Paper Evaluation Method Based on Publication Time Standardization System: A Case Study of *Journal of Irrigation and Drainage* (Postprint)

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Abstract

Objective: To scientifically evaluate journal articles, a temporal standardization system for evaluation metrics is introduced at the preliminary selection stage, which temporally standardizes and converts the evaluation metrics of articles published in different months to avoid potential unfair influences.

Methods: Taking articles published in the Journal of Irrigation and Drainage in 2016 as an example, download count, citation frequency, online reading count, favorite count, comment count, and recommendation count were selected as evaluation metrics. Each metric was converted using the temporal standardization system, and the distance-based comprehensive evaluation method was employed to assess the quality of journal articles, providing a new and scientific evaluation approach for journal article assessment.

Results: When temporal standardization was not performed, Paper P2 achieved the best comprehensive evaluation result, followed by Paper P7, with Paper P4 being the worst. After temporal standardization, Paper P2 remained the best, followed by Paper P7, while Paper P5 became the worst. Comparing the two evaluation results, the ranking of the top two papers (P2, P7) remained unchanged, while the rankings of the remaining papers changed significantly.

Conclusion: When evaluating individual papers, two sets of quantitative indicators—before and after temporal standardization—can be calculated simultaneously for comprehensive judgment, which helps enhance the persuasiveness of preliminary evaluation results.

Full Text

A Paper Evaluation Method Based on a Publication Time Standardization System: A Case Study of the *Journal of Irrigation and Drainage*

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Abstract

Objective: To scientifically evaluate journal papers, this study introduces a time-standardization system for evaluation indicators in the initial selection stage, which standardizes the evaluation metrics of papers published in different months to avoid potential unfair influences. **Method:** Taking papers published in the *Journal of Irrigation and Drainage* in 2016 as an example, download counts, citation frequency, online reading counts, bookmark counts, comment counts, and recommendation counts were selected as evaluation indicators. Each indicator was standardized using the time-standardization system, and the distance comprehensive evaluation method was employed to assess paper quality, providing a novel and scientific approach for journal paper evaluation. **Results:** Without time standardization, paper P2 achieved the best comprehensive evaluation result, followed by P7, with P4 being the worst. After time standardization, P2 remained the best, P7 second, while P5 became the worst. Comparing the two evaluation results, the top two papers (P2, P7) maintained their positions, while the rankings of other papers changed substantially. **Conclusion:** When evaluating individual papers, two sets of quantitative indicators (before and after time standardization) can be calculated simultaneously for comprehensive judgment, which enhances the persuasiveness of preliminary evaluation results.

Keywords: time standardization; paper evaluation; distance comprehensive evaluation method; academic journals
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Academic journals constitute an essential component of scientific research activities, serving to report and disseminate scientific discoveries and technological innovations within their disciplines. With the development of modern science and technology, the quality of journal papers must be improved. To attract high-quality submissions and accelerate quality enhancement, academic journals have implemented various paper award systems, most of which operate through excellence awards. A fair, just, scientific, and reasonable paper evaluation system is crucial for selecting outstanding papers and promotes improved paper quality.

Using core journals and impact factors to measure academic level and intrinsic value is inappropriate [1]; evaluation should focus on individual papers, particularly their recognition by peers, assessing research outcomes through both citation count and quality [2]. Current evaluation methods primarily target journals [3-4], with "evaluating papers by their journals" being common practice. However, this approach is unsuitable for evaluating digitally published papers and inadequate for individual paper assessment [5].

Evaluation of individual papers has gradually gained academic attention. For instance, Zheng Meiying et al. [2] proposed the PaperRank algorithm to evaluate single papers by calculating their PaperRank values. He Chunjian [6] advocated building a comprehensive evaluation system that considers both the quantity and quality of citing documents, establishing an indicator system including TVF, TVF(n), and VF(t) for individual paper impact. Zhong Wenyi et al. [7] proposed a paper influence evaluation method based on citation coefficients. Wang Xianwen et al. [8] developed a continuous, dynamic, and composite evaluation system for individual papers. These methods have various advantages and disadvantages, and their indicators are not comprehensive. Currently, excellence awards primarily rely on download counts and citation frequency, yet page views, comment counts, and print counts also reflect paper quality [9]. Therefore, individual paper evaluation should consider more indicators.

