Analysis of High-Quality Open Access Papers in Academic Journals: A Case Study of Web of Science Core Collection

Authors: Zhu Jiang, Ren Xiaoya, Zhu Jiang

Date: 2018-10-16T00:00:00+00:00

Abstract

[Purpose/Significance] This study aims to comprehensively investigate the quantity and open access rate of open access papers, and provide a preliminary evaluation of their quality. [Methods/Process] Using the Web of Science (WoS) Core Collection as the data source, this paper statistically analyzes papers published in high-quality academic journals indexed by WoS during the 15-year period from 2002 to 2016 across four dimensions: publication year, research field, country (region), and publishing institution, thereby analyzing and interpreting the changing trends of OA papers; finally, taking Nature as a case study and using average citations per paper and the proportion of highly cited papers as metrics, a brief analysis of OA paper quality is conducted. [Results/Conclusions] The number of global OA papers has increased year by year, with China being a typical representative; the Chinese Academy of Sciences is the institution with the most papers indexed in the WoS platform, and its OA paper volume ranked first in 2016, but its OA rate still lags behind major European and American institutions; the OA practice in the biomedical field is more effective than in other research fields.

Full Text

Research on Open Access Papers in High-Quality Academic Journals: A Case Study of the Web of Science Core Collection

Zhu Jiang[1], **Ren Xiaoya**[1],[2]
[1]Chengdu Library and Information Center, Chinese Academy of Sciences, Chengdu 610041, China
[2]University of Chinese Academy of Sciences, Beijing 101408, China

Abstract

[**Purpose/Significance**] This study aims to comprehensively understand the quantity and open access (OA) ratio of OA papers while providing a preliminary evaluation of their quality. [**Method/Process**] Utilizing the Web of Science (WoS) Core Collection as the data source, we examined papers published in high-quality academic journals indexed by WoS from 2002 to 2016 across four dimensions: publication year, research area, country/region, and institution. We subsequently analyzed and interpreted the changing patterns of OA papers. Finally, taking *Nature* as a case study, we conducted a brief quality analysis of OA papers based on citations per paper and the proportion of highly-cited papers. [**Result/Conclusion**] The number of OA papers worldwide has increased year by year, with China being a particularly representative case. The Chinese Academy of Sciences (CAS) is the institution with the largest number of papers indexed by WoS, and its OA paper volume ranked first in 2016; however, its OA ratio still lags behind major European and American institutions. The OA practice in the biomedical fields has proven more effective than in other research areas.

Keywords: open access; OA; OA ratio; Web of Science; high-quality academic journal

---

The "Budapest Open Access Initiative" (BOAI), released in February 2002, marked the formal global advancement of the open access movement. BOAI proposed two primary OA approaches: self-archiving and open access journals, with the latter being its main focus—establishing peer-reviewed OA journals or transforming traditionally published journals into OA journals [1]. Since then, driven jointly by academia, publishing houses, and libraries, the green and gold OA movements have flourished worldwide. Various forms of repositories have been widely established, and pure OA and hybrid OA journals continue to emerge, enabling rapid and broad dissemination of academic research outcomes. However, due to the uneven quality of OA journals, coupled with the emergence of "predatory" OA journals and excessive article processing charges (APCs), some researchers remain skeptical about the OA publishing model.

Open access literature is voluminous and scattered across OA publications and repositories, making quantitative and qualitative analyses challenging. Qiu et al. [2] employed bibliometric methods to analyze the quantity, citation frequency, country of origin, and subjects of OA papers in information science and library science from 1995 to 2010. Zang et al. [3] constructed quality evaluation indicators for network journal papers. Based on studies by D. J. Solomon et al. [5] and B. Bo-Christer et al. [6], Chen [4] utilized multivariate statistical methods to analyze OA journals indexed in Scopus and Web of Science, comparing differences in evaluation indicators and improvement rates. Liu [7] integrated Altmetrics concepts and employed multiple scientometric indicators to comprehensively evaluate OA papers from both traditional static perspectives

(citations, views, etc.) and dynamic viewpoints.

By the end of 2017, Clarivate began providing open access full-text links for abstracts indexed in the Web of Science platform. Gold OA links are labeled as "Free Full Text from Publisher," directing users to OA full texts, free full texts, or texts that became open after a certain embargo period in pure OA and hybrid OA publications (not limited to gold OA literature in the traditional sense). Green OA links are divided into dark green "Free Accepted Article in Repository" (accepted version manuscript) and light green "Free Published Article in Repository" (published version), respectively pointing to final peer-reviewed manuscripts and published articles freely available from repositories [8]. WoS users can access these full texts free of charge through these links.

