Research Progress and Visualization Analysis of Altmetrics in China: Postprint

Authors: Qi Shijie, Zheng Junwei, Shi Haiyan

Date: 2023-10-08T00:00:00+00:00

Abstract

[Purpose / Significance] Altmetrics research in China has gradually deepened. Analyzing its development trends will help researchers clarify research progress and hot topics, providing references for future theoretical research and practical exploration. [Method / Process] This study selects the CNKI database as the data source and adopts bibliometric and visualization methods to conduct a comprehensive analysis of Altmetrics research in China from three major aspects: research overview, literature co-authorship, and research content. [Results / Conclusions] Altmetrics research in China is developing well, transitioning from theoretical research to empirical research; Scientific collaboration is an important characteristic of Altmetrics research in China, with disciplinary distribution showing a structural feature centered on library and information science, with publishing, medicine, and scientific research management at the periphery; Developing embedding mechanisms for Altmetrics tools and resource platforms in the domestic environment, reconstructing the scientific communication process from an Altmetrics perspective, and integrating traditional evaluation with communication process-based evaluation pathways are the future development trends of Altmetrics research in China.

Full Text

Preamble

Visualization Analysis on the Research Development of Altmetrics in China

Qi Shijie[1],[2], Zheng Junwei[1], Shi Haiyan[3]
[1]Lanzhou Library, Chinese Academy of Sciences, Lanzhou 730000
[2]University of Chinese Academy of Sciences, Beijing 100049
[3]School of Management, Hebei University, Baoding 071000

Abstract

[**Purpose/Significance**] As Altmetrics research in China has gradually deepened, analyzing its development trends will help researchers clarify research progress and hot topics, providing valuable references for future theoretical studies and practical explorations. [**Method/Process**] This paper selects the CNKI database as its data source and employs bibliometric and visualization methods to conduct a comprehensive analysis of domestic Altmetrics research from three perspectives: research overview, literature co-authorship, and research content. [**Result/Conclusion**] (1) Domestic Altmetrics research is developing robustly, transitioning from theoretical to empirical studies; (2) Scientific collaboration represents a key characteristic of Altmetrics research in China, with disciplinary distribution centered on library and information science, and publishing, medicine, and research management forming the periphery; (3) Developing Altmetrics tools and embedded mechanisms for resource platforms in the domestic context, reconstructing the scientific communication process from an Altmetrics perspective, and integrating traditional evaluation with communication-process-based evaluation pathways will be future research trends in Chinese Altmetrics.

Keywords: Altmetrics; Bibliometric Analysis; Research Frontier; Information Visualization
Classification Number: G251
Citation Format: Qi Shijie, Zheng Junwei, Shi Haiyan. Visualization Analysis on the Research Development of Altmetrics in China [J/OL]. Knowledge Management Forum, 2017, 2(5): 439-447 [citation date]. http://www.kmf.ac.cn/p/1/662/.

1 Introduction

Since J. Priem et al. [1] proposed Altmetrics in 2010, numerous scholars in China's metrology, research evaluation, and subject service fields have conducted extensive research on the topic. As a product of Web 2.0 and the Open Access (OA) movement, Altmetrics offers a broad perspective beyond traditional science, capable of reflecting composite influence based on scientific communication processes in real time, with a massive online user base. These advantages have gradually emerged in the increasingly open online communication environment, playing important roles in enhancing user experience, guiding academic behavior, building academic resources, optimizing collection structures, and promoting the development of institutional repositories within regions. Meanwhile, researchers have also identified certain issues with Altmetrics, such as data heterogeneity, data reliability, and practical application challenges. To advance deeper research on Altmetrics, this paper analyzes the overall trends and research forces in current domestic studies from three aspects: literature growth, disciplinary distribution, and literature co-authorship, and identifies highly cited literature, thematic distribution, and research hotspots through bibliometric and visualization methods to explore future development

trends, providing references and insights for relevant researchers.

Funding: This work is supported by the "Chinese Academy of Sciences Talent Introduction Program in Library, Information and Publishing Fields" (Project No. Communication [2014] No. 10).