Quantitative evaluation and peer review are interrelated and mutually reinforcing, with citation analysis providing objective data and references for expert judgment [10]. Main quantitative evaluation methods for scientific papers include traditional bibliometric evaluation, network analysis, Altmetrics-based evaluation, and comprehensive evaluation methods [11]. Comprehensive evaluation generally incorporates citation counts, click counts, paper age, self-citations, availability channels, page numbers, and paper type [12], often combining internal, external, and social network analysis indicators to consider both academic and social impact [8-9]. Using social network analysis to extract evaluation indicators and standardizing them produces a universally applicable indicator system [13]. Altmetrics has gained widespread attention [14-15], offering broad public participation, real-time data updates, and low costs, making it highly suitable for evaluating individual papers in the digital publishing era. Interactive reader feedback respects readers' agency while enhancing authors' sense of presence in their research journey [16].

However, due to inconsistent publication months (or years) across papers, evaluations become inequitable—earlier publications accumulate higher download counts, citation frequencies, and online reading counts, gaining unfair advantages. Moreover, published papers' value is not solely reflected through citations. For practitioners, government agencies, or enterprise decision-makers who reference academic papers to improve production efficiency, economic benefits, or decision-making rationality, value manifests more through browsing and downloading. The burgeoning development of digital publishing and WeChat public platforms has expanded paper dissemination channels, with bookmark counts, comment counts, and recommendation counts also reflecting paper value. Therefore, this study integrates download counts, citation frequency, online reading counts, bookmark counts, comment counts, and recommendation counts, introducing a time-standardization system for evaluation indicators to construct a fair, just, scientific, and reasonable multi-indicator comprehensive evaluation method for rapid quantitative assessment of individual papers.

1. Data Sources and Research Methods

1.1 Determining Primary Evaluation Indicators for Journal Paper Quality

While journal papers vary in type, each journal represents its field. In practice, representative and easily obtainable indicators should be selected according to each journal' s characteristics. This study uses the *Journal of Irrigation and Drainage* as an example, selecting download counts, citation frequency, online reading counts, bookmark counts, comment counts, and recommendation counts as primary quality indicators, assuming all indicators equally influence evaluation results.

1.2 Time-Standardization System for Evaluation Indicators

Inconsistent publication months (or years) across papers create evaluation inequities—earlier publications show higher download counts, citation frequencies, and online reading counts, increasing their likelihood of favorable evaluation. Using citation count as an example, more citations indicate greater attention and academic impact [17]. Figure 1 [Figure 1: see original paper] shows the distribution of the top 50 most-cited papers from the *Journal of Irrigation and Drainage* in 2016 (citation data from CNKI, as of December 30, 2017). Highly-cited papers were predominantly published more than 19 months prior, mainly in issues 1-5 of 2016, with issue 1 having the most citations, while papers published 12-18 months prior had relatively lower citation frequencies. Evaluating individual papers primarily by citation frequency disadvantages later-published papers.

To avoid such temporal inequities and evaluate papers more scientifically, a time-standardization system is introduced. Each indicator is time-standardized by multiplying it by a time conversion coefficient calculated as:

$$K_i = \frac{T - T_i}{\sum_{i=1}^{n} (T - T_i)}, \quad i = 1, \ldots, n$$

where K_i is the time conversion coefficient, T is the time distance (in months) from the publication date of the first issue in the evaluation year to the evaluation date, and T_i is the publication time (in months) of the paper. Generally, publication duration significantly affects citation frequency only during the first two years, so $T_i < 24$. Each indicator is then multiplied by its time conversion coefficient to achieve time standardization and avoid temporal bias.

1.3 Comprehensive Paper Quality Evaluation Based on Distance Comprehensive Evaluation Method

The distance comprehensive evaluation method ranks objects by their proximity to an ideal target, providing relative quality assessment among existing candidates. The fundamental concept is illustrated in Figure 2 [Figure 2: see original paper].

The specific calculation steps are:

1) Construct the original evaluation matrix, standardize it, and identify the optimal and worst solutions (represented by optimal and worst vectors). For n papers and 6 evaluation indicators, the original data matrix is $X = (X_{ij})_{n\times 6}$. After normalization, the standardized matrix $Y = (Y_{ij})_{n\times 6}$ is obtained, with optimal ($Z_{\max}$) and worst ($Z_{\min}$) vectors formed by each indicator' s maximum and minimum values:

$$Z_{\max} = (\max Y_{i1}, \max Y_{i2}, \dots, \max Y_{i6})$$
$$Z_{\min} = (\min Y_{i1}, \min Y_{i2}, \dots, \min Y_{i6})$$

2) Calculate each paper' s distance to the optimal and worst solutions—closer to the optimum is better, farther from the worst is better. For the i-th paper, distances to the optimal ($Z_{\max}$) and worst ($Z_{\min}$) solutions are:

$$D_i^+ = \sqrt{\sum_{j=1}^{6}(Y_{ij} - Z_{\max j})^2}$$
$$D_i^- = \sqrt{\sum_{j=1}^{6}(Y_{ij} - Z_{\min j})^2}$$

3) Calculate each paper' s relative closeness C_i to the optimal solution, then rank papers by this value for comprehensive evaluation:

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-}$$

where C_i represents the i-th paper' s relative closeness to the optimal solution; larger C_i values indicate better evaluation results.

