Bibliometric Analysis of Scientific Achievement Dissemination Patterns in University Journals: A Case Study of the Journal of Xi'an University of Science and Technology (Postprint)

Authors: Li Keyong

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Abstract

[Purpose] University journals serve as the primary platforms for scientific research development and achievement dissemination. This study aims to investigate the communication models of scientific and technological journals through bibliometric data analysis of university journals. [Method] Grounded in the theoretical framework of bibliometrics and taking the *Journal of Xi'an University of Science and Technology* as a case study, this research employs Lotka's Law and Price's Law from bibliometrics to analyze the journal's literature indicators, thereby examining the development models of scientific and technological journals. [Results] The study posits that accurately positioning characteristic columns constitutes the foundation for developing scientific and technological journals, strengthening topic planning serves as the key, organizing and soliciting high-quality thematic manuscripts represents the core, and multi-media integrated publishing stands as an essential prerequisite. [Conclusion] The research reveals that analyzing journal communication methods through bibliometric indicators and proposing a dissemination model for scientific and technological achievements in university journals can provide valuable references for university journal development and offer insights for other types of scientific and technological journals.

Full Text

Bibliometric Analysis and Research on the Communication Model of Scientific and Technological Achievements in University Journals: A Case Study of the Journal of Xi'an University of Science and Technology

Journal Center of Xi'an University of Science and Technology, Xi'an, Shaanxi 710054

Abstract

[**Objective**] University journals serve as primary platforms for scientific research development and achievement dissemination. This study aims to investigate the communication patterns of scientific and technological journals by analyzing bibliometric data from university journals. [**Method**] Based on the theoretical framework of bibliometrics and using the Journal of Xi'an University of Science and Technology as a case study, this research employs Lotka's Law and Price's Law from bibliometrics to analyze the journal's literature indicators and study its development model. [**Results**] The study identifies that accurately positioning distinctive columns forms the foundation for developing scientific and technological journals, strengthening topic planning represents the key to their development, soliciting high-quality special issue manuscripts constitutes the core of their development, and integrated multimedia publishing serves as an essential condition for their development. [**Conclusion**] The findings demonstrate that using bibliometric indicators to analyze journal communication methods and proposing a communication model for scientific and technological achievements in university journals can provide valuable references for the development of university journals and offer insights for other types of scientific and technological journals.

Keywords: communication model; distinctive columns; Lotka's Law; Price's Law; bibliometrics
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University journals, as scientific and technological periodicals sponsored by universities, have become an important driving force for accelerating scientific research development and achievement dissemination. In recent years, with the

development of domestic scientific and technological journals, university journals have exhibited characteristics including multiple disciplinary categories, relatively low quality of academic achievements, limited audience scope, insufficient funding and personnel, unclear professional features, and lack of high-quality manuscript sources. Although different experts have proposed various operational models for university journals from different perspectives and discussed their development models from multiple angles [1], university journals still cannot break free from the influence of traditional operational models during their development, and most research on journal development lacks feasibility verification.

The Journal of Xi'an University of Science and Technology (hereinafter referred to as "the Journal") is a scientific and technological periodical featuring distinctive columns in safety science and engineering, mining engineering, geological resources and geological engineering, and other specialties. Using the Journal as a case study, this paper employs Lotka's Law and Price's Law from bibliometrics, combined with the Journal's operational practices, to analyze its bibliometric data and achievement dissemination, summarizing the patterns of achievement dissemination and development models for university journals.

1. Application of Bibliometrics in University Journal Research

In recent years, bibliometric laws such as Lotka's Law, Bradford's Law, Zipf's Law, Price's Law, and Garfield's Law have attracted increasing attention and research from journal editors and scholars. This study selects Lotka's Law and Price's Law to analyze the Journal's literature indicators, providing a basis for its development model.