Author Biographies: Qi Shijie (ORCID: 0000-0001-8757-7037), Master's student, E-mail: qishijie@mail.las.ac.cn; Zheng Junwei (ORCID: 0000-0001-7390-5757), Researcher, Ph.D., Master's supervisor; Shi Haiyan (ORCID: 0000-0003-1635-0323), Associate Professor, Ph.D.

Received Date: 2017-05-02
Published Date: 2017-10-26
Responsible Editor: Wang Shanjun
Knowledge Management Forum ISSN 2095-5472 CN11-6036/C
E-mail: kmf@mail.las.ac.cn
http://www.kmf.ac.cn

2 Data Sources and Research Methods

This study takes Altmetrics as its research object and selects CNKI's China Academic Journal Network Publishing Database as its data source. The search formula was: Subject = 'altmetrics' + 'supplementary metrology' + 'alternative metrology' + 'selective metrology' + 'alternative metrology' (exact match), with the time period set to 2010-2016 and the search date being February 5, 2017. This retrieved 139 relevant documents, which after manual review to remove duplicates and irrelevant literature yielded 136 valid documents.

This paper primarily employs bibliometric methods to statistically analyze the relevant literature and utilizes CiteSpace knowledge mapping software for visualization analysis. Visualization mapping can reveal the core structure, research hotspots, and frontiers of a knowledge domain, serving a knowledge navigation function [2]. CiteSpace is frequently used as a tool for detecting disciplinary or domain research frontiers through knowledge mapping [3].

3 Altmetrics Research Overview

3.1 Publication Volume and Growth Trends

After organizing the valid documents, an annual growth trend chart was created, shown in [Figure 1: see original paper]. Overall, Altmetrics literature has consistently shown an upward trend, with an average annual publication volume of approximately 27 papers. Between 2012 and 2014, the number of publications grew steadily year by year but remained below the annual average. During this stage, China began preliminary exploration of Altmetrics, with relevant research starting in 2012. Liu Chunli [4] introduced the basic concepts of Altmetrics, including its definition, research objects, significance, and specific indicators, and distinguished it from webometrics, pioneering domestic Altmetrics

research. Since 2015, the number of publications has grown rapidly, reaching its peak in 2016, with annual growth rates of 213.3% and 36.2% for 2015 and 2016 respectively (2016 data incomplete). The cumulative number of publications reached 111, accounting for 81.6% of the total. These results indicate that Altmetrics research has received increasing attention in recent years, demonstrating favorable development momentum closely related to China's increasingly open access to literature resources and online research communication environment, coupled with growing attention from research management professionals. This new situation has driven the rapid development of Altmetrics, which takes new media as its measurement object.

3.2 Disciplinary Distribution Analysis

The disciplinary attributes of literature reflect its research domain, and analyzing paper distribution across disciplines reveals the interdisciplinary research status of the topic. After organizing the disciplinary data from CNKI research samples, the disciplinary distribution of domestic Altmetrics research was obtained.

As shown in , Altmetrics research in China covers a broad range of disciplines, including library and information science, publishing, medical education, general industrial technology, social science theory and methods, military medicine, journalism and media, biomedical engineering, computer software and applications, and macroeconomic management. The disciplinary distribution presents a structure centered on library and information science, with publishing, medical education, and research management at the periphery. However, literature volumes in disciplines other than library and information science remain relatively small. The reason is that Altmetrics in China is still in its initial development stage, with basic theoretical research dominating, requiring further consolidation and improvement by library and information professionals to promote structural and systematic theoretical frameworks. For researchers across disciplines, Altmetrics serves as a tool to support research activities, and as Altmetrics tools become more widespread, their disciplinary impact will inevitably expand, with interdisciplinary characteristics becoming increasingly prominent, showing a trend of multi-disciplinary joint research and development.

4 Literature Co-authorship Analysis

Academic exchange and collaboration are important pathways to enhance researchers' productivity and promote scientific innovation. Analyzing collaborative group relationships and cooperation intensity helps identify important research forces in China's Altmetrics field. Using CiteSpace, an author co-occurrence map was created with a threshold of Top100% and pruned using the Pathfinder algorithm. The map modularity is 0.954, indicating significant clustering effects, as shown in [Figure 2: see original paper].

