Article-level Metrics Research: Case Study Analysis

Authors: Gu Liping

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Abstract

This study briefly introduces the distinctions between article-level metrics (ALMs) and traditional bibliometrics, and systematically reviews current application cases of ALMs. Through case analysis, it delineates the operational mechanisms of PLoS-ALMs, including data sources, metadata and raw data, and open data. It further discusses how ALMs can support the development of future open innovation.

Full Text

Preamble

Research on Article-Level Metrics (ALMs): A Case Analysis

Ku Liping
(National Science Library, Chinese Academy of Sciences, Beijing 100190, China)

Abstract: This paper introduces the differences between Article-Level Metrics (ALMs) and traditional bibliometrics, and summarizes current cases of ALMs applications. Using case study methodology, the author outlines the operational mechanisms of PLoS-ALMs, including its data sources, metadata and raw data, and open data provisions. The discussion concerns how ALMs support future open innovation development.

Keywords: Alternative metrics, Scholarly visibility, Social visibility, Research impact indicators, Information filtering, Knowledge discovery, Public Library of Science (PLoS)

1. Introduction: The Special Characteristics and Importance of Article-Level Metrics

Article-Level Metrics (ALMs) enable the tracing of immediate and social impacts of scholars' work—something that citation metrics cannot accomplish. Traditional bibliometrics has long served as the basis for evaluating the importance of newly published papers. However, in the digital, networked, and open-access era of scholarly communication, the influence of individual papers can be more easily parsed and calculated separately.

The main differences between these approaches are threefold. First, traditional bibliometrics focuses on the utilization of references at the end of articles, particularly through citation matrices, and is especially prominent in journal evaluation and in assessing the influence of individual papers or authors based on journal metrics. Second, altmetrics specifically emphasizes the analysis and application of Web 2.0 data to examine the social and immediate impacts of journals and the community influence of individual papers. Third, article-level metrics integrates both approaches, valuing traditional citation data and its analytical indicators while also attending to Web 2.0 user community influence in digital, networked, and open environments.

Building on previous research [1-3], the author compares these three approaches and presents their theoretical differences in Table 1 . The evolution from bibliometrics to altmetrics [4] has generated various service mechanisms [5]. Based on the work of Kazuhiro Hayashi [4], Figure 1 [Figure 1: see original paper] illustrates the varying levels of attention reflected by different metric methods and the size of their community reach, showing that traditional bibliometrics captures only the tip of the iceberg of literature utilization.

In terms of audience, the public cares about practical applications while scholars focus on theoretical breakthroughs. Regarding dimensions, traditional bibliometrics concerns paper influence, whereas ALMs concern social attention and scholar self-improvement. Temporally, journal evaluation systems operate on an annual basis, while ALMs calculate in months and days. In short, ALMs require more detailed and precise computational capabilities, offering greater advancement in granularity and immediacy. The comprehensive landscape of impact measurement [1] is shown in Figure 2 [Figure 2: see original paper].

Because ALMs analyze individual papers rather than journals, their timeliness reflects daily usage and citations after publication rather than accumulated journal citations over years. As an emerging journal service capability and a new type of institutional evaluation indicator, ALMs are well-suited for measuring the immediate academic impact and social contribution of a paper or its authors in open-access environments.

2. Analysis of Application Cases

The industry has already developed numerous ALMs implementations. Case analysis approaches include: based on prior research on open data applications [7] and open platforms with APIs [8], conducting literature reviews, then following clues [9] to explore the functions and structure of PLoS-ALMs and 梳理 its data model.

Based on previous case studies [1, 5, 10] and accessible domestic platforms, the author examined services including PLoS.com, Altmetric.com, Plum Analytics.com, CiteULike.org, F1000.com, Mendeley.com, and Zotero.org, as summarized in Table 2 . These cases share the common feature of having data pipelines that extract user statistics—particularly raw data from system logs—originally closed within information service systems, then organizing and providing them for open sharing.

Compared with traditional bibliometrics, ALMs differ in three main aspects [6]: (1) Audience: the public cares about practical applications while scholars focus on theoretical breakthroughs; (2) Dimension: traditional bibliometrics concerns paper influence, while ALMs concern social attention and scholar self-improvement; (3) Time: journal evaluation systems use annual units, while ALMs use monthly and daily calculations.

