 2, 22 hot keywords appeared in 2000, which shows that some words appeared in 2000 and before. Therefore, the hot keywords that appeared in 2000 are called "hot keywords 20 years ago", Such as "knowledge economy, Internet, network information resources, search engine, librarian, information management, information technology, informatization, database, library management, network environment, intellectual property rights, e-commerce, library science, resource sharing, information resources, information retrieval, competitive intelligence, digital library, information service, competitive intelligence, and information science", It also includes the "university library, library" appeared in 2000. Figure 3 shows the 15 hot keywords that began to appear in the second stage from 2001 to 2009. The ordinate in the figure is the number of keywords and the abscissa is the year.

As can be seen from Figure 3, 15 hot keywords appeared from 2001 to 2009. We regard these 15 words as "hot keywords in the previous 10 years", Such as "digitization, reader service, statistical analysis, e-government, citation analysis, bibliometrics, data mining, knowledge service, subject librarian, public library, digital resources, knowledge sharing, college students, scientific and technological novelty search, influencing factors". Figure 4 shows the 21 hot keywords that began to appear between 2011 and 2019. The ordinate in the figure is the number of keywords and the abscissa is the year.

As can be seen from Figure 4, 21 hot keywords began to appear between 2011 and 2019, which can be regarded as "hot keywords in recent 10 years", Such as "cloud computing, library services, information literacy, document measurement, social network analysis, CO word analysis, knowledge map, network public opinion, discipline services, mobile library, big data, visualization, reading promotion, patent analysis, research hotspots, emergencies, smart library, artificial intelligence, in-depth learning, information work, and scientific data".

Comparative Analysis of Keyword Characteristics between Information Discipline and the Whole Discipline

Comparative analysis of key words between information science journals and whole discipline journals

In order to compare the relationship between the subject characteristics of hot keywords of information science journals in China and the overall

Table 1. Selected 60 hot keywords.

| Starting Year	Termination Year	Key Words - Duration Year	Starting Year	Termination year	Key Words - Duration Year	Starting Year	Termination Year	Key Words - Duration Year
2000	2020	Library-21	2000	2007	Information Management-7	2011	2020	Social network analysis-10
2000	2020	University library-21	2000	2006	Network information resources-6	2011	2019	Information literacy-8
2000	2019	Digital library-20	2000	2004	Internet-5	2011	2018	Library services - 6
2000	2019	Information Service-20	2000	2003	Knowledge Economy-4	2011	2015	Cloud computing-5
2000	2019	Competitive intelligence-20	2001	2010	Reader Service-8	2012	2020	Internet public opinion-9
2000	2020	Informatics-18	2001	2005	Digitization-8	2012	2019	Knowledge map-8
2000	2015	Knowledge management-16	2004	2012	Statistical Analysis-9	2012	2016	Co-word analysis-4
2000	2013	Information resources-14	2004	2013	E-government-8	2013	2020	Big data-8
2000	2015	Information retrieval-13	2005	2020	Knowledge Services-16	2013	2018	Discipline services-6
2000	2010	Network environment-11	2005	2020	Data Mining-14	2013	2018	Mobile library-6
2000	2010	Database-11	2005	2019	Bibliometrics-12	2014	2020	Reading promotion-7
2000	2012	Resource sharing-11	2005	2015	Citation analysis-8	2014	2020	Patent analysis-6
2000	2011	Library science-11	2007	2020	Public library-14	2014	2018	Visualization-5
2000	2011	E-commerce-9	2007	2015	Subject librarian-9	2016	2019	Research hotspot-4
2000	2010	Library management-9	2008	2014	Knowledge sharing-7	2016	2020	Emergency - 4
2000	2008	Informatization-9	2008	2016	College Students - 7	2018	2019	Smart Library-2
2000	2007	Search engine-8	2008	2014	Digital Resources-6	2019	2020	AI-2
2000	2007	Information technology-7	2009	2020	Influencing Factors-12	2019	2020	Deep Learning-2
2000	2007	Librarian-7	2009	2013	Science and Technology Novelty Search-5	2019	2020	Intelligence work-2
2000	2010	Intellectual property - 7	2011	2020	Bibliometrics-10	2019	2020	Scientific Data-2
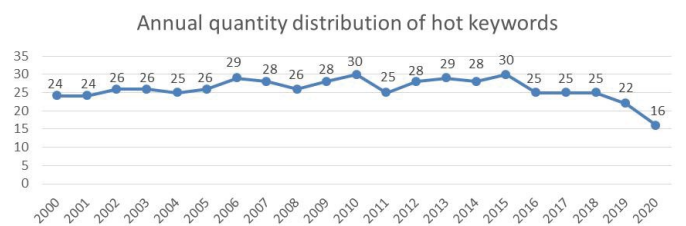
Figure 1. Annual quantity distribution of 60 hot keywords in journals in the field of information science from 2000 to 2020.
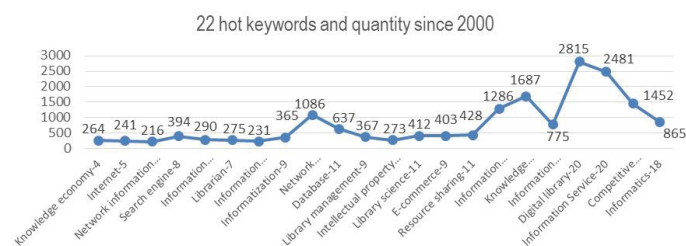