[Figure 2: see original paper] displays authors with two or more co-authored papers, where font size represents publication volume and connecting lines indicate collaboration. The figure shows that overall collaboration in the Altmetrics field is evident, with collaboration patterns primarily forming small groups. Statistical analysis reveals a co-authorship rate of 61.76%, with most co-authored papers having two or three authors. Specifically, 51 papers (37.5%) had two authors, and 26 papers (19.12%) had three authors.

As an emerging interdisciplinary research field, good collaborative research helps scholars expand Altmetrics research topics comprehensively and at multiple levels, promoting the field's penetration and interweaving with various disciplines. Major collaborative groups include the following six: (1) Qiu Junping and Yu Houqiang from Wuhan University, whose research shows strong continuity and broad themes, including Altmetrics concepts and progress, empirical analysis of indicator coverage and disciplinary differences, online communication pattern studies from an Altmetrics perspective, and applications in libraries and institutional repositories. (2) The collaborative group led by You Qingbin (China Defense Science and Technology Information Center) and the group led by Wang Rui (Lanzhou University Library), whose research focuses on indicator correlation analysis and evaluation model construction [5-7]. (3) Liu Chunli and Wang Cong from China Medical University Library, who primarily research Altmetrics applications in institutional repositories, pointing out current challenges such as lack of unified data standards, difficulty identifying social media platform papers through DOI, and tool incompatibility [8]. (4) Wang Xianwen, Mao Wenli, and Fang Zhichao from Dalian University of Technology WISE Lab, who explore the construction of paper evaluation systems based on Altmetrics, developing comprehensive evaluation systems reflecting academic and social impact, and dynamic evaluation systems reflecting long-term and short-term impact [9-10]. (5) Liu Limin from Nankai University and Wang Qing from Shanxi University, who primarily review domestic and international Altmetrics research and propose distinctive integration paths between Altmetrics and library services.

In summary, Altmetrics researchers demonstrate good collaborative awareness and an active research atmosphere, with broad research themes. However, collaboration is largely limited to within the same institution, lacking interdisciplinary and inter-institutional cross-collaboration. It is hoped that library and information science scholars will gradually penetrate and diffuse Altmetrics into more disciplines, promoting the vigorous development of interdisciplinary research.

5.1 Highly Cited Literature Analysis

Highly cited papers constitute an important literature foundation and knowledge source in a research field, possessing high academic reference value and leading significance, and serving as crucial evidence for exploring hot topics and frontiers. lists the top ten highly cited documents in domestic Altmetrics research.

Content analysis reveals that highly cited literature covers relatively broad research topics, which can be roughly categorized into three types:

(1) **Background, Concepts, and Research Progress of Altmetrics.** Altmetrics' birth is closely related to the networking of scientific communication, initiating an evaluation model based on the scientific communication process and creating opportunities for resource management services. Document A [11] traces Altmetrics' development process, clearly stating that current research is in the stage of theoretical investigation of Altmetrics' external validity and empirical research on indicator internal relationships. Documents C [12] and H [13] view Altmetrics as a new development in bibliometrics based on social networks, with advantages in enriching impact connotations and instantly selecting high-impact papers. These early theoretical studies opened the prelude for domestic Altmetrics research, playing a foundational and enlightening role in the field.

(2) **Altmetrics Data and Indicator Research.** As research deepens, exploring the internal mechanisms of Altmetrics indicators has become a key issue concerning their future development prospects. Document E [14] deeply analyzes Altmetrics' connotation and discusses its credibility and practicality from perspectives of avoiding data manipulation and ensuring data rigor and consistency, affirming Altmetrics' status in metrology. In empirical research, Document G [15] first attempts to systematize complex Altmetrics indicators, stratifying them from the perspective of academic impact generation mechanisms and deeply analyzing the characteristics and transformation relationships between layers. Obviously, indicator usability is a prerequisite for realizing their value and utility, and the above research represents important academic achievements driving the transition from theoretical to empirical studies, making outstanding contributions to the field's development.

(3) **Altmetrics Practice and Application Exploration.** Document D [16] summarizes Altmetrics by analyzing foreign practice cases, providing references for domestic tool development. Documents F [17] and J [18] depict the application prospects of Altmetrics in libraries and institutional repositories, pointing out challenges for comprehensive application. In summary, these studies preliminarily explore Altmetrics' application prospects and problems in literature and data resource platforms, forming a theoretical foundation for guiding future practice and operations, and playing a critical role in domestic applied research and theoretical verification.

