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Analysis of Topics of Interdisciplinary Research in the Field of Library Science and Information Science from the Perspective of Altmetrics

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Abstract

On the basis of identifying the interdisciplinary research topics in the field of Library and Information Science, this paper constructed Altmetrics indicator systems and makes SOFM neural network clustering analysis on the comprehensive influence of the research topics, in order to provide reference for the interdisciplinary crossover and integration of Library and Information discipline in China under the background of "New Liberal Arts". The study found that the 20 interdisciplinary research topics could be divided into four types according to their influence composition characteristics: comprehensive hotspots, online social hotspots, academic hotspots, potential hotspots. Interdisciplinary hot topics were important for the intersection and integration of library and information field and other disciplines, and high impact research topics deserved close attention from Chinese scholars.

Subject Areas

Library and Information Science

Keywords

Altmetrics, Library and Information Science, Interdisciplinary Research

1. Introduction

Interdisciplinary research refers to research activities that break down disciplinary barriers and organically integrate theories or methods from different disciplines into one, which is one of the important sources of original scientific achievements [1], and is of great significance in promoting the rapid development of the discipline of Library and Information Science. In 2020, China re-

leased the "Declaration on the Construction of New Liberal Arts", which strongly advocates interdisciplinary knowledge integration and deep integration, and interdisciplinary cross-fertilization has become a problem that must be faced for the survival and development of the discipline of Library and Information Science [2], and there is an urgent need to promote the development and transformation of the discipline through interdisciplinary research.

Scholars in China have been paying close attention to interdisciplinary research in the field of Library Science & Information Science since the 1990s [3] [4] [5] [6], and the relevant results have laid a solid foundation for exploring the characteristics and laws of interdisciplinary research, but there is still room for further expansion in the following two aspects: 1) The quantitative characteristics and content characteristics of interdisciplinary research themes in the field of library and information science were not fully revealed; 2) The impact of interdisciplinary research themes in the field of Library Science & Information Science has not been comprehensively compared and evaluated, and the future development direction of interdisciplinary research needs to be further clarified. Based on the identification of interdisciplinary research themes in the field of Library Science & Information Science, this study introduces the Altmetrics index system to measure and analyze the comprehensive influence of research themes, with a view to providing reference for the development of China's Library Science & Information Science discipline in the context of the New Liberal Arts.

2. Data Sources and Methods

2.1. Data Sources

We searched for research papers in the field of Library Science & Information Science on the Web of Science (WOS) platform through the "advanced search" function with the search formula "WC = INFORMATION SCIENCE LIBRARY SCIENCE", the type of literature was limited to "Article, Review and Proceedings Paper", and the year was limited to 2016-2020. 25,153 research papers in the field of Library Science & Information Science were retrieved, and the search period was February 2021.

The common sources of Altmetrics metrics data are ImpactStory, Altmetric.com, Plum Analytics, PLOS ALM and other databases, among which Altmetric.com has the most specific evaluation objects and relatively complete and diverse data sources [7], so this study uses Altmetric.com to collect the Altmetrics metrics data of the papers. The DOI numbers of 25,153 papers exported from the WOS platform were searched in Altmtrics.com, and a total of 12,466 papers with Altmetrics index data were obtained.

The Web of Science platform identifies papers in the "WC" field according to its disciplinary classification system, and each paper belongs to one or more disciplines, and this disciplinary classification system is mostly used in previous studies to determine the disciplinary affiliation of papers [8]. Therefore, this

study defines papers involving two or more disciplines at the same time as interdisciplinary research papers based on the disciplines marked in this platform. Among 12,466 papers in the field of library and intelligence, a total of 8,541 papers involved both library and intelligence disciplines and other disciplines (including computer science, management, communication, medical informatics, etc.), and the number of interdisciplinary research papers reached 68.51%.

2.2. Analysis Methodology

2.2.1. Interdisciplinary Research Topics Identification

In this study, we propose to identify research topics from 8541 interdisciplinary research papers. In 2020, CoreVian introduced the "Citation Topics" analysis function in Incites, which uses Leiden University's clustering algorithm to identify topics in the direct citation network of SCI and SSCI papers [9], and constructs a composite topic classification framework system, which can for users to search, identify and analyze topics at three levels: macro (10 topics), meso (326 topics) and micro (2444 topics) [10]. This topic classification system assigns each paper to a single research topic, providing researchers with a stable and reliable way to identify topics. Therefore, in this study, the 8541 retrieved interdisciplinary research papers were imported into Incites to identify each paper's microscopic research theme through its citation theme function.