To gain a comprehensive understanding of global OA paper quantities and proportions (OA ratio), we conducted a search in early January 2018 using the Web of Science Core Collection as the data source. We retrieved articles (referred to as "papers") published between 2002 and 2016 in high-quality academic journals indexed by WoS, and utilized WoS' s built-in statistical analysis module to examine all papers and OA papers across the dimensions of publication year, research area, country/region, and institution.

2.1 Quantity and Annual Growth of OA Papers in High-Quality Academic Journals

We statistically analyzed the total number of papers published and indexed by WoS from 2002 to 2016, along with the quantities of OA papers and their breakdown into gold, green-published, and green-accepted categories, as well as annual growth rates. The results are presented in Table 1 .

As shown in Table 1, several key patterns emerge. First, the number of OA papers in WoS increased annually from 2002 to 2016, with an overall OA ratio of 21.52%. The annual OA ratio rose from 14.00% in 2002 to 26.54% in 2015 (with a slight decline in 2016), representing an increase of nearly 90%. Second, the annual growth rate of OA papers showed irregular patterns, peaking at 17.69% in 2008. After 2014, the annual growth rate began to slow noticeably, with the 2016 increase being only 1.17%, suggesting a potential bottleneck period. Third, gold OA papers constitute the primary channel for accessing OA papers on the WoS platform, while the two types of green OA papers serve merely as supplementary channels with very low proportions.

2.2 OA Paper Quantities and Trends Across Research Fields

We selected WoS research areas as the analytical perspective and separately counted the top 20 research fields by total paper volume, total OA paper volume, and OA ratio from 2002 to 2016, conducting a cross-comparison of their rankings (Tables 2 –4).

Several conclusions can be drawn from this analysis. Overall, during 2002–

2016, three research fields—oncology, cell biology, and cardiovascular system & cardiology—simultaneously ranked in the top 20 across all three metrics. The four disciplines with the highest total paper volumes were chemistry, engineering, physics, and materials science; however, their OA ratios were not particularly impressive, ranking around 100th among 151 research fields. The biomedical fields exhibited substantially larger OA paper volumes than other research areas. Except for large disciplines such as mathematics and chemistry, and the "other topics in science and technology" category, all top ten fields by OA paper volume belonged to the biomedical domain. Specifically, biochemistry and molecular biology ranked 5th in total papers but 1st in OA paper volume by a large margin, with an OA ratio of 41.52%. Although cell biology did not rank high in total paper volume, it placed 5th in both OA paper volume and OA ratio. Tropical medicine achieved the highest OA ratio at 65.55%. These findings indicate that the biomedical field has shown strong support for the open access movement with favorable development momentum, as evidenced by major OA publishers such as the UK' s BioMed Central (BMC) [9], the US PubMed Central (PMC) [10], and PLoS [11], all of which have been key drivers of the OA movement.

When ignoring disciplinary scale differences, biomedical fields accounted for 85% of the top 20 research fields by OA ratio, with the top ten positions all occupied by biomedical disciplines (similar to the OA paper volume ranking), except for astronomy & astrophysics, mathematical & computational biology, and other topics in science and technology. Notably, seven biomedical research fields—tropical medicine, microbiology, virology, developmental biology, cell biology, infectious diseases, and physiology—achieved OA ratios exceeding 50%, demonstrating significant effectiveness in OA implementation.

2.3 Changes in OA Paper Quantities Across Major Countries/Regions

We selected the top ten countries/regions by total paper volume on the WoS platform from 2002 to 2016 and statistically analyzed their total paper volumes and rankings, OA paper volumes and rankings, and annual changes. Due to space limitations, Table 5 presents data for selected years only, while Figures 1 [Figure 1: see original paper] and 2 [Figure 2: see original paper] illustrate the trends.