5.2 Research Frontier Analysis Based on Keyword Co-occurrence

High-frequency keywords can reveal research themes and hotspots in a field, and keyword co-occurrence time-zone maps can disclose the migration process

of research hotspots and track research frontiers. Using CiteSpace, a keyword co-occurrence time-zone map was created with a time slice of 1 year, selecting the top 30 high-frequency keywords in each time slice and pruning the network using the minimum spanning tree algorithm, as shown in [Figure 3: see original paper]. Node size represents keyword frequency, and purple circles indicate keyword centrality.

[Figure 3: see original paper] shows that domestic Altmetrics research themes and content have continuously evolved. Combined with qualitative analysis, they can be divided into three stages: (1) 2012-2013, including keywords such as altmetrics, academic influence, research evaluation, open access, and social media, primarily focusing on theoretical exploration of Altmetrics concepts, the background of Altmetrics and open access, characteristics of social networks, and the value of research evaluation. (2) 2014 marked the beginning of empirical Altmetrics research in China, including keywords such as alternative metrology, social impact, and principal component analysis, aiming to verify indicator usability and value, covering both data source platform research and indicator empirical analysis. (3) 2015-2016 leaned toward application, including keywords such as institutional repository, library, scientific evaluation, and correlation analysis, focusing on research about Altmetrics application strategies and framework design for institutional repositories and libraries on one hand, and exploring Altmetrics' significance in journal evaluation and comprehensive evaluation through case verification on the other. Applied practice exploration will be the future development direction of this field. The above development stages align with the international Altmetrics development process proposed in highly cited Document A [11], proving that domestic research can keep pace with international research, laying a foundation for Altmetrics' rapid development in China and its leading position in international research.

5.3 Research Theme Analysis Based on Keyword Clustering

Analysis of keyword clustering maps can reveal hot topics in a research field. Using CiteSpace, a keyword co-occurrence clustering map was created, as shown in [Figure 4: see original paper]. The map contains 77 keyword nodes, clustered into 10 groups using the TF-IDF naming algorithm, with parameters Modularity=0.8108 and Mean Silhouette=0.6857, indicating significant clustering effects.

Based on clustering and literature content analysis, Altmetrics research content can be summarized into six categories:

5.3.1 Basic Theoretical Exploration of Altmetrics (including clusters #4 paper-level metrics and #9 professional doctoral students)

Altmetrics is a new type of metrology that analyzes and disseminates scientific research through social networks, a product of Web 2.0, open data, and online scientific communication, proposed by J. Priem in 2010 [19]. Compared with

traditional metrology, Altmetrics' openness and immediacy reveal multiple values, with measurement perspectives focusing on the academic communication process in an open and transparent review environment, helping to stimulate researchers' academic enthusiasm, ensure fairness in academic activities, and create conditions for more detailed research evaluation. Faced with Altmetrics' numerous advantages, determining its connotation, perfecting its systematic theoretical framework, and achieving academic institutionalization are important prerequisites for unleashing its enormous potential.

5.3.2 Reconstruction of Scientific Communication Process Based on Altmetrics (including cluster #7 academic social networks)

Traditional formal communication has hindered the optimization of scientific information exchange to some extent, causing researchers' cognitive bias and dissonance [20]. Altmetrics' scientific measurement targets the entire scientific communication process of scientific production, dissemination, and utilization, having an inseparable and mutually reinforcing relationship with the online scientific communication environment, providing new perspectives and approaches for reconstructing online scientific communication mechanisms under new circumstances. For example, Yu Houqiang [21] proposed a new scientific communication model including transmission and filtering mechanisms by combining social network communication channels with Altmetrics indicators and functions. Wang Xianwen [9] constructed a dynamic dissemination mechanism for academic achievements from three aspects: cost mechanism, promotion mechanism, and content mechanism, believing that Altmetrics indicators focusing on open peer review and post-publication scientific communication have different emphases from traditional citation indicators.