Figure 3. 15 hot keywords starting to appear between 2001 and 2009.

Figure 2. 22 hot keywords since 2000.

Figure 4. 21 hot keywords starting to appear between 2011 and 2019.
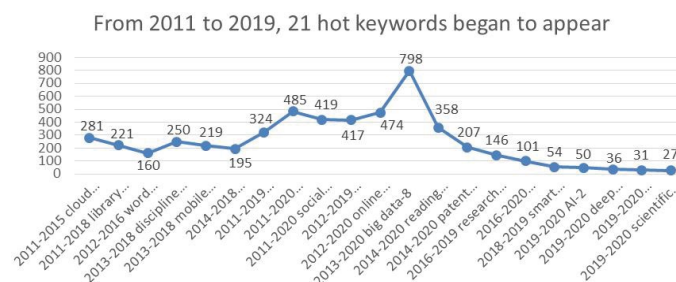
characteristics of all subject journals, in order to find the overall era background of the evolution track of journal paper hot research in the field of Information Science in China. In order to simplify the expression of terms, "21 kinds of information science j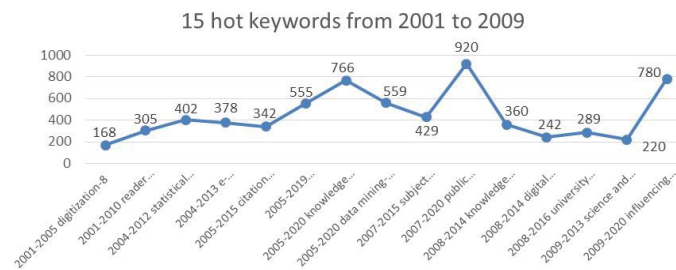ournals" are called "Information Science Journals" and "all discipline journals except 21 kinds of information science journals" are called "all discipline journals".

The statistical method is divided into four steps:

a) Carry out word frequency statistics on the keywords of "Information Science Journals", the statistical time is 2000-2020, and the keywords with word frequency ranking higher than 100 in each year are called hot keywords.

b) 370 annual hot words are obtained from the statistical results of the first step.

c) The 370 hot keywords are used to count the keyword frequency of "whole discipline journal" and "Information Science Journal" respectively.

d) Compare the time difference between "Information Science Journal" and "whole discipline journal".

Compare the analysis results

a) All 370 annual hot words obtained from the statistics of "Information Science Journals" appear in "whole discipline journals".

b) The 370 annual hot words appeared in the "whole discipline journal" for more than 10 years, 349 keywords, and 321 keywords appeared in the "Information Science Journal" for more than 10 years.

c) The word frequency of key words in "whole discipline journal" and "Information Science Journal" in the same year varies greatly, such as "countermeasures" 495807 times.

d) There are also great differences in the years when the same keywords appear in "whole discipline journals" and "Information Science Journals". For example, the time difference of "big data" is 9 years, and the word frequency difference is 45984 times.

e) The annual maximum word frequency of the same keyword is also very different. For example, the number of "countermeasures" and "whole discipline journals" is 1565 and that of "Information Science Journals" is 16.

Leading and lagging analysis of information science journals and whole discipline keywords

The keywords of "Information Science Journal" and "whole discipline journal" are ahead and behind. The data analysis takes 2010 as the boundary and is divided into two stages.

Stage 2000-2010: 332 keywords began to appear in 2000-2010, of which

10 keywords appeared in the "Information Science Journal" in the year ahead of the "whole discipline journal", which is represented by Table 2. The number of years in the table is marked with "-" to represent the year ahead and "+" to represent the year behind. 322 keywords are lagging, and 36 keywords lagging more than 3 years, as shown in Table 3.

