Quantitative Research on Content Quality Indicators for Foreign Language Journal Databases (Postprint)

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Abstract

[Purpose/Significance] To address the quantification of dual-library and multi-library indicators for assessing the content quality of foreign journal databases, this study proposes a multi-library comparison algorithm based on a unified journal space, which enables journal identification and comparison across any number of databases, thereby enhancing the accuracy of these quantitative indicators. [Method/Process] Building upon an analysis of the composition and complexity of content quality indicators for foreign journal databases, we design a multi-library comparison algorithm grounded in a unified journal space, and employ this algorithm to compute the JCR journal count and unique journal count metrics for 57 databases in the 2018 DRAA, thereby validating the algorithm's effectiveness and accuracy. [Results/Conclusion] As an extension of research on various electronic resource evaluation indicator systems, this study assists libraries in optimizing their collection development, rendering the procurement of foreign journal databases more economical and rational.

Full Text

Preamble

Title: Quantitative Research on Content Quality Indicators of Foreign Journal Databases

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Abstract: *[Purpose/Significance]* This study proposes a multi-database comparison algorithm based on a unified journal space to address the quantification of dual-database and multi-database indicators for content quality evaluation of foreign journal databases. The algorithm enables journal identification and

comparison across any number of databases, improving the accuracy of these quantitative indicators. *[Method/Process]* Based on analysis of the content and complexity of content quality indicators for foreign journal databases, we designed a multi-database comparison algorithm using a unified journal space. We applied this algorithm to calculate the number of JCR-indexed journals and unique journals among 57 databases in the 2018 Digital Resource Acquisition Alliance (DRAA) as validation of the algorithm's effectiveness and accuracy. *[Result/Conclusion]* As an extension of various electronic resource evaluation indicator systems, this research helps libraries optimize their collection development and makes foreign journal database procurement more economical and rational.

Keywords: foreign journals; database evaluation; content quality; indicator quantification; unified journal space

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In an era of ubiquitous mobile and cloud reading, electronic resources account for an increasingly large proportion of both library resource utilization and library procurement expenditures, with many libraries now spending more on electronic resources than on traditional print materials. Particularly under the impact of the COVID-19 pandemic, how to maximize electronic resource construction and services with limited funding has become an urgent challenge for libraries.

Faced with diverse and expensive electronic resources, researchers have proposed evaluation indicators from multiple perspectives including content quality, system functionality, usage, cost-effectiveness, vendor services, and long-term preservation. In the big data era, the "data is king" concept has become deeply rooted, making content quality the core competitiveness of electronic resource platforms and the top priority for libraries building electronic collections.

Therefore, accurate quantification of electronic resource content quality has become the primary task of electronic resource evaluation. While some evaluation indicators are quantitative, others are qualitative or semi-quantitative. Content quality indicators are generally quantitative, making their quantification feasible. However, researchers have typically focused on which indicators to establish, how to screen them and set weights, and how to validate these indicators and weights, with few papers addressing how to correctly quantify them. In practice, most rely on data provided by database vendors, which is insufficient because vendors do not provide cross-platform comparison data.

To address this gap, we propose a universal quantification method for content quality indicators of foreign journal databases based on the resource encyclopedia data from the Digital Resource Acquisition Alliance of Chinese Academic Libraries (DRAA) system. This method serves as an extension of various electronic resource evaluation indicator systems to help libraries optimize foreign journal database procurement and maximize the utility of limited funds.

2 Research Status

As libraries increasingly procure electronic resources, which occupy a growing position in collection development, the evaluation of electronic resources has received greater attention. Foreign research began in the late 1990s, primarily focusing on digital libraries, with projects led by the UK, US, and international institutions. The Association of Research Libraries' "ARL" E-Metrics project developed a manual for collecting web statistics and performance measures for ARL member libraries. The COUNTER project established usage statistics standards for four categories of digital resources. The European EQUINOX project designed its own digital resource service performance evaluation indicator system. ISO 2789 Appendix A designed more accessible evaluation indicators for library electronic services. The Networked Statistics and Performance Measures for Public Libraries project published the "Statistics and Performance Measures for Public Library Networked Services" manual. The NISO, NCLIS, and IMLS jointly revised the American National Standard for Library Statistics (ANSI/NISO Z39.7) through a series of library and network service statistics standards. Various procurement decision-making practices based on COUNTER reports have also been studied.

