A Review of Research on the Impact of Open Access Resources—From the Perspective of Bibliometric and Citation Analysis (Postprint)

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Abstract

[Purpose / Significance] Open Access (OA) has continuously developed over the past decade, with corresponding resources growing and enriching. Timely research and analysis of literature on OA resource impact evaluation helps elucidate research trajectories, better carry forward academic achievements, and further enhance the impact of OA resources. [Method / Process] From the perspectives of literature analysis and citation analysis, using tools such as SCI, HistCite, and CNKI, we collected data on domestic and international literature, citations, highly-cited papers, research institutions, key authors, and publishing venues related to OA resource impact evaluation, reviewed the state of research both domestically and internationally, and identified key research institutions and seminal literature. [Results / Conclusion] It was found that OA resource impact continues to attract researchers' attention, with the United States and the United Kingdom forming the first research tier, followed by a cohort of countries including India, Canada, Germany, and China. Important foreign research mostly studies OA impact from the perspective of paper citations, considering gold OA as the currently prevalent publishing model, while important domestic literature mainly discusses the impact of OA journals from aspects such as citations, web links, impact factors, and eigenfactors. Developing OA journals can be regarded as an important approach to enhancing OA impact.

Full Text

A Review of Research on Open Access Resource Impact

From the Perspective of Literature Analysis and Citation Analysis

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Abstract

[**Purpose/Significance**] Open Access (OA) has been developing for over a decade, with corresponding resources continuously growing and enriching. Timely research and analysis of literature evaluating OA resource impact helps clarify research trajectories, better inherit academic achievements, and further enhance the influence of OA resources. [**Method/Process**] From the perspectives of literature analysis and citation analysis, this study utilizes tools such as SCI, HistCite, and CNKI to collect data on domestic and international literature, citations, highly-cited papers, research institutions, core authors, and source publications related to OA resource impact evaluation, thereby mapping the research landscape and identifying important research forces and literature. [**Results/Conclusions**] The study finds that OA resource impact continues to attract researcher attention. The United States and United Kingdom constitute the first research tier, followed by countries including India, Canada, Germany, and China. Important foreign research predominantly examines OA impact through paper citations, considering gold OA as the currently popular publishing model, while important domestic literature primarily explores OA journal impact from perspectives of citation, web links, impact factors, and eigenfactors. Developing OA journals can serve as an important pathway for enhancing OA impact.

Keywords: Open Access; Influence; Literature Analysis; Citation Analysis

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Introduction

In December 2001, the Open Society Institute (OSI) in the United States introduced the concept of Open Access at the Budapest meeting, and on February 14, 2002, announced the *Budapest Open Access Initiative* [1]. Since then, Open Access (hereinafter referred to as OA) has entered a substantive development phase, traversing more than a decade of development while continuing to evolve. Various OA resources—including OA papers, OA journals, institutional repositories, and OA platforms—have continuously enriched and grown, influencing academic and scientific research fields. To further develop OA, enhance OA resource impact, better inherit academic achievements, and promote the sharing and innovation of scientific research, it is necessary to review relevant literature on OA resource impact evaluation and understand domestic and international research trajectories and recent concerns to predict approaches and pathways for enhancing its influence. This study examines the literature from the perspective of literature and citation analysis.

1. Analysis Approach and Tools

This study employs literature analysis and citation analysis to systematically review literature on OA resource impact (hereinafter referred to as "OA impact").

Literature analysis involves collecting, identifying, and organizing literature to conduct systematic and comprehensive analysis of existing relevant literature from different perspectives to discover new information. Citation analysis involves statistical analysis of citation relationships among literature or authors and is widely applied in science management. For literature collection, OA and impact serve as retrieval concepts, with keywords including "open access," "开放存取," "开放获取" for the former, and "影响力," "影响因子" (the primary basis for current impact evaluation) for the latter. Relationships among academic literature reflect the continuous accumulation, inheritance, and breakthrough process of academic innovation, embodying the inheritance and dissemination of academic achievements [2]. Using SCI, HistCite, and CNKI, this study retrieves and analyzes domestic and international research literature on OA impact evaluation, examining relationships among literature to reveal the research landscape and developmental trajectory of OA impact from a literature research perspective.