2011-2020: during this period, "information journal" appeared 145 hot keywords in the first 100 times of the year, and the number of 145 keywords of "Information Science Journal" ahead and behind "whole discipline journal" is shown in Figure 5. In Figure 5, the abscissa is the number of years leading and lagging, the negative number is leading, and the positive number is lagging. The ordinate is the number of leading and lagging keywords.

As can be seen from Figure 5, there are two words ahead of 9 years (Library and information work, information reform); 26 words appeared in the same year; 40 words lag one year; 2 words are lagging 11 years (intelligence analysis, data-driven); One word (traditional Chinese Medicine Culture) lags for 15 years.

The 36 keywords of "information discipline" leading and lagging "whole discipline" after 2011 are shown in Table 4 below.

The statistical analysis shows that although the years of the occurrence of the keywords "Information Science Journals" and "all discipline journals" are ahead and behind, from 2000 to 2020, there are 370 "Information Science Journals" with a year of occurrence of more than 10 years, 349 "all discipline journals" and 321 "Information Science Journals". This shows that "Information Science Journal" is developing continuously in the process of absorption and innovation, and has its core keywords. We can predict new keywords by using the lag phenomenon in the year of the emergence of keywords in "Information Science Journals" and "whole discipline journals".

Prediction of Hot Keywords in Information Science Journals

Prediction method of future hot keywords

According to the statistical results the hot keywords of "whole discipline journal" appeared nearly 10 years earlier than the hot keywords of "Information Science Journal" [12], G30 (scientific research theory), G31 (scientific research work), G32 (scientific research undertakings all over the world), G35 (Information science, information work), G20 (information and communication

Table 2. Keywords of Information Science Journal ahead of whole discipline journal.

Key Words	Leading Year	Key Words	Leading Year
Scientific service	-1	Information research	-1
Reading promotion	-1	Topic evolution	-2
Information architecture	-1	Intelligence sharing	-2
Compound library	-1	Intelligent service	-2
Intelligence analysis	-1	Information reform	-9

Table 3. 36 key words of Information Science Journal lagging whole discipline journal for more than 3 years.

Key Words	Lagging Year	Key words	Lagging Year	Key Words	Lagging Year
Linked data	9	Open data	6	Grid	4
Seminar	9	Cloud computing	6	Intelligent technology	4
Grounded theory	9	H-index	6	Mobile library	3
Reading service	9	Complex network	6	Scientific research cooperation	3
Collaborative innovation	8	Structural equation model	6	Performance evaluation	3
Visual analytic	7	Factor analysis	6	Performance appraisal	3
Research frontier	7	Topic model	4	Emergency events	3
Evolutionary game theory	7	Network public opinion	4	Library alliance	3
Contingency management	7	Patent quality	4	New media	3
Times cited	7	Information system	4	Information visualization	3
System dynamics	7	Social network	4	Knowledge distribution	3
Social networks	6	Ontology	4	Resource integration	3

Figure of the number of leading and lagging 145 keywords of "information discipline" and "whole discipline" from 2011 to 2020
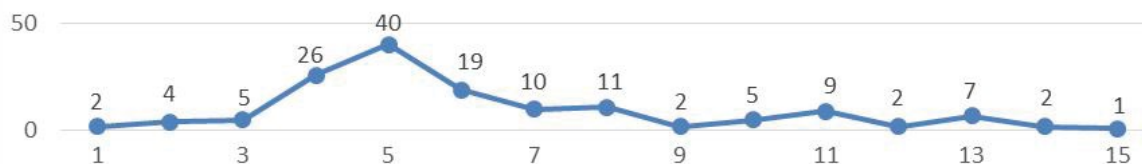
Figure 5. Quantity distribution of 145 keywords of information discipline and whole discipline in lead and lag years from 2011 to 2020.

Table 4. 36 key words of information discipline leading and lagging whole discipline after 2011.

Key Words	Year	Key Words	Year	Key Words	Year
Chinese medical culture	15	Digital humanities	3	A holistic view of national security	1
Emotion analysis	11	Online review	3	Wechat public platform	1
Data driven	11	User portrait	2	Wechat platform	1
Value co-creation	9	Wechat official account	2	MOOC	1
Deep learning	9	ZhiHu	2	Government data opening	1
Big data	9	Wechat	2	Reader decision procurement	1
Think tank	7	Smart library	2	Artificial intelligence	1
New type think tank	5	Social media	2	Maker space	0
Counterpart employment	4	COVID-19	1	Virtual academic community	0
Lda model	4	Blockchain	1	Government data	-1
Social media	4	Internet plus	1	Open government data	-1
Rain class	3	The belt and road	1	Intelligence perception	-2

Table 5. 30 hot keywords of Information Science Journal and reference whole discipline journal.