2. Data Analysis

2.1 Paper Quality Evaluation Without Considering Publication Time

Ten highly-cited papers published in the *Journal of Irrigation and Drainage* in 2016 were selected for evaluation. Indicator data calculated using the aforementioned methods served as a case study for comprehensive assessment.

Download counts, citation frequency, online reading counts, bookmark counts, comment counts, and recommendation counts were collectively used as quality indicators. Original data are shown in Table 1 .

The evaluation matrix was constructed based on the distance comprehensive evaluation method and normalized to obtain the standardized matrix. From this standardized matrix Y', the optimal solution ($Z_{\max}$) and worst solution vector ($Z_{\min}$) were derived:

$$Z_{\max} = (0.4522, 0.4287, 0.4493, 0.5472, 0.5231, 0.5455)$$
$$Z_{\min} = (0.2189, 0.2572, 0.1667, 0.1412, 0.1162, 0.1091)$$

Using equations (5) and (6), distances to the optimal and worst solutions were calculated for all 10 papers. Relative closeness C_i values were then computed using equation (7) and ranked, with results shown in Table 2 .

Larger C_i values indicate better evaluation. Table 2 shows the comprehensive ranking: P2 > P7 > P6 > P10 > P1 > P9 > P5 > P8 > P3 > P4. Paper P2 ranked highest, P7 second, with minimal C_i difference between them. Paper P4 ranked worst, with P2' s relative closeness C_i being 65.34% higher than P4' s.

2.2 Paper Quality Evaluation Considering Publication Time

The time-standardization system was applied to all indicators. Publication times for the evaluated papers were $T_i = (7, 3, 3, 3, 5, 8, 1, 4, 1, 4)$ (for i = 1-10). Using equation (1), time conversion coefficients were $K_i = (0.0846, 0.1045, 0.1045, 0.1045, 0.0945, 0.0796, 0.1144, 0.0995, 0.1144, 0.0995)$. Time-standardized results are shown in Table 3 .

After constructing the evaluation matrix and normalizing indicators, the standardized matrix yielded:

$$Z_{\max} = (0.4291, 0.4492, 0.4925, 0.5378, 0.5872, 0.6182)$$
$$Z_{\min} = (0.2130, 0.2054, 0.1350, 0.1457, 0.1191, 0.1075)$$

Distances to optimal and worst solutions were calculated using equations (5) and (6), and relative closeness C_i values were computed using equation (7). Results are shown in Table 4 .

After time standardization, the ranking became: P2 > P7 > P10 > P9 > P1 > P6 > P3 > P8 > P4 > P5. Paper P2 remained optimal, P7 second, with minimal C_i difference between them. Paper P5 became the worst, with P2' s relative closeness C_i being 61.86% higher than P5' s.

Across both evaluations, the top two positions (P2, P7) remained unchanged, but the worst paper shifted from P4 to P5. Compared with Table 3 results, Table 4 shows adjusted rankings: P6 and P5 each dropped three positions, while P3, P9, and P10 advanced. This demonstrates that time-standardization adjustments affect paper quality evaluation, promoting more scientific and rational assessment and yielding more persuasive results.

3. Conclusion

1) The distance comprehensive evaluation method for individual paper evaluation yields relatively accurate quantitative data that can inform qualitative evaluation.
2) Using 10 papers from the *Journal of Irrigation and Drainage* (2016) as a case study, evaluation without time standardization identified P2 as optimal and P4 as worst. After time-standardizing download counts, citation frequency, online reading counts, bookmark counts, comment counts, and recommendation counts, the ranking adjusted, with P2 remaining optimal but P5 becoming worst.
3) Publication time effects on evaluation indicators should be considered in individual paper assessment. Calculating both pre- and post-standardization quantitative indicator sets simultaneously enhances evaluation persuasiveness.

This study only compared 10 papers from the *Journal of Irrigation and Drainage* (2016). Whether this method applies to other journals or larger samples requires further research. Additionally, how time-standardized results influence qualitative evaluation needs systematic analysis integrated with qualitative assessment.

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