For foreign literature, SCI data and its analytical functions are employed. SCI is a globally recognized high-quality paper indexing tool with large data volume and strong analytical capabilities. Therefore, the Web of Science Core Collection is used for data collection and multi-angle analysis of publication and citation counts to macroscopically understand the foreign research landscape. HistCite is a citation chronology visualization software developed by SCI inventor Garfield, which graphically displays relationships among literature in a field based on citation analysis. It analyzes SCI literature data to help quickly map a field's developmental history, identify important literature, and locate the latest significant works. HistCite analysis compensates for SCI's limitation of focusing solely on citation counts (as not all citations are effective citations), avoiding inaccuracies in identifying important literature. For domestic literature, CNKI data and its literature analysis and index analysis functions are used to review relevant research. CNKI's literature data is relatively comprehensive, and its analytical functions are well-developed among domestic full-text databases.

2.1.1 SCI Retrieval Strategy

Since the abbreviation "OA" is frequently used in English literature as an acronym for the medical term osteoarthritis, only "open access" is used as the retrieval term. On September 1, 2016, Retrieval Formula 1: Title: (open access) AND Title: (influence or affect or impact or effect*) yielded 162 records, while Retrieval Formula 2: Title: (open access) AND Topic: (influence or affect or impact or effect*) yielded 631 records. Although Retrieval Formula 1 is more precise, it retrieves fewer documents. Retrieval Formula 2 balances precision and recall, retrieving more documents with greater statistical significance, and thus its results are adopted for analysis.

2.1.2 SCI Literature Analysis

First, analysis is conducted from the perspective of publication and citation counts. The dataset contains 631 papers with 4,551 total citations and an H-index of 30, indicating that 30 papers have been cited more than 30 times, demonstrating numerous important works in this field. Annual publication counts from 1998-2016 are shown in [Figure 1: see original paper]. Publications remained below 20 papers annually from 1998-2005, nearly doubled in 2006, and increased modestly thereafter, reaching a peak of 70 papers in 2014 and 2015. Annual citation counts [Figure 2: see original paper] have continued to climb steadily and uniformly, reaching nearly 800 citations in 2015. The overall continuous growth in both publication and citation counts indicates that OA impact has remained within the research vision of foreign scholars and represents a worthwhile research topic.

It is noteworthy that the dataset's statistical year begins in 1998, a time node when domestic literature also mentioned OA, indicating that both domestic and international academic communication experienced long-term development. Around 1998, OA was explicitly proposed as a concept and widely recognized and supported by the international community [3].

Among the 631 papers, three of the top six highly-cited works examine OA impact from the perspective of paper citations: G. Eysenbach's "Citation advantage of open access articles" [4], P. M. Davis et al.'s "Open access publishing, article downloads, and citations: randomised controlled trial" [5], and I. D. Craig et al.'s "Do open access articles have greater citation impact?" [6].

The first paper conducts bibliometric analysis of OA and non-OA articles published in the same journal between June 8 and December 20, 2004, finding that even in a journal widely used by research libraries, OA articles are identified and cited by peers faster than peer-reviewed non-OA articles, suggesting that OA may benefit science by accelerating the dissemination and absorption of research results. The second paper, a highly-cited work, measures the impact of OA on downloads and citations of scientific literature. Selecting 1,619 research articles and reviews from 11 journals published by the American Physiological Society for a randomized controlled trial, it finds that OA publishing reaches more readers than subscription publishing but detects no citation advantage for OA articles in the first year after publication, suggesting that the widely reported citation advantage of OA may be an artifact caused by other factors. The third paper, also identified as important in HistCite analysis, notes that several OA approaches have emerged in recent scholarly communication, broadly categorized as gold OA and green OA. It reviews the relationship between OA status and citation counts of scholarly literature, pointing out that early studies showed correlation between free online availability or OA status and higher citation counts, while more recent investigations have explained the nature of this relationship. The most rigorous studies to date indicate that remaining differences in citation counts between OA and non-OA articles are explained by

the selection bias hypothesis, finding no evidence supporting the OA hypothesis itself—requiring further research using similarly rigorous methods to determine the generality of this finding. These three papers explore citation differences between OA and non-OA literature, the impact of OA publishing on downloads and citations, and the evolution of research on the relationship between OA status and citations, providing a quick understanding of the research trajectory on OA impact.

The distribution of research forces can be understood through country/region and institutional analysis. [Figure 3: see original paper] shows that the United States and United Kingdom clearly lead in OA impact research, with the U.S. ranking first (accounting for approximately 30% of total publications) and the U.K. second (about half the U.S. volume), followed by Canada, Germany, India, Italy, China, Spain, and Australia. The U.S. and U.K. implemented OA earlier, resulting in greater publication volume and advantage in specific topic research. [Figure 4: see original paper] lists the top 10 institutions by publication volume: University of London, Indiana University, University of California, Indiana University-Purdue University Indianapolis, University of North Carolina, French National Centre for Scientific Research, Hanken School of Economics, University of Tehran, Harvard University, and King's College London, comprising three U.S., two U.K., and two Indian institutions, corroborating the country rankings.