Key Words	Percentage (%)	Key Words	Percentage (%)	Key Words	Percentage (%)
Bibliometrics	18.37	Blockchain	1.39	We media	0.54
Smart library	13.38	Collaborative innovation	1.38	Rain class	0.52
Knowledge map	12.88	Mobile internet	1.12	Convolutional neural network	0.47
Network public opinion	11.51	Performance appraisal	1.08	New media	0.36
Reading promotion	8.60	Data analysis	0.98	Big data era	0.36
Social media	5.73	Deep learning	0.91	Internet of things	0.32
Collaborative filtering	3.50	Feature integration	0.83	The belt and road	0.32
Wechat public platform	3.12	MOOC	0.76	Short video	0.22
Privacy protection	2.28	Internet plus	0.62	Image recognition	0.20
Big data	1.73	Big data technology	0.54	Artificial intelligence	0.20

Table 6. 72 hot keywords that may appear in Information Science Journals after 2021.

Key Words					
Information reform	Cluster analysis	Civil military integration	Scientific research cooperation	Intelligent technology	Evolutionary game theory
Intelligence perception	Evaluation system	Scientific data	Emergency events	Topic model	Contingency management
Intelligence sharing	Blockchain	Content analysis	Library alliance	new type think tank	Think tank
Intelligent service	Artificial intelligence	Social media	Information visualization	H-index	Collaborative innovation
Topic evolution	Text mining	Data sharing	Mobile library	Complex network	Big data
Intelligence analysis	Virtual community	Data management	Knowledge distribution	Open data	Linked data
Information research	Research hotspots	Information collaboration	Resource integration	Social networks	Value co-creation
Information architecture	User experience	Information behavior	Lda model	Factor analysis	Deep learning
Scientific service	User behavior	User portrait	Ontology	Cloud computing	Reading service
Reading promotion	User requirement	Knowledge network	Information system	Visual analysis	Sentiment analysis
Personalized recommendation	Knowledge transfer	Smart library	Social network analysis	System dynamics	Data driven
Machine learning	Personalization	Patent analysis	Network public opinion	Research frontier	Chinese medical culture

theory), G23 (Publishing Industry) were selected, G25 (Library Science, library cause), G27 (archival science, archival cause) and tp39 (computing technology, computer technology) to establish a relatively specific prediction and statistical test scope of "reference whole discipline journals". Firstly, the relevant journals are retrieved with these nine categories, which are called "reference whole discipline journals". Make statistics of all keywords of "reference whole discipline journals", and finally select hot keywords from these keywords. The statistical time is 2000-2020. Take the first 300 keywords appearing every year as hot keywords, select 833 keywords, and appear 4516745 times. Among them, 258 keywords appeared after 2011.

Make statistics on the distribution of 258 keywords in "reference subject journal" and "Information Science Journal" after 2011, and compare the distribution law of 258 keywords in "reference subject journal" and "Information Science Journal". 258 keywords appeared 624873 times in "reference whole discipline journal" and 174 keywords appeared 630 times in "Information Science Journal".

Prediction results of hot keywords in the future

The first 30 hot keywords with a ratio greater than 0.20% are selected through the ratio of the occurrence times of "Information Science Journal" and "reference whole discipline journal", as shown in Table 5.

After statistical prediction and analysis, we get 72 possible hot keywords in the future, as shown in Table 6.

Conclusion

This paper makes a statistical analysis on the keywords of papers published in domestic information science journals from 2000 to 2020, obtains 60 hot keywords, and divides the 60 hot keywords into three stages: 2000 and before, 2001-2009, and 2010-2020. The hot keywords in the three stages represent the research focus and basic evolution track of information journal papers. Through the comparative analysis with the hot keywords of the whole discipline, it is found that the hot keywords of information science journal papers also have unique hot keywords different from the keywords of the whole discipline. At the same time, some hot keywords of information science journal papers lag behind the keywords of the whole discipline for 10 years. This feature reflects the law of the domain characteristics and overall characteristics of the field discipline and the whole discipline, and also reflects the characteristics of the hot keywords of the journal papers of information science closely following the technological development of the whole discipline and the continual introduction and innovative development of social needs, Through the method of "referring to the whole discipline journal", the leading and lagging data of hot keywords in the papers of "Information Science Journal" and "referring to the whole discipline journal" are statistically analyzed, and 72 hot keywords that may appear in the papers of information science journals in the future are predicted. Although our statistical prediction method has obtained some results, these results will still need to be further tested in practice.

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