5.3.3 Introduction and Functional Comparison of Altmetrics Tools (including clusters #6 Altmetric.com and #8 measurement tools)

Altmetrics tools represent an open, timely, and diversified information filtering approach. Currently, tools developed by various companies differ in data sources, evaluation objects, evaluation strategies, and indicator quantities, with varying data mining depths and processing methods for the same indicators. Indeed, each tool has its pros and cons [22-24], and as long as unified data specifications and technical standards are established along with reasonable tool integration strategies to achieve complementary advantages, they will surely play greater roles in the future. However, current tools still rely on third-party database platforms, and readers should correctly understand and use Altmetrics tools [25].

5.3.4 Exploration of Intrinsic Relationships Between Altmetrics Indicators and Correlation with Traditional Citations (including cluster #5 social impact)

Altmetrics' numerous indicators present a discrete state, and empirical analysis of their intrinsic relationships can enhance readers' understanding of indicators and improve their usability and systematicity. Most research is based on hierarchical division of the communication process. Representative research includes: Yu Houqiang [15] stratified Altmetrics indicators into three dimensions—dissemination layer, acquisition layer, and utilization layer—according to the academic impact generation model. Qiu Junping [26] re-stratified Altmetrics indicators into perception layer, social media layer, and application layer based on engagement theory, revealing transformation and progressive relationships between indicator levels. Additionally, relevant studies have found that these indicators can play a multi-dimensional composite impact evaluation advantage at the paper, journal, and institutional levels [27-29]. Thus, Altmetrics' measurement oriented toward social impact has new practical significance for academic achievements to realize their social and economic value.

5.3.5 Construction of Scientific Research Evaluation System Based on Altmetrics (including clusters #1 comprehensive evaluation and #2 citation analysis)

Altmetrics indicators differ from traditional citation indicators in their focus, being able to simultaneously reflect academic and social impact of academic papers, compensating for the time lag and one-sidedness of traditional citation analysis to improve paper evaluation systems. For example, You Qingbin [6] found that these indicators have consistency with citation frequency in evaluating high-impact papers. Wang Xianwen [30] comprehensively evaluated papers by combining traditional citation indicators with Altmetrics indicators, pointing out that this evaluation system provides more comprehensive measurement of paper impact. Indeed, Altmetrics plays an important role in improving the scientific validity and effectiveness of evaluation mechanisms and promoting innovation in research evaluation systems, objectively demonstrating the impact of research achievements. However, some social media indicators, such as comments, have certain randomness, requiring in-depth analysis of indicators from the perspective of Altmetrics' essential connotation and user behavior to integrate them more reasonably into evaluation systems, providing powerful explanations and important references for research management.

5.3.6 Application of Altmetrics in Resource Management Platform Construction (including clusters #0 academic social networks and #3 library services)

In the open access environment, Altmetrics provides libraries and institutional repositories with methods to promote academic achievements and improve institutional academic impact. Among them, Li Guojun [31] proposed technical

implementation methods for embedding Altmetrics tools in institutional repositories by investigating cases of Altmetrics indicator application in university institutional repositories at home and abroad. Qiu Junping [18] theoretically proposed indicators applicable to institutional repositories from three perspectives: the institutional repository as a whole, specific resources, and publishers. Altmetrics embedding can improve literature retrieval efficiency, promote literature recommendation accuracy, provide users with personalized literature information services, and simultaneously provide decision-making basis for optimizing resource allocation and collection development in resource construction [17]. Among these, the integration of Altmetrics indicators and cross-institutional, cross-disciplinary comparability will be key issues requiring emphasis in their application.

6 Conclusion

As a product of the open access and Web 2.0 environment, Altmetrics has promising development prospects. This paper utilizes CNKI database resources to conduct bibliometric and visualization analysis of domestic Altmetrics literature, sorting out research progress in China from two major aspects: overall trends and research content, reaching the following conclusions: (1) The volume of domestic Altmetrics research literature has grown rapidly, with overall favorable development momentum, remaining a hot topic in library and information science. Considering China's current ubiquitous online research environment and growing open academic resources, Altmetrics has enormous development potential. (2) From a disciplinary perspective, Altmetrics research shows a structure centered on library and information science, with publishing, medical education, and research management at the periphery, but the involved disciplines remain relatively singular, mainly in library and information science. (3) From a co-authorship perspective, scientific collaborative research is a major characteristic of domestic Altmetrics research, with core author groups gradually forming, but most collaboration remains small-scale within institutions, with insufficient interdisciplinary and inter-institutional cooperation. (4) From a research content perspective, domestic Altmetrics research is primarily theoretical, transitioning toward empirical research on research evaluation and application exploration in libraries and institutional repositories. Developing Altmetrics tools and embedded mechanisms for resource platforms in the domestic context, reconstructing the scientific communication process from an Altmetrics perspective, and integrating traditional evaluation with communication-process-based evaluation pathways will be future research hotspots and trends.