2.2.2. Impact Measurement of Interdisciplinary Research Topics

A normality test of the Altmetrics indicators of the papers revealed that the indicators were not normally distributed, and therefore it is not appropriate to use the arithmetic mean of the indicators to describe the influence of different topics. The rank-sum test was a nonparametric test that did not depend on the specific form of the overall distribution [1] and could be applied without regard to what kind of distribution the subject of study is and whether the distribution is known, so this study measured the influence of the subject of study by calculating the rank mean of each indicator.

The advantage of Self-Organizing Feature Maps (SOFM), also known as Kohoen network, was that the classification results were represented in the competitive layer by self-organizing learning of the input patterns in an unsupervised manner, fully preserving the distributional properties and topology of the input vectors [11]. In this study, the rank mean values of research topics on each Altmetrics metric were imported into Matlab, and the SOFM neural network was built using SOM Toolbox to cluster and analyze the distribution characteristics of multiple Altmetrics metrics for each research topic in order to reveal the influence characteristics of interdisciplinary research topics in depth.

3. Results and Analysis

3.1. Altmetrics Indicators of the Papers

The descriptive statistics of 17 Altmetrics indicators of 8541 interdisciplinary research papers were shown in **Table 1**. In terms of concentration trends, the 75%

Table 1. Altmetrics indicators for interdisciplinary research papers in the field of library science & information science.

Indicators	Concentration trends				Degree of dispersion				Distribution pattern		Coverage
	25%	Median	75%	Mean	Min	Max	Range	Sd	Skewness	Kurtosis	
Mendeley	12	25	50	42.82	0	2294	2294	70.93	10.95	237.16	99.08%
Citation	1	3	8	7.06	0	790	790	18.05	22.61	837.78	77.38%
Twitter	1	2	7	8.85	0	1188	1188	29.88	16.45	441.31	76.89%
Facebook	0	0	0	0.20	0	17	17	0.62	6.67	93.42	14.11%
Blog	0	0	0	0.16	0	21	21	0.66	10.37	198.41	9.81%
News	0	0	0	0.33	0	148	148	3.06	26.10	958.63	6.08%
Policy	0	0	0	0.04	0	8	8	0.28	11.68	213.86	3.23%
Google+	0	0	0	0.04	0	15	15	0.31	20.40	754.90	2.61%
Wikipedia	0	0	0	0.03	0	6	6	0.23	13.09	236.16	1.93%
Reddit	0	0	0	0.01	0	4	4	0.14	15.17	301.64	0.97%
Patent	0	0	0	0.05	0	75	75	1.25	49.36	2795.32	0.70%
Syllabi	0	0	0	0.25	0	171	171	4.15	25.54	833.13	0.66%
Video	0	0	0	0.00	0	2	2	0.05	21.38	501.16	0.26%
Peer review	0	0	0	0.00	0	5	5	0.08	42.20	2204.05	0.23%
Sina Weibo	0	0	0	0.00	0	30	30	0.33	91.08	8372.89	0.12%
F1000	0	0	0	0.00	0	2	2	0.04	37.97	1619.78	0.09%
Q&A	0	0	0	0.00	0	1	1	0.03	34.89	1215.86	0.08%

quartiles of most indicators were 0, and the median was more different from the mean, indicating that the concentration of these indicators was low. In terms of dispersion, the standard deviation of each indicator was much larger than the mean, and the extreme deviation is also larger, indicating that the data dispersion was very high. From the dispersion degree, the standard deviation of each indicator was much larger than the mean value, and the extreme deviation is also larger, indicating that the data were very discrete. In terms of the distribution pattern, the skewness of each indicator was greater than 0, and the kurtosis is greater than 3, showing a long-tailed right-skewed spike curve. In general, the non-zero scores of most indicators were concentrated in a very small number of literature, which obviously did not obey normal distribution.