The analysis reveals several patterns. First, the top ten countries/regions by total paper volume on WoS from 2002 to 2016 were essentially the same as those ranking in the top ten for OA paper volume, with the exception of Spain. Spain, which ranked 9th in total papers, placed 12th in OA paper volume, with Brazil taking the 9th position instead. Second, as the world's leading power, the United States consistently ranked first globally in total papers, OA papers, and annual rankings throughout 2002–2016. While the absolute number of papers increased yearly, the growth rate has slowed significantly in recent years, with negative growth occurring in total papers in 2015 and in OA papers in 2016. Third, China, as another global power, ranked second worldwide in both total and OA paper volumes during 2002–2016. In 2002, China ranked 6th in total

papers and only 14th in OA papers, but its rankings rose steadily thereafter, reaching second place for both metrics by 2010–2011, where it has remained. Conversely, Japan, which ranked second in both metrics in 2002, has experienced a continuous decline. Fourth, England, as an active proponent of open access, consistently maintained an OA paper ranking one position ahead of Germany, despite Germany' s higher total paper ranking. Fifth, countries such as India, South Korea, and Brazil have shown substantial OA paper growth in recent years, with annual statistics indicating they have entered or approached the top ten.

2.4 Statistical Analysis of OA Papers from Top 20 Institutions

We selected the top 20 institutions by total paper volume on the WoS platform from 2002 to 2016 and counted their total paper volumes, OA paper volumes, and rankings over the 15-year period. Due to space limitations, Table 6 presents data for selected years only.

The findings reveal several notable institutional patterns. First, although the Chinese Academy of Sciences (CAS) ranked first in total papers on WoS from 2002 to 2016, it had very few OA papers in 2002—only 398, ranking 83rd. Since then, CAS' s OA paper volume has increased annually, rising to 2nd place in 2014 and capturing the top position in 2016, a achievement closely related to CAS' s active advocacy for and participation in open access, as well as its successful operation of one of the world' s largest institutional repositories. In contrast, the Russian Academy of Sciences, which ranked second in total papers during the same period, has shown no significant improvement in OA papers, never entering the top 50 from 2002 to 2016 and exhibiting a trend of initial decline followed by slow recovery, ranking 113th in 2016. Second, Harvard University, which ranked first in the US and third globally in total papers from 2002 to 2016, consistently held the global top position in OA paper volume from 2002 to 2015, only to be surpassed by CAS in 2016. Third, the University of Tokyo and Kyoto University, the two Japanese institutions among the top 20 by total paper volume (ranking 4th and 18th respectively), placed 9th and 19th in OA paper volume. While the overall gap was not substantial, annual data reveals a clear declining trend for both, with Kyoto University dropping out of the top 50 by 2013. In contrast, Chinese institutions such as Shanghai Jiao Tong University, Zhejiang University, Peking University, Fudan University, and Sun Yat-sen University, along with Korea' s Seoul National University and France' s CNRS, have recently entered the top 50 in both total and OA paper volumes, gradually displacing established European and American universities. Fourth, UK universities generally exhibit OA paper rankings higher than their overall paper rankings, with Oxford University showing particularly significant improvement in recent years, ranking 3rd in OA papers in 2016—behind only CAS and Harvard—a trend partly attributable to UK Research Council OA policies and indicating strong recognition and implementation of OA among UK researchers. Fifth, the University of São Paulo in Brazil has shown steady annual

improvement, rising from 39th in 2002 to 15th in 2016, representing a typical case among developing countries. Sixth, in 2016, CAS ranked first globally in OA paper volume with an OA ratio of 21.09%, while the 2nd–4th ranked institutions —Harvard University, Oxford University, and the University of Washington—all achieved OA ratios around 50%, with Harvard reaching 55.68%. This reveals a clear gap between CAS and other leading institutions in terms of OA ratio.

3. Preliminary Quality Analysis of OA Papers in High-Quality Academic Journals

Taking *Nature* as an example, we briefly analyze the quality of OA papers through citation counts and contribution to journal impact factors (measured by citations per paper and proportion of highly-cited papers), as shown in Table 7 .

As a prestigious traditional journal, *Nature* enjoys an exceptional reputation in academia. From 2002 to 2016, WoS indexed 13,059 *Nature* articles, which received a total of 3,262,144 citations from WoS-indexed documents, averaging 249.80 citations per paper. During the same period, OA papers numbered 3,955, receiving 954,769 total citations with an average of 241.41 citations per paper —slightly lower than the overall average. However, data from the most recent decade (2007–2016) present a different picture: the 8,277 total papers published during this period received 1,697,772 citations, averaging 205.12 citations per paper, while the 3,543 OA papers received 804,862 citations, averaging 227.17 citations per paper—9.71% higher than the overall average.

Furthermore, *Nature* published 3,365 highly-cited papers from 2007 to 2016, of which 1,543 were OA highly-cited papers. As illustrated in Figure 3 [Figure 3: see original paper], the proportion of highly-cited papers among all papers showed an overall upward trend, increasing from 34.27% in 2007 to 43.48% in 2016. The proportion of OA highly-cited papers among all OA papers rose from 41.12% in 2007 to 48.35% in 2016, peaking at 51.09% in 2012.