Examining funding agencies [Figure 5: see original paper], among the top 10 funders, three U.S. agencies funded eight relevant papers, China's National Natural Science Foundation funded four, two U.K. agencies funded four collectively, two German agencies funded four collectively, and Spain and Sweden each funded two papers. The appearance of China's National Natural Science Foundation among the top 10 indicates that although domestic research volume lags behind foreign counterparts, research has commenced with high-level funding support, promising to lead domestic research development in this field.

From the perspective of source publications [Figure 6: see original paper], *Journal of the American Society for Information Science and Technology*, *Scientometrics*, *Learned Publishing*, *Online Information Review*, *PLOS One*, and *Gastroenterology* show high publication volumes, indicating these journals are major publication venues in this field with long-term accumulation and attraction effects. Core authors in this field include B. C. Bjork, J. F. Xia, S. Harnad, and S. Arunachalams [Figure 7: see original paper]. From SCI's research direction and Web of Science category perspectives, information science and library science constitute the primary disciplinary fields studying OA impact, accounting for nearly 30% of research share [Figure 8: see original paper][Figure 9: see original paper]. Additionally, relevant research in computer science, engineering, medicine, chemistry, communication, and business also occupies prominent positions, indicating extensive research in OA resource technical implementation and in medicine, which possesses substantial OA information resources.

2.2.1 Data Import and Metrics Description

Unlike statistical analysis focusing on publication volume, HistCite is a citation analysis tool that analyzes large batches of literature from a citation perspective, quickly identifying important and key literature in thematic research and mapping overall research trajectories—such as understanding pioneering questions in a field, milestone literature, inter-literature relationships, and important scientists and institutions.

This study examines 631 foreign OA impact research papers from 1998-2016 retrieved from the Web of Science Core Collection. After importing these into HistCite, the analysis reveals: 1,888 authors, publication in 398 journals, 14,686 total citations, and 2,070 keywords identified, with viewing options by publication year, document type, language, institution, expanded institution, and country.

HistCite features several important metrics: LCS (Local Citation Score), GCS (Global Citation Score), LCR (Local Cited References), and CR (Cited References). LCS and GCS indicate local and total citation counts, respectively, helping judge literature importance but not reflecting the importance of recent articles. In analysis, LCS ranking is typically selected because LCS better reflects how many citing articles are related to the current research field than GCS, more accurately determining literature importance.

2.2.2 Citation Analysis and Interpretation

All 631 papers were sorted by LCS and visualized [Figure 10: see original paper]. The vertical axis represents years, circles represent papers (one circle per paper), circle size indicates citation count, and arrows indicate citation relationships with numbers representing paper IDs.

The visualization shows most literature forming a network structure, indicating citation interconnections, while some papers remain discrete, suggesting their research topics are relatively detached from mainstream content. Due to the large literature volume creating a dense network structure that hinders analysis, adjustments were made to select the top 100 LCS-ranked papers and display only the networked portion [Figure 11: see original paper] for interpretation and identification of important literature.

[Figure 11: see original paper] reveals several important papers. Among connected literature, J. D. Wren's paper 94 [7] received 11 local citations and 41 total citations, discussing open access and open accessibility (sharing scientific publications via the Internet) and representing important pioneering work in the field. I. D. Craig's paper 159 [6] is the largest circle in the network—the most important literature—with 42 local citations and 111 total citations. While ranking fourth in total citations, HistCite analysis shows it performs best in local citations, indicating that within this research field, numerous papers have adopted its viewpoints or data, significantly influenced other research, or spawned ad-

ditional research branches. Two subsequent papers, 167 [8] and 212 [9], also perform excellently with 25 local citations each (58 and 64 total citations, respectively), examining OA's impact on citations based on ArXiv analysis and the citation advantage of OA papers. These papers reflect important content in OA impact research. Among recent literature, three 2014 papers—484 [10], 527 [11], and 480 [12]—received 4, 3, and 2 local citations respectively (15, 8, and 4 total citations), indicating their importance. Their research focuses on green OA anatomy, global OA repositories, and characteristics of OA journals in India under green, gold, and hybrid models.