The coverage ratio in Table 1 was the ratio of the number of papers with non-zero values under a certain indicator to the total number of papers, which could reflect to some extent the value of the indicator available in the evaluation of papers, and also to see where the influence of papers mainly comes from. The seven indicators with the highest coverage of interdisciplinary research papers in the field of Library Science & Information Science were, in order, Mendeley readership, Citation, Twitter mentions, Facebook mentions, Blog mentions, News mentions, and Policy mentions. Therefore, these seven indicators were chosen to analyze the influence of interdisciplinary research topics.

3.2. Identification of Interdisciplinary Research Topics

After importing 8541 interdisciplinary research papers into Incites, the micro themes of each paper were identified through the "citation theme" function, and a total of 587 micro themes were obtained, among which the 20 micro themes with the largest number of papers are shown in Table 2. The themes were listed in descending order of the number of papers. The keywords were extracted from 4634 papers for word frequency statistics, and a total of 9312 keywords were obtained, among which 98 high-frequency keywords with a word frequency of 14 or more. In this study, a "topic-high-frequency keyword" (20 rows * 98 columns) matrix was constructed to calculate the TF-IDF value of each high-frequency keyword on each topic, and then the three keywords with the highest TF-IDF values were extracted from each topic to characterize the content of each topic. For example, the main feature keywords of theme 1 "bibliometrics" were Bibliometrics, Altmetrics, and Citation Analysis, and the theme names and feature keywords show a strong consistency, which further verified the reasonableness of "citation themes" in classifying the topics of papers.

Table 2. Interdisciplinary research topics and their keywords.

Rank	Research Topics	Papers	Keywords
1	6.238.166 Bibliometrics	1462	bibliometrics, citation analysis, scientometrics
2	4.48.228 Information Literacy	522	information behavior, information literacy, information seeking
3	6.3.2 Knowledge Management	471	knowledge management, knowledge sharing, information technology
4	6.185.184 Journalism	327	fake news, digital media, elections
5	4.48.672 Sentiment Analysis	216	text mining, sentiment analysis, clustering
6	1.273.870 Health Literacy	202	patient engagement, patient portals, personal health records
7	1.14.703 Electronic Health Records	188	electronic health record, health information technology, policy
8	6.3.368 Technology Acceptance Model	131	digital divide, digital inclusion, technology acceptance
9	6.3.65 Customer Satisfaction	128	social media, content analysis, online communities
10	4.48.120 Complex Networks	128	social networks, network analysis, scientific collaboration
11	6.185.1004 Internet Addiction	103	facebook, social capital, social networking sites
12	1.54.79 Gene Expression Data	98	machine learning, natural language processing, metadata
13	6.185.1644 Privacy	96	big data, trust, transparency , digital inclusion
14	4.48.322 Semantic Web	89	ontology, linked data, digital libraries
15	1.155.1378 Null Hypothesis Significance Testing	88	open data, data sharing, research data management
16	4.48.817 Collaborative Filtering	85	personalization, collaborative filtering, recommender systems
17	4.17.128 Deep Learning	78	deep learning, neural networks, digital libraries
18	6.321.2444 Open Government Data	78	open data, transparency, open government
19	6.288.2155 Digital Humanities	73	digital humanities, project management, university libraries
20	4.187.2134 Blockchain	71	blockchain, security, distributed ledger technology

3.3. Influence of Interdisciplinary Research Topics

The rank mean values of Altmetrics indicators of the 20 research topics were counted, and the results were shown in Table 3. To further analyze the influence composition characteristics of each research topic, the data of the 7 indicators in Table 3 were imported into Matlab, a matrix of 20 rows and 7 columns was built, and the SOFM neural network was trained with SOM Toolbox: the input layer was set to 7 neurons, corresponding to the 7 research topic influence indicators; the competitive layer is set as a 2 × 2 two-dimensional structure, all research topics were classified into 4 categories by 4 neurons. The number of iterations (epochs) was set to 1000, and the final training results of the SOFM network were shown in Figure 1.

The neurons were represented by blue hexagons in Figure 1, and the neurons corresponding to each of the 20 study topics were labeled. The connection color between neurons indicated the distance: the closer the connection color between neurons was to yellow, the closer the distance between two neurons, the more

Table 3. Rank means of Altmetrics indicators for research topics.