1.1 Application of Lotka's Law

Lotka's Law analyzes the relationship between the number of authors and the number of papers, proposing that the number of authors who write 2 papers is 1/4 of those who write 1 paper, the number of authors who write N papers is $1/n^2$ of those who write 1 paper, and the number of authors who write only 1 paper accounts for approximately 60% of all authors. Based on this theory, an analysis of the Journal's publications from 2017 to 2021 reveals a total of 760 articles published over five years, with authors who wrote only 1 paper accounting for 56.84% of the total—approximately 60%—which conforms to Lotka's Law. According to this law, by counting the number of authors who published 1 paper in a particular field or discipline, we can calculate the number of authors who wrote 2, 3, 4, 5, …, n papers, enabling journal editors to develop publication plans, solicit manuscripts, and identify target authors in a focused manner.

Price's Law is similar to current metrics such as the 5-year impact factor, representing the ratio of citations within 5 years to the total number of citations

and reflecting the literature's half-life. The Price Index = (number of cited documents in the past five years / total number of cited documents) × 100%. The Price Index is superior to half-life and median citation age, as it can be applied to all literature in a particular field and can also be used to evaluate individual journals, institutions, authors, and articles. For example, the article "Study on the Influence of Freeze-Thaw Cycles on Structural Loess Index" published in the Journal in 2015 has been cited 26 times since publication. From the annual citation count, the article reached a small peak of 4 citations in its second year after publication, with the peak value of 7 citations occurring in the fifth year, after which citations dropped sharply to 3, 1, and 2 times, indicating a half-life of 5 years, which is comparable to the Price Index (Figure 1 [Figure 1: see original paper]). Similarly, the article "Types and Spatiotemporal Distribution Patterns of Loess Landslides in the Jinghe River Terrace Area" published in 2015 has been cited 22 times, reaching a small peak of 5 citations in its second year, with the peak value of 8 citations occurring in the sixth year, after which citations dropped sharply to 2, 0, and 1 times, also indicating a half-life of 5 years, comparable to the Price Index (Figure 1).

These two citation analyses demonstrate that articles experience their first citation peak in the second year after publication, with a second peak occurring in the fifth year, followed by a sharp decline, indicating that the Journal's half-life is 5 years. Therefore, studying the 5-year impact factor and the 5-year impact factor excluding self-citations provides valuable reference for analyzing both the journal and individual papers. The 5-year impact factor is calculated as the total number of citations in the statistical year to papers published in the previous five years divided by the total number of papers published in those five years. For the Journal (2017-2021), the 5-year impact factors were 1.188, 1.056, 1.183, 1.227, and 1.475, respectively, while the 5-year impact factors excluding self-citations were 0.85, 0.818, 0.897, 0.983, and 1.207, respectively, showing rapid growth in both metrics (Figure 2 [Figure 2: see original paper]).

1.3 Application of Zipf's Law

Zipf's Law states that there exists a quantitative relationship between the frequency (f) of words in an article and their ranking (r), proposing that for any article containing n keywords, when these keywords are sorted in descending order of frequency, the product of the rank r and frequency f (fr) approximates a constant, i.e., fr = C (where r = 1, 2, 3, …). Simon constructed a probability model suggesting that the more frequently a word is used in literature, the more likely it is to be used again, a model that closely approximates Zipf's Law. Based on these laws, this study analyzed the quantitative relationship between keyword frequency (f) and ranking (r) in two articles published in the Journal. In Article 1, "Characteristics and Favorable Interval Optimization of Tight Sandstone Reservoirs in the Benxi Formation of the Central-Eastern Ordos Basin," the word "reservoir" with rank r = 1 appeared 135 times (fr = 135), "Benxi Formation" with rank r = 2 appeared 71 times (fr = 142), "pore" with

rank r = 3 appeared 48 times (fr = 144), "tight sandstone" with rank r = 4 appeared 34 times (fr = 136), and "Ordos Basin" with rank r = 4 appeared 28 times (fr = 140). For these five words, fr values range from 135 to 144, with an average fr = 139, indicating a certain regularity in word frequency distribution (Table 1, Figure 3 [Figure 3: see original paper]).