Domestically, the China Academic Library & Information System (CALIS) articulated the evaluation objects and content of the CALIS digital resource evaluation indicator system, listing complete indicators and their attributes with application guidelines. Xiao Long discussed methods for establishing electronic resource evaluation indicator systems and their main components. Yao Xiaoxia introduced the international library performance evaluation standard ISO 11620 and the EQUINOX project's electronic library performance indicators and systems. Xiang Yingming explored and established a comprehensive evaluation indicator system and mathematical model for electronic resources. Xu Ge investigated the importance and accessibility of evaluation indicators through expert surveys. Liu Jun used expert scoring and analytic hierarchy process to select and validate evaluation indicators. Tang Qiong used factor analysis to extract the most representative electronic resource selection criteria. He Yuanyuan evaluated library electronic resource utilization through fuzzy multi-attribute decision-making methods. Liu Wenmei investigated the applicability of existing indicators for "211 Project" university digital libraries. Suo Chuanjun constructed a digital collection service performance evaluation indicator system based on international and national standards and domestic data availability. Li Xinxia compared domestic and international digital library performance evaluation systems. Zhang Yihua decomposed the comprehensive evaluation model construction into three key components: indicator selection, data collection and processing, and weight setting.

These studies primarily focused on guiding principles for indicator selection, indicator screening, and applicability analysis, but paid less attention to indicator value acquisition. Particularly for content quality evaluation indicators, the complexity of data acquisition often forces reliance on database vendors

and electronic resource analysis platforms, yielding only single-database indicators. For multi-database indicators, researchers employed varied methods that required redesigning data analysis approaches whenever comparison objects changed, without forming a systematic quantification method. To address this limitation, we propose a multi-database comparison algorithm in a unified journal space specifically for secondary indicators under content quality of foreign journal databases. This algorithm maps journals from databases to a unified journal space using ISSN, EISSN, and journal titles. For title mapping, we first normalize journal titles to extract features for candidate journal identification, then apply the N-Gram algorithm to select the best match from candidates based on original titles. The title normalization method was developed through extensive study of title formats across different databases, ensuring concise and accurate feature extraction. The N-Gram algorithm enables rapid optimal title matching.

3 Quantitative Analysis and Algorithm Design for Content Quality Indicators

3.1 Content Quality Indicators for Foreign Journal Databases

Foreign literature generally provides only guiding principles for electronic resource evaluation indicator selection, with COUNTER reports primarily used to guide procurement. Domestic researchers have extensively expanded indicator completeness and systematicity, reaching some consensus. Xiao Long and Zhang Yuhong proposed six first-level indicators: electronic resource content, retrieval system functionality, usage, value and cost accounting, publisher/vendor services, and archiving. Subsequent research has largely followed this framework. This study focuses on quantifying the first indicator—"electronic resource content"—which for foreign journal databases corresponds to "content quality," evaluating the quantity and quality of journal titles. Key secondary indicators include: (1) total number of journals; (2) number/proportion of current journals; (3) number/proportion of JCR/SNIP-indexed journals; and (4) number/proportion of unique journals.

Analyzing these indicators reveals several challenges. First, quantification requires multiple journal lists. The database being evaluated is called the source database, with data downloadable from DRAA websites, database platforms, or obtained from vendors. Reference databases used for evaluation, such as JCR and SNIP, can be downloaded from their respective websites. Second, based on the number of journal databases used in quantification, these four indicators can be categorized as single-database, dual-database, or multi-database indicators. Total journal count and current journal count/proportion involve only the source database itself, making them single-database indicators. JCR/SNIP journal count/proportion requires comparison between source and reference databases, making them dual-database indicators. Unique journal count/proportion involves comparison among multiple source databases,

making them multi-database indicators.