Rank	Research Topics	Rank means						
		Mendeley	Citation	Twitter	Facebook	Blog	News	Policy
1	Bibliometrics	2053	2376	2600	2152	2427	2197	2251
2	Information Literacy	1628	1730	1987	2081	2161	2127	2156
3	Knowledge Management	3201	2535	1459	1994	2012	2150	2167
4	Journalism	1940	2104	2762	2650	2194	2293	2205
5	Sentiment Analysis	1919	2054	1587	2006	1980	2129	2144
6	Health Literacy	2564	2473	2599	2679	2125	2307	2450
7	Electronic Health Records	2812	2442	3032	2799	2257	2564	2237
8	Technology Acceptance Model	3006	2347	1602	2032	2033	2176	2177
9	Customer Satisfaction	3085	2505	1434	2102	2001	2283	2161
10	Complex Networks	1497	1594	1463	2068	2004	2190	2144
11	Internet Addiction	2848	2624	1916	2392	2184	2631	2165
12	Gene Expression Data	2364	2411	2545	2586	2082	2202	2144
13	Privacy	2631	2115	2150	2133	2169	2260	2241
14	Semantic Web	1208	1299	1484	2043	2105	2089	2144
15	Null Hypothesis Significance Testing	2089	1997	2750	2099	2385	2142	2378
16	Collaborative Filtering	1375	1610	1288	1943	2059	2089	2144
17	Deep Learning	1676	1654	2011	2183	2002	2144	2144
18	Open Government Data	2040	1925	2478	2625	2007	2089	2203
19	Digital Humanities	1717	1698	2769	2366	2430	2207	2144
20	Blockchain	3010	2596	2243	2675	2345	2337	2388

similar the influence distribution characteristics of the study topic; the closer the connection color between neurons was to black, the more distant the distance between two neurons, and the more different the influence distribution characteristics of the study topic. The connection between the first neuron and the third neuron was black, which means the influence of the two corresponding research topics was very different; the connection between the first neuron and the second neuron was yellow, which means the influence of the two corresponding research topics was closer.

According to the results of clustering of SOFM network, the influence characteristics of 20 research topics could be divided into 4 categories (see Table 4), namely, comprehensive attention hotspots, online social hotspots, academic research hotspots, and potential attention hotspots.

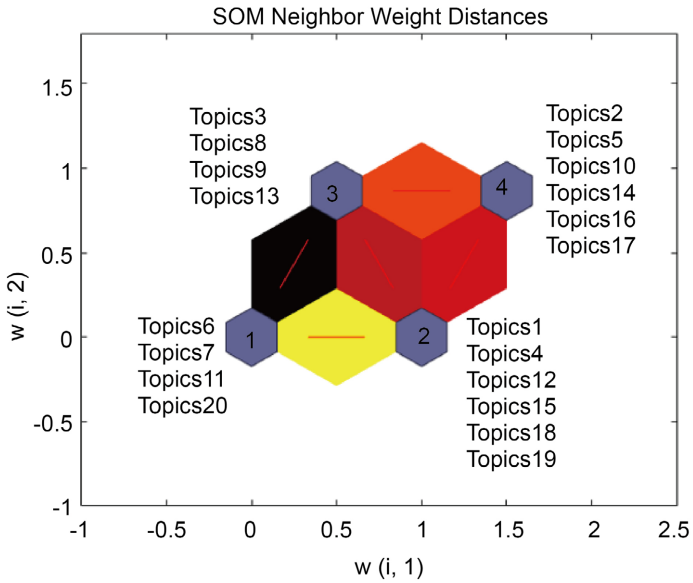

Figure 1. Results of interdisciplinary research topic clustering based on SOFM network.

Table 4. Characteristics of impact distribution of interdisciplinary research themes.