Similarly, in Article 2, "Simulation Study on Creep Characteristics of Large Ancient Loess Landslides," the word "numerical simulation" with rank r = 1 appeared 35 times (fr = 35), "ancient loess landslide" with rank r = 2 appeared 19 times (fr = 38), "creep effect" with rank r = 3 appeared 13 times (fr = 39), "long-term stability" with rank r = 4 appeared 9 times (fr = 36), and "field monitoring" with rank r = 5 appeared 7 times (fr = 35). For these five words, fr values range from 35 to 39, with an average fr = 36, also demonstrating regularity in word frequency distribution (Table 2 , Figure 4 [Figure 4: see original paper]).

1.4 Application of Garfield's Law

Garfield's Law proposes that the tail of literature in a discipline is composed of the core literature from other disciplines, thereby reflecting the degree of interdisciplinary cross-pollination in papers published by scientific and technological journals. This cross-disciplinary exchange is significant, with a relatively small number of journals concentrating the majority of papers.

Taking 2021 as an example, we calculated the Journal's impact factor: n = total number of citations in 2021 to all papers published by the Journal in 2019 and 2020; Y = total number of papers published by the Journal in 2019 and 2020; IF2021 = (n (2019, 2020) / Y (2019, 2020)). The Journal's (2021) comprehensive immediacy index, comprehensive impact factor, comprehensive impact factor excluding self-citations, and comprehensive 5-year impact factor were 0.259, 1.246, 0.901, and 1.019, respectively (Table 3).

2. Development Strategies for University Journals

2.1 Developing Journal Characteristics and Creating Distinctive Columns

University journals generally have unique operational purposes and models, but all are influenced by their sponsoring university's characteristics. The number of distinctive columns in a university journal corresponds to the number of advantageous disciplines at the university, resulting in a "patchwork" operational model characterized by "numerous columns, comprehensive disciplinary coverage, and inclusion of most university disciplines" [2]. University journals possess natural advantages in disciplines, achievement resources, and team strengths [3], which can be leveraged to cultivate high-level author groups, expand academic resources, and increase journal recognition. By soliciting contributions from experts and scholars in the university's advantageous specialties, university journals can create distinctive columns, refine their operational characteristics, and

pursue a specialized development path [4-5]. Through the unique expertise of their universities' specialists, university journals have inherent conditions for developing distinctive columns and maintaining stable author groups, facilitating the establishment of such columns [6-8]. For example, based on the university's advantageous disciplines and the Journal's publication history, the Journal has established distinctive columns such as "Coal Mine Safety Management and Mining Theory," "Distribution Patterns and Mining Technology of Steeply Inclined Coal Seams," "Green Mines and Dual-Carbon Technology," "Geological Resource Distribution and Exploration Technology," and "Intelligent Mines and Intelligent Robots," which account for 52.63% of total publications. These published achievements have addressed critical scientific research challenges in production, disseminated academic results, promoted the Journal's specialized operational capabilities, and enhanced its influence.

2.2 Strengthening Topic Planning and Soliciting Special Issue Manuscripts

Scientific and technological journal editors collect and research academic information closely related to their journals, as well as disciplinary development frontiers and hotspots. They actively maintain close contact with academic leaders and experts in fields related to the journal's distinctive columns to understand research progress and latest achievements, plan topic content, adjust the direction of distinctive columns and manuscript solicitation, and timely solicit special issue manuscripts to disseminate academic achievements. This enables journals to serve discipline construction and allows disciplinary achievements to use journals as communication media, fully leveraging the function of scientific and technological journals as information exchange and dissemination platforms. Through planning distinctive special issues and other methods, journals can strengthen topic planning to ensure acquisition of high-quality manuscripts [9]. Regarding distinctive columns, scientific and technological journals should fully discuss and demonstrate column settings and topic planning, give full play to the role of editorial boards, solicit opinions and suggestions from experts, scholars, and editorial peers, and develop appropriate topic planning to solicit special issue manuscripts [10-11]. For example, the Journal planned a special issue on "Intelligent Coal Mine Robots," soliciting 10 special manuscripts. Among them, the article "Research on Key Technologies of Intelligent Roadway Excavation Robot Systems in Coal Mines" has been cited 50 times and downloaded 1,150 times, and was selected as a high-impact paper, a "three highs" paper, and a high PCSI paper in the Academic Essentials Database, achieving significant impact and positive results in a short period.