In summary, China's Altmetrics development has achieved certain results. Based on the current research status, we suggest that future domestic research should focus on two points: (1) Gradually strengthen multi-disciplinary integrated collaborative research models. Altmetrics itself is an emerging interdisciplinary field whose service targets cover readers across all disciplines. Strengthening interdisciplinary and inter-institutional collaboration will bet-

ter leverage Altmetrics' role as a powerful tool for evaluating scholars and achievements, understanding latest research trends and frontiers amid massive scientific literature. Particularly, in the increasingly open and networked scientific communication environment, there remains no structured Altmetrics tool suitable for China's context. Accordingly, researchers should expand studies into computer science, big data, and other technical fields, introducing information visualization, semantic processing, and contextual analysis technologies to develop integrated thinking for large-scale integration of structured, systematic Chinese Altmetrics platforms, providing references for library and institutional repository applications. (2) Emphasize both practical application exploration and theoretical research. Continue deepening Altmetrics theoretical research to construct and perfect its theoretical framework, guiding Altmetrics development in China more scientifically; simultaneously, learn from advanced foreign Altmetrics application cases to explore optimal practice models for China, including developing emerging data sources, cross-platform unified identification and authentication, data monitoring and collection, and indicator classification and calculation. Especially, user behavior should be analyzed in specific usage contexts combined with contextual semantics to ensure indicator data value, better leveraging Altmetrics' effectiveness in practical applications and promoting the common development of metrology theory and practice.

References

[1] PRIEM J, TARABORELLI D, GROTH P, et al. Altmetrics: a manifesto[EB/OL]. [2017-06-27]. http://altmetrics.org/manifesto/.
[2] SKUPIN A. Colloquium paper: mapping knowledge domains: the world of geography: visualizing a knowledge domain with cartographic means[J]. Proceedings of the National Academy of Sciences of the United States of America, 2004, 101(S1): 5274-5278.
[3] Lü Hong. Research Force Distribution and Frontier Identification of Big Data Research in Domestic Humanities and Social Sciences[J]. Modern Intelligence, 2017, 37(3): 132-140.
[4] Liu Chunli. Scientometrics in Web 2.0 Environment: Altmetrics[J]. Library and Information Service, 2012, 56(14): 52-56.
[5] You Qingbin, Tang Shanhong. Research on Correlation Between Different Types of Article-Level Metrics[J]. Library and Information Service, 2014, 58(8): 79-84.
[6] You Qingbin, Wei Bo, Tang Shanhong. Construction of Paper Impact Evaluation Model Based on Altmetrics[J]. Library and Information Service, 2014, 58(22): 5-11.
[7] Wang Rui, Hu Wenjing, Guo Wei. Research on Academic Impact of High Altmetrics Papers[J]. Library and Information Service, 2014, 58(21): 92-98.
[8] Wang Cong, Liu Chunli. Comparative Analysis of Institutional Repositories in Two Medical Universities in China and the United States[J]. Chinese Journal of Medical Library and Information Science, 2016, 25(11): 12-15.
[9] Wang Xianwen, Zhang Chunbo, Mao Wenli, et al. Research on the Dissemi-