Except for the first secondary indicator, the others can be quantified by first calculating the absolute number, then dividing by the total journal count to obtain the proportion.

3.2 Quantification Methods for Content Quality Indicators

Single-database indicator quantification is relatively straightforward—simply counting within the source database's journal list. Using DRAA resource encyclopedia data as an example, the journal list includes fields such as database name, journal title, publisher, ISSN, EISSN, subject classification, keywords, coverage range, URL, platform, DOI, full-text embargo period, and start/end dates of full-text coverage. These fields enable quantification of total journals and current journals, plus other important indicators like full-text embargo periods. However, these values depend on accurate and complete data; errors or missing values in fields can interfere with calculations.

From 57 foreign journal source databases in DRAA 2018 (43 e-journal databases and 14 full-text databases), we calculated single-database content quality indicators. To clearly reveal differences between e-journal and full-text databases, we grouped the statistics, listing the top 7 e-journal databases and top 3 full-text databases, as shown in through .

Dual-database and multi-database indicator quantification is more complex. For dual-database indicators, calculating JCR journal count for a source database involves taking the intersection of set A (journals in the source database) and set B (journals in the JCR reference database), then calculating the cardinality of intersection set C. For multi-database indicators, calculating unique journals involves finding the difference between set A (journals in the source database) and set B (union of journals in other source databases), where the difference set contains unique journals and its cardinality gives the unique journal count.

The primary difficulty in quantifying dual-database and multi-database indicators lies in journal identification. Many foreign journal database vendors' title lists commonly lack ISSN and EISSN data, with inconsistent and arbitrary cataloging of title and publisher fields, making journal identification challenging. While manageable with few databases, the difficulty increases dramatically when dozens or hundreds of databases require various combinations for comparison. Without a unified methodology, quantifying dual-database and multi-database indicators becomes nearly impossible.

3.3 Complexity Analysis of Multi-Database Indicator Quantification

The complexity stems from three main issues: (1) Many foreign journal database vendors' title lists lack both ISSN and EISSN; (2) Title fields lack uniform standards and show significant cataloging arbitrariness; and (3) When many

databases participate in comparison, the workload becomes enormous and tedious if each requires separate journal identification and comparison algorithms.

Taking DRAA 2018 as an example with 57 source databases, designing separate journal identification and comparison algorithms for each would be extremely cumbersome. Therefore, we propose a multi-database comparison algorithm in a unified journal space. By mapping journals from various databases to a single ID system and performing set operations based on this ID, the problem becomes much simpler. The database used for mapping must comprehensively cover journals from all other databases. Ulrich's Serials Directory meets this requirement, containing detailed data on 150,000 publishers and over 390,000 journal titles, making it ideal as a unified journal space. Our algorithm maps source database journal records to Ulrich's journal space using ISSN, EISSN, and title fields (including normalized titles), returning a Ulrich journal ID (jid) for each record. Subsequent comparisons between databases then use only these jids for set operations to quantify required indicators.

Note that jids in Ulrich's database are not visible on list or detail pages but appear in the TitleId field when downloading selected records, as shown in [Figure 1: see original paper]. Additionally, some ISSNs or EISSNs correspond to multiple journal records in Ulrich's database, requiring title similarity comparison to select the jid with highest similarity. If multiple records have equal similarity, the first record's jid is selected, ensuring the same ISSN or EISSN from different source databases maps to the same record in Ulrich's space.

3.4 Multi-Database Comparison Algorithm in Unified Journal Space

When mapping using titles, the algorithm matchByTitle employs more than simple title matching. For records lacking both ISSN and EISSN, it uses normalized titles for exact matching. To handle diverse title inconsistencies across databases, we developed the following normalization rules: (1) Remove small/medium/large brackets and their contents; (2) Remove colons, commas, hyphens with surrounding spaces, and subsequent content; (3) Replace "&" with "AND" (with spaces); (4) Replace characters other than numbers, letters, and hyphens without spaces with spaces; (5) Capitalize all letters; (6) Merge consecutive spaces into single spaces; (7) Remove leading/trailing spaces.