L. Leydesdorff argues that paper citations should be further distinguished between long-term and short-term citations. Short-term citations indicate that cited papers are at the research frontier or hotspots, reflecting topic advancement and rationality. Studying short-term citations facilitates enhancing academic research purposefulness and forming forward-looking predictions and recommendations. Long-term citations fully demonstrate cited papers' academic influence and originality, reflecting academic inheritance and dissemination [13]. HistCite identifies important literature inheritance nodes, including classic important works (with high long-term citation counts) and recent papers with high short-term citation counts.

Among the three recent important papers, the first notes that for peer-reviewed journal articles, OA has two main approaches: publishing in OA journals (called gold OA) or archiving article copies or manuscripts in other online locations (called green OA). It focuses on summarizing and extending current knowledge about green OA. Previous research indicates green OA coverage of all published journal articles is approximately 12%, with green OA copies becoming available after considerable time delays. Repositories are ideal archiving locations, but storage on homepages and similar locations cannot guarantee long-term preservation and may infringe upon publishers' proprietary rights. Due to the rapid increase in institutional repositories, the technical foundation for green OA uploading is becoming increasingly stable, but the number of articles within OA authorization remains small. The second paper uses data collected by the OpenDOAR project to review global growth of OA repositories from 2005-2012. Initial repository development concentrated primarily in North America, Western Europe, and Australasia, particularly the U.S., U.K., Germany, and Australia, followed by Japan. Since 2010, development has focused on East Asia, South America, and Eastern Europe, particularly Taiwan (China), Brazil, and Poland. During this period, some countries including France, Italy, and Spain maintained stable growth, while others, notably China and Russia, showed limited growth. The paper identifies major factors affecting initial repository development and use as IT infrastructure, cultural factors, policy initiatives, awareness-raising activities, and usage authorization. The third paper examines characteristics of 462 OA journals selected from DOAJ, IndianJournal.com, and Open J-Gate published under green, gold, and hybrid models in India. It notes that citation counts for these journals are calculated using Google Scholar and Indian citation indices, that gold OA is now the most popular OA publishing form in the sub-

continent, that OA journals are primarily influenced by a few major publishers and journals, that the highest impact factor of gold OA journals is 0.58, and that publication fees are not a major obstacle for authors in computer science, pharmacy, and medicine fields.

HistCite analysis intuitively presents the development trajectory and latest progress of OA impact research, helping understand important literature, academic achievements, and contributors, and providing beneficial entry points for OA resource construction and impact enhancement.

3.1.1 Retrieval Strategy and Results

CNKI is used to retrieve domestic literature on OA impact research. On September 9, 2016, Retrieval Formula 3: TI=(开放存取 + 开放获取 +OA) AND TI=(影响力 + 影响因子) yielded 29 results, while Retrieval Formula 4: TI=(开放存取 + 开放获取 +OA) AND SU=(影响力 + 影响因子) yielded 210 results. Compared with SCI retrieval results, domestic research volume is significantly smaller, indicating differences in research strength and interest between domestic and international communities.

3.1.2 CNKI Literature Analysis

Using literature retrieved by Retrieval Formula 4 as the analysis object, the H-index is 18, indicating that 18 papers have been cited more than 18 times. From the research strength perspective, Wuhan University, National Science Library (Chinese Academy of Sciences), Central South University, Nanjing Agricultural University, and Jilin University rank high in publication volume, indicating these institutions have conducted substantial research on this topic. Core authors include Hu Dehua, Liu Hui, Fang Qing, Chen Wei, Huang Ying, Li Lin, Shen Ou, and others, each with three or more relevant papers. Hu Dehua leads with six papers, making him a major researcher. Additionally, over 30 authors including Ren Shengli, Cheng Weihong, Huang Ruhua, and Yuan Shunbo have two or more papers, demonstrating that OA impact attracts attention from numerous scholars and represents a worthwhile research topic. Regarding funding, polarization is evident: on one hand, high-level funding exists, including 13 papers funded by the National Social Science Foundation and four by the National Natural Science Foundation; on the other hand, few papers receive funding, with most lacking project support, indicating an overall dispersed and weak research status that has not received strong attention from funding agencies at various levels. This is corroborated by publication growth patterns, with high-volume years occurring between 2009-2015 (averaging over 20 papers annually) and fewer publications in earlier years.