nation Mechanism of Scientific Papers in Social Networks[J]. Studies in Science of Science, 2013, 31(9): 1287-1295.
[10] Wang Xianwen, Fang Zhichao, Wang Hongyin. Research on Constructing Continuous, Dynamic and Composite Single-Paper Evaluation System[J]. Science of Science and Management of S.&.T., 2015, 36(8): 37-48.
[11] Qiu Junping, Yu Houqiang. The Proposal Process and Research Progress of Altmetrics[J]. Library and Information Service, 2013, 57(19): 5-12.
[12] You Qingbin, Tang Shanhong. Altmetrics and Its Application Prospects[J]. Information Studies: Theory & Application, 2013, 36(12): 6-10.
[13] Cui Yuhong. From Bibliometrics to Altmetrics: Research on Academic Impact Evaluation Based on Social Networks[J]. Information Studies: Theory & Application, 2013, 36(12): 17-20.
[14] Qiu Junping, Yu Houqiang. On Several Basic Issues Promoting the Development of Altmetrics[J]. Journal of Library Science in China, 2015, 41(1): 4-15.
[15] Yu Houqiang, Qiu Junping. Theoretical Research on Altmetrics Indicator Stratification and Aggregation[J]. Library Journal, 2014, 33(10): 13-19.
[16] Gu Liping. Review of Open Data Measurement Research: Altmetrics for Computing Network User Behavior and Scientific Community Influence[J]. New Technology of Library and Information Service, 2013, 234(6): 1-8.
[17] Yu Houqiang, Qiu Junping. On the Application of Altmetrics in Library Document Services[J]. Journal of Intelligence, 2014(9): 163-166.
[18] Qiu Junping, Zhang Xinyuan, Dong Ke. Research on the Application of Altmetrics Indicators in Institutional Repositories[J]. Library and Information Service, 2015, 59(2): 100-105.
[19] Liu Chunli. Altmetrics: From Theoretical Hypothesis and Terminology Proposal to Redefinition of Connotation[J]. Library and Information Service, 2015, 59(6): 82-89.
[20] Han Yi. The Integration Path Orientation of Science and Technology Evaluation in the Context of Informal Communication Return[J]. Journal of Library Science in China, 2016, 42(4): 64-74.
[21] Yu Houqiang, Qiu Junping. A New Online Scientific Communication Model from the Perspective of Altmetrics[J]. Library and Information Service, 2014, 58(15): 42-47.
[22] Liu Chunli. Development, Current Status and Related Issues of Altmetrics Tools[J]. Library and Information Service, 2016, 60(5): 87-92.
[23] Wu Shengnan, Zhao Rongying. Analysis of the Development Status and Trends of Altmetrics Application Tools[J]. Knowledge of Library and Information Science, 2016(1): 84-93.
[24] Liu Entao, Li Guojun, Qiu Xiaohua, et al. Comparative Study of Altmetrics Tools[J]. Library Journal, 2015(8): 85-92.
[25] Yang Liu, Chen Ming. Comparative Study of Common Altmetrics Tools[J]. Information Studies: Theory & Application, 2015, 38(9): 114-119.
[26] Qiu Junping, Yu Houqiang. Research on Altmetrics Indicator Stratification Based on Impact Generation Model[J]. Journal of Intelligence, 2015(5): 53-58.
[27] Cheng Fei, Duan Qingfeng. Comparative Analysis of Evaluation Indicators

for Different Types of Scientific Papers[J]. Information Research, 2015(10): 119-123.
[28] Yang Liu, Chen Gong. Research on Correlation of Research Institution Impact Evaluation Indicators from Altmetrics Perspective[J]. Library and Information Service, 2015, 59(15): 106-115.
[29] Fan Xueming, Peng Dingyuan, Shen Dan. Research on the Application of Altmetrics in Science and Technology Journal Resource Evaluation[J]. China Science and Technology Resources Review, 2015(2): 98-103.
[30] Wang Xianwen, Liu Chen, Mao Wenli. Research on Comprehensive Evaluation of Scientific Papers in the Digital Publishing Era[J]. Chinese Journal of Scientific and Technical Periodicals, 2014, 25(11): 1391-1397.
[31] Li Guojun, Qiu Xiaohua, Ji Shujuan, et al. Research on Measurement Services of Institutional Repositories: Integration of Altmetrics and WOS[J]. Library Journal, 2015(10): 85-92.

Author Contributions

Qi Shijie: Literature investigation and organization, paper writing;
Zheng Junwei: Proposition and conceptualization, paper revision;
Shi Haiyan: Final version revision.

Note: Figure translations are in progress. See original paper for figures.