Identifying high-quality manuscript sources and gathering high-quality author groups are key to developing scientific and technological journals. Topic planning on hot issues and high-quality author research teams that attract the attention of both editorial departments and authors are crucial for attracting quality manuscripts [6-8]. University journals can absorb high-quality manuscripts by

relying on their universities' key laboratories, research institutes, and support from research teams for academic achievements [8-11]. Simultaneously, scientific and technological journals should actively organize and participate in international and domestic academic conferences related to their distinctive columns, identify research hotspots, priorities, and frontiers in their industries, establish good relationships with industry experts and scholars, maintain regular contact, invite their research teams' latest achievements, and absorb high-quality manuscripts [8]. For example, the Journal solicited manuscripts from an academician's team on "Geological Assurance for In-situ Coal Development" and from a renowned professor's team on "Influencing Factors of Solar-Energy Coupled Backfill Heat Pump Cross-Seasonal Heat Storage Systems." Additionally, by participating in CHINA ROCK 2023—the 20th Chinese Conference on Rock Mechanics and Engineering—the Journal invited submissions on "Evolution of Loess Pore Water Pressure and Energy Dissipation Under Cyclic Loading" and "Strength Characteristics and Crack Evolution of Laterite Under Collaborative Action of Load and Wet-Dry Cycles," achieving excellent results and praise from experts and scholars, disseminating academic achievements and enhancing the Journal's influence.

2.4 Media Convergence Publishing and Strengthening Achievement Dissemination

As primary venues for knowledge dissemination and academic exchange, scientific and technological journals have aggregated numerous research achievements. With the increasing number of published papers, they have effectively promoted the dissemination of academic results [12]. The emergence of media convergence publishing in recent years has both impacted traditional media and significantly promoted the dissemination of scientific and technological journal papers [13-15]. For example, the Journal has intensified the content development of its website, enhanced the functionality of its submission and peer-review system, added mobile HTML reading capabilities, and provided full-text downloads of published articles. Using WeChat groups, the Journal has created an official WeChat account for disseminating scientific and technological achievements, promptly releasing information about the Journal's distinctive columns, special issue titles, key manuscripts, published articles, and editorial activities on the WeChat account and groups, enabling readers to obtain relevant Journal information instantly and timely through mobile clients. Through the OSID platform, the Journal provides extended functions for scientific research achievements, including audio introductions to papers, interactive Q&A between authors and readers, author academic circles, and open scientific data, facilitating the dissemination of scientific and technological achievements in university journals. Utilizing the Founder Publishing Cloud Platform, the Journal achieves XML intelligent production and dissemination, generating print and online PDF files, enabling XML full-text reading, providing multimedia storage and online playback capabilities for images and videos, and implementing one-click forwarding to related media.

Although university journals have weaker focus on specialized achievements compared to professional scientific and technological journals during their development, they possess high-quality academic resources from their universities. Editorial departments of university journals should fully leverage their advantages, use bibliometrics and related methods to analyze journal evaluation indicators and publication situations, strengthen the construction of distinctive columns, enhance editors' topic planning capabilities, solicit higher-quality special manuscripts that facilitate achievement dissemination, intensify media convergence publishing, and establish a good communication model suitable for scientific and technological achievements in university journals.

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Author Biography: Li Keyong (1970—), male, from Junan, Shandong, Ph.D., Associate Editor, Master's Supervisor, Executive Editor-in-Chief of Journal of Xi'an University of Science and Technology. Research interests focus on editorial theory and practice.

(Responsible Editor: Li Yansong)

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