The most highly-cited domestic paper is "Using Open Access to Enhance the Impact of University Natural Science Journals" by Ge Zhaoqing et al. [14], with 98 citations. Li Ruoxi et al.'s "International Academic Publishing Open Access (OA)" [15] has 51 citations. Hu Dehua's co-authored works "Research on Quality

Evaluation of Open Access Journals" [16] and "Research on Quality and Impact Evaluation of Open Access Journal Papers" [17] received 36 and 26 citations respectively. Reviewing top-cited literature reveals research primarily examines OA impact from OA journal and OA paper perspectives. Regarding source journals, *Library and Information Service* leads with 11 papers, followed by *Modern Information*, *Library Tribune*, *Acta Editologica*, *Journal of Intelligence*, *Library and Information Knowledge*, *Library Construction*, and *Science-Technology and Publication*, each publishing five or more papers, making these the primary journals for this topic.

Since CNKI's analysis function supports a maximum of 150 records per analysis, [Figure 12: see original paper] shows most literature clustered together with relatively average network connections, indicating frequent mutual citation. One relatively prominent cluster discusses OA journal impact, suggesting this theme receives comparatively more attention and yields more research 成果. A small portion of literature remains marginalized and discrete, indicating these papers' research viewpoints are self-contained, have not received endorsement from other studies, and have not formed schools of thought.

Analyzing results from Retrieval Formula 3 yields [Figure 13: see original paper]. Although involving fewer papers, [Figure 13: see original paper] shows clearer inheritance citation relationships, with one region connecting numerous papers. Larger circles indicate more important literature, including Hu Dehua and Chang Xiaowan's "Research on Quality and Impact Evaluation of Open Access Journal Papers" [17], Yuan Shunbo and Hua Weina's "Evaluation of Open Access Journal Academic Impact Based on Citation and Web Links" [18], Wang Jue and Fang Qing's "Evaluation of Open Access Journal Academic Quality (II)—Analysis Based on the Impact Factor Perspective" [19], Han Pengming's "Research on Evaluation of Open Access Journal Academic Impact Based on Eigenfactors" [20], and Zhao Tiehan and Huang Ying's "Research on Evaluation of Open Access Journal Academic Impact" [21], all exploring impact issues from the OA journal perspective. Additionally, Ge Zhaoqing et al.'s "Using Open Access to Enhance the Impact of University Natural Science Journals" [14] is surrounded by numerous papers, indicating its viewpoints have also received considerable endorsement.

4. Summary and Discussion

Analysis of domestic and international literature on OA impact research reveals that foreign research significantly surpasses domestic research in publication volume, research strength, funding, and citation relationships. U.S. and U.K. research generally leads the field. Among authors, J. Wu, I. D. Craig, H. F. Moed, B. Bjork, Hu Dehua, Liu Hui, Fang Qing, Ren Shengli, Cheng Weihong, and Huang Ruhua constitute influential and productive core author groups. High-impact literature primarily investigates and discusses citation, OA journal quality, and academic impact of institutional repositories. Several high-impact foreign papers examine OA impact from the paper citation perspective, explor-

ing citation differences between OA and non-OA literature, the impact of OA publishing on downloads and citations, and the evolution of research on the relationship between OA status and citations. Recent well-cited papers summarize and extend current knowledge on green OA, review global growth of OA repositories from 2005-2012, and examine characteristics of OA journals under green, gold, and hybrid models in India, noting that gold OA is now the popular OA publishing form. High-impact domestic literature primarily explores academic impact issues from the OA journal perspective, employing research angles including citation, web links, impact factors, and eigenfactors. The likely reason for domestic focus on OA journal impact research is that journals can be analyzed and compared using relatively recognized indicators such as impact factors, facilitating research, while analysis of specific papers is particularistic and lacks universality, making it difficult to obtain convincing generalizable results. From this perspective, evaluating OA journal impact represents a more feasible and convenient research and development path and a viable focus for subsequent research. Therefore, enhancing OA impact should proceed from developing OA journals.

Another noteworthy detail is that among the 631 papers retrieved from SCI, 108 are OA papers, allowing users free and convenient access to full text. For domestic literature, since CNKI does not provide an OA filtering function, the Wanfang platform was checked for OA source literature, revealing none. From this perspective, current domestic OA development remains weak in practice, with insufficiently convenient OA resource access from commonly used databases, small available literature quantities, and lack of corresponding functions. Compared with foreign counterparts, the gap is even larger. Therefore, enhancing support for OA in major domestic database platforms could be considered, including adding functional modules for providing, displaying, filtering, and analyzing OA source literature to facilitate user access, utilization, and research, thereby providing literature support for enhancing OA resource impact.

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