Citation counts are influenced by multiple factors and should not be considered the sole indicator of paper quality. Beyond journal and paper quality, citation counts are also affected by paper visibility and accessibility [12]. The higher average citation counts for *Nature*'s OA papers during the recent decade, combined with the consistently higher proportion of OA highly-cited papers compared to the overall proportion, suggest that—while we cannot simply conclude that OA papers are of higher quality—OA papers have generally contributed to enhanced dissemination and inheritance of scientific research outcomes and have likely played a role in sustaining *Nature*' s rising impact factor.

Although the OA links in the Web of Science Core Collection are not entirely accurate, analysis of the past 15 years of data yields the following main conclusions: (1) Gold OA papers represent the primary channel for accessing OA papers on the WoS platform, while green accepted and green published OA papers serve merely as supplementary channels. (2) From 2002 to 2016, OA pa-

pers accounted for 21.52% of all papers indexed in WoS, showing a year-by-year upward trend; however, after 2014, the annual growth rate slowed significantly, with the 2016 increase being only 1.17%, suggesting a potential bottleneck period. (3) From a research field perspective, the biomedical fields led in OA paper volume over the 15-year period, with all top ten fields by OA ratio belonging to the biomedical domain—demonstrating that this field has been a major driver of the OA movement. (4) From a country/region perspective, the top ten countries/regions by total paper volume on WoS from 2002 to 2016 were essentially the same as those ranking in the top ten for OA paper volume, with the exception of Spain. The United States has consistently led globally in total papers, OA papers, and rankings, though negative growth has occurred in the past two years; China' s OA paper volume has risen annually, stabilizing at second place globally in recent years; Japan' s rankings in both metrics have continued to decline; and developing countries such as India and Brazil have shown substantial OA paper growth in recent years. (5) From an institutional perspective, the Chinese Academy of Sciences has been the institution with the most papers indexed on WoS over the past 15 years. Through active participation in the OA movement, CAS rapidly reversed its initially low OA paper ranking, surpassing Harvard University for the first time in 2016 to rank first globally in OA paper volume, though its OA ratio still lags behind major European and American institutions. Japanese universities such as the University of Tokyo and Kyoto University have continued to decline in OA paper volume rankings, while UK university institutions have shown significant ranking improvements, reflecting both OA policy support and high researcher acceptance and implementation.

References

[1] Zhu Jiang. Research on the Open Access Guarantee System for Scientific Conference Literature[D]. Chengdu: Sichuan University, 2006.
[2] Qiu Fengming, Chen Huilan. Analysis of Open Access Papers Based on Web of Science[J]. Modern Information, 2011, 31(8): 115-118.
[3] Zang Guoquan, An Ming, Wang Xiaomei. Research on Quality Evaluation of Open Access Network Journal Papers[J]. Library, 2013(4): 24-26.
[4] Chen Juan. Quantitative Study of Open Access Journals Indexed in Scopus and Web of Science[J]. Chinese Journal of Scientific and Technical Periodicals, 2015, 26(4): 405-413.
[5] SOLOMON D J, LAAKSO M, BJORK B C. A longitudinal comparison of citation rates and growth among open access journals[J]. Journal of informetrics, 2013, 7(3): 642-650.
[6] BO-CHRISTER B, DAVID S. Open access versus subscription journals: a comparison of scientific impact[J]. BMC medicine, 2012, 10(1): 1-10.
[7] Liu Chen. Research on the Advantages of Open Access Based on Multiple Metrics[D]. Dalian: Dalian University of Technology, 2016.
[8] Clarivate analytics open access: the future of open access discovery is NOW[EB/OL]. [2018-01-10]. http://info.clarivate.com/openaccess?utm_{source}=wos&utm_{medium}=pro
[9] BioMed Central Introduction[EB/OL]. [2018-01-12]. https://www.biomedcentral.com/.

[10] PubMed Central Introduction[EB/OL]. [2018-01-12]. https://www.ncbi.nlm.nih.gov/pmc/.
[11] Public Library of Science PLoS Introduction[EB/OL]. [2018-01-12]. https://www.plos.org/.
[12] Openaccessaspracticeinthe humanities[EB/OL]. [2018-01-10]. https://www.fosteropenscience.eu/sites/defa

Author Contributions: Zhu Jiang: responsible for research design, paper writing, and revision; Ren Xiaoya: responsible for data collection, data processing, and paper writing.

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