3. Examining ALMs Mechanisms Using PLoS as an Example

3.1 PLoS-ALMs Data Flow

As an open data publishing platform for open-access journal articles, the PLoS-ALMs data flow comprises three stages: first, acquiring Web 2.0 user behavior data about individual PLoS papers from various open platforms and storing it in the PLoS system; second, within the PLoS platform, corresponding, organizing, and merging this heterogeneous data into a comprehensive data table; third, extracting significant metadata elements from this master table to create new tables for open sharing.

3.2 PLoS-ALMs Data Sources and Types

Data types determine source selection. PLoS-ALMs generally identifies four data categories: usage statistics, citations, social networks, and blogs. However, a fifth category—real-time interaction—was originally designed but is now imported periodically rather than instantaneously. The data sources are detailed in Table 3 .

3.3 PLoS-ALMs Data Model

After determining data types and sources, the focus of PLoS-ALMs analysis is its data model, broadly divided into raw data (from various sources) and

metadata. Based on data provided by PLoS [23, 24] and referencing PLoS' s ALMs documentation [25, 26], the model is organized in Table 4 . In the raw data, strings separated by "|" can conveniently correspond to metadata elements, while "···" indicates omitted lengthy strings.

In addition to ALMs data, PLoS also provides data suitable for journal-level metrics (JLMs), though these differences are not elaborated here.

3.4 PLoS-ALMs Open Data Model

Following data types, sources, and model structure, PLoS provides ALMs open data through an open platform for institutional or individual application development via APIs. However, the open data refined from the PLoS-ALMs model is stored in a separate knowledge base (KB) and shared through this KB, as organized in Table 5 .

3.5 Role of PLoS-ALMs

Analysis of the PLoS-ALMs open data model reveals that it maximally provides statistical data relevant to open-access journals (or papers) to facilitate the development of more open applications. For example, the open-source platform Impactstory not only integrates PLoS data but also provides ALMs APIs. As more users interact with Web content, they leave more data records, fostering services like Altmetrics. With open data, applications, and source code becoming deeply embedded in social infrastructure, harvesting useful data can be parsed into actionable intelligence [27, 28].

Impactstory.org provides a panoramic view of such tools for ALMs, as shown in Table 6 . Compared with Impactstory.org' s data model, the commercial company Plum Metrics proposes more diverse measurement variables under Web 2.0 service mechanisms [30, 31], organized in Table 7 .

4. Discussion: How Article-Level Metrics Support Open Innovation

The scholarly communication system is advancing toward open access, open knowledge, and open innovation. New open knowledge service models include: positioning libraries as platforms supporting user innovation, and developing libraries into open public knowledge service innovation platforms. Libraries need to actively master various analysis and selection tools to implement practices supporting open science.

Traditional judgment criteria based on citability and frontier-matter 评审 can be misleading without context and suffer from time-delay issues, making it difficult to identify potentially impactful papers [33]. ALMs may help discover research findings of broad public interest and, through other technical tools, enable rapid community discussion mechanisms.

New scholarly communication tools (like Altmetrics) [34] can organize open data and present visualized content, enabling: sharing datasets, code, and experimental designs; publishing parameters or semantic content; allowing users to review and suggest improvements to ongoing research through Web 2.0 forms (blogs, microblogs, bookmarks, etc.). These provide more favorable information filtering and community review methods for scholarly communication. For instance, the Royal Society of Chemistry formally adopted this mechanism [35, 36], requiring five of its journals to implement Altmetrics functionality with ALMs to promote transformation in traditional academic journals and evaluation systems. The Royal Society signed the DORA declaration on October 23, 2013; released on June 24, 2013, its first principle abandons journal-based metrics like impact factors in favor of evaluating scientists based on individual research paper quality [37, 38].

Not only journals but also institutional repositories can apply ALMs [39]. Based on practical analysis of ALMs principles, cases, implementation mechanisms, and data frameworks, this paper concludes that the service model is mature, and both journal publishing platforms and institutional repositories can draw lessons from existing cases to conduct preliminary experiments. This paper aims to spark further discussion.

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(Author E-mail: gulp@mail.las.ac.cn)

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