Cluster	Characteristics	Research Topics	Main indicators
1	comprehensive hotspots	Topic 6 Health Literacy, Topic 7 Electronic Health Records, Topic 11 Internet Addiction, Topic 20 Blockchain	Twitter, Facebook, Blog, News, Policy, Citation, Mendeley
2	online social hotspots	Topic 1 Bibliometrics, Topic 4 Journalism, Topic 12 Gene Expression Data, Topic 15 Null Hypothesis Significance Testing, Topic 18 Open Government Data, Topic 19 Digital Humanities	Twitter, Facebook, Blog
3	academic hotspots	Topic 3 Knowledge Management, Topic 8 Technology Acceptance Model, Topic 9 Customer Satisfaction, Topic 13 Privacy	Mendeley, Citation
4	potential hotspots	Topic 2 Information Literacy, Topic 5 Sentiment Analysis, Topic 10 Complex Networks, Topic 14 Semantic Web, Topic 16 Collaborative Filtering, Topic 17 Deep Learning	Lack of prominent indicators

4. Conclusions

Interdisciplinary research topics were important grip between the field of Library Science & Information Science and other disciplines, and were good entry points to enhance the comprehensive influence of the discipline. In the past five years, the interdisciplinary research papers in the field of Library Science & Information Science have accounted for 68.51% of the total number of papers in this discipline, and the discipline of Library Science & Information Science has formed a closer cross-fertilization with computer science, management, communication, medical informatics and other disciplines, forming 20 more concentrated interdisciplinary research themes, which in turn reflect and enhance the influence of this discipline through a series of Altmetrics indicators. These interdisciplinary research topics were reflected and enhanced by a series of Altmetrics indicators.

Seven indicators such as the number of Mendeley readers, Twitter mentions, and Facebook mentions have high coverage in interdisciplinary research papers, indicating that interdisciplinary research results were widely mentioned in academic activities (Mendeley), academic reviews (blogs), social activities (Twitter, Facebook), social media (news), and national policies. The academic influence, social influence, and policy influence of the discipline of Library Science & Information Science have been significantly reflected and enhanced. This study classifies 20 interdisciplinary research topics into four types according to SOFM network: comprehensive hotspots, online social hotspots, academic hotspots, and potential hotspots, which can provide reference for discipline construction and development of interdisciplinary research in the field of Library Science & Information Science. The introduction of Altmetrics indicators and the clustering analysis of the comprehensive influence of research topics through SOFM modeling are the innovation of this paper, and these methods can also be extended and applied to other disciplines to further promote the development and deepening of Altmetrics in scientific evaluation. As data of Altmetrics indicators of Chinese papers are difficult to obtain at present, the comprehensive influence and content characteristics of Chinese interdisciplinary research topics are yet to be further explored in the future.

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Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Li, J. (2014) The Concept and Measurement of Interdisciplinarity. *Documentation Information Knowledge*, **3**, 87-93.

[2] Ma, F.C. and Li, Z.Y. (2020) Future Prospect of Library and Information Science in China in the Context of New Liberal Arts. *Journal of Library Science in China*, **6**, 5-16.

[3] Jiang, J. (1995) Interdisciplinary Research in Chinese Librarianship. *Journal of Library Science in China*, **6**, 18-24.

[4] Zhong, X. (2000) Study of Bibliometrics in Interdisciplinary Research of Information Library and Archive Science in China. *Journal of the China Society for Scientific and Technical Information*, **2**, 187-192.

[5] Gong, H.P. and Mei, J. (2020) Research on Knowledge Exchange Dynamics of Library Intelligence Disciplines Based on Interdisciplinary Research. *Research on Library Science*, **2**, 2-11.

[6] Wang, S.M. and Teng, G.Q. (2020) Evolution Analysis on Interdisciplinarity and Differences across Countries in Library and Information Science. *Documentation Information Knowledge*, **3**, 109-118.

[7] Yang, L. and Chen, M. (2015) A Comparative Study of Commonly Used Alternative Metrological Tools. *Information Studies: Theory & Application*, **9**, 114-119.

[8] Zheng, D.M., Yu, Y.J. and Wen, J.Y. (2020) Characteristics and Evolution of the Trend of Interdisciplinarity in China: An Analysis Based on Web of Science Classifications. *Journal of the China Society for Scientific and Technical Information*, **8**, 872-884.

[9] Traag, V., Waltman, L. and van Eck, N.J. (2019) From Louvain to Leiden: Guaranteeing Well-Connected Communities. *Scientific Reports*, **1**, 1-12. https://doi.org/10.1038/s41598-019-41695-z

[10] Ian Potter (2020) Introducing Citation Topics in InCites. https://clarivate.com/webofsciencegroup/article/introducing-citation-topics/

[11] Wang, X.C. (2013) MATLAB Neural Networks 43 Case Studies. Beijing University of Aeronautics and Astronautics Press, Beijing.