These rules ensure different title formats for the same journal retain identical basic features, enabling direct matching via normalized titles. After normalization mapping, if no match is found in Ulrich's space, jid returns null; if one jid matches, it returns that jid; if multiple jids match, it returns the jid of the record with highest original title similarity. The formal algorithm for matchByTitle is shown in Algorithm 2.

Normalized titles quickly identify candidate journals in Ulrich's space, then the N-Gram algorithm calculates similarity between original titles to select the best match. N-Gram, also called N-gram model, evaluates string similarity through fuzzy matching. Our N-Gram algorithm returns a score where smaller values

indicate higher similarity. The formal algorithm is shown in Algorithm 3, with parameter n set to 3 in this study.

All journals failing to map in Ulrich's space, whether through ISSN/EISSN or title, are excluded from subsequent comparisons. Mapping rates for DRAA 2018 and JCR 2018 to Ulrich's space are approximately 91% and 99% respectively, as shown in [Figure 2: see original paper] and [Figure 3: see original paper].

4 Quantification of Dual-Database and Multi-Database Indicators

Using DRAA 2018's 57 source databases and JCR 2018 as reference, we demonstrate mapping results and calculate key indicators: JCR journal count/proportion and unique journal count/proportion.

4.1 Mapping DRAA 2018 to Ulrich's Space

Using our unified journal space mapping algorithm with Ulrich's as the unified space, we mapped DRAA 2018 journals to jids, with results shown in . Unmapped records (approximately 9%) likely result from: (1) erroneous records in DRAA 2018; (2) erroneous records in Ulrich's; or (3) incomplete coverage in Ulrich's.

4.2 Mapping JCR 2018 to Ulrich's Space

Applying the same algorithm, JCR 2018 achieved a 99% mapping rate to Ulrich's space, as shown in and [Figure 3: see original paper]. This high rate reflects JCR's high data quality and its importance, as most JCR journals are included in Ulrich's.

4.3 JCR Journal Counts and Proportions in DRAA 2018

Using these mapping results, we quantified JCR journal counts and proportions for each DRAA 2018 source database by intersecting each source database's jid set with JCR 2018's jid set, then calculating intersection cardinality and proportion relative to total journals. through show top and bottom 10 databases by JCR count and proportion, grouped by database type (7:3 ratio for e-journal vs. full-text databases). Notably, no e-journal database ranks in the top 7 for both JCR count and proportion, while several databases (SAE, Thieme, APS) appear in the bottom 7 for both metrics.

4.4 Unique Journal Counts and Proportions in DRAA 2018

Similarly, we quantified unique journal counts and proportions by calculating the difference between each source database's jid set and the union of all other source databases' jid sets, then deriving proportions. through show top and

bottom 10 databases by unique journal count and proportion. Unique journals can be absolute (publisher-exclusive) or relative (unique within a library's procurement scope). While vendors provide absolute unique counts, libraries must quantify relative unique journals themselves. Our algorithm facilitates relative unique journal calculation and allows easy adjustment when adding or removing databases. The calculated values for DRAA 2018's 57 databases represent relative unique journals, which typically exceed absolute unique counts and approach them as the comparison scope expands.

This methodology can derive additional content quality indicators such as full-text journals, JCR full-text journals, JCR current journals, SNIP-indexed journals, OA journals, and unique full-text/current journals, given appropriate data.

5 Algorithm Analysis

The unified journal space multi-database comparison algorithm offers several advantages: (1) **One-time mapping, multiple comparisons**: Once mapped, a database can be compared with any other mapped database without algorithm redesign; (2) **High accuracy**: Unlike methods using only ISSN/EISSN (which ignore missing values) or only normalized titles (which may conflate different journals), our combined approach with sophisticated title preprocessing minimizes statistical error; (3) **Error record exclusion**: Mapping to a unified space helps identify and exclude non-journal and erroneous records, maintaining consistent standards across comparisons.

Indicator accuracy depends on unified journal space quality. Low correctness, incomplete coverage, or poor consistency in the unified space introduces errors. Nevertheless, this approach provides systematic, accurate quantification of content quality indicators to support rational, economical foreign journal database procurement decisions.

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