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Research Article

Implementation of a Framework-Based Information System for Evaluating the Quality of Scientific Publications in Indonesian Higher Education Institutions Using Promethee

Dedy Kurniadi[1,2], Rahmat Gernowo[1], Bayu Surarso[1]
[1]Doctoral Program of Information Systems, Universitas Diponegoro
[2]Department of nformatics Engineering, Universitas Islam Sultan Agung

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ABSTRACT

Introduction: Scientific publications play a crucial role in assessing the academic performance of higher education institutions, especially in Indonesia. The current evaluation system still prioritizes the quantity of publications over their quality, with citation indicators and journal quartile rankings not yet being the main focus. Based on this, there is a need for an evaluation system that can provide a comprehensive assessment, ensuring that the quality of scientific publications in Indonesian universities can be measured transparently and objectively.

Objectives: aims of this study is to develop a framework-based information system using the promethee method to objectively and data-driven evaluate the quality of scientific publications in Indonesian universities. The system is designed to assess publications based on indicators such as citations, and journal quartile rankings.

Methods: This study employs an information system approach and multi-criteria analysis to evaluate the quality of higher education scientific publications in Indonesian. The primary data is obtained from Scopus and Scimago Journal Rank (SJR), which provide information on the number of publications, journal indexing, citation counts, and journal quartile rankings (Q1 – Q4, Non-Q) as a journal metrics. The data from Scopus is then ranked using the promethee method, with Min-Max normalization applied to standardize the evaluation process.

Results: we analysis of 83,601 data scientific publications during the 2020-2024 period, the distribution is as follows: 19,921 publications in Q1, 18,745 in Q2, 25,573 in Q3, 11,125 in Q4, and 8,237 publications classified as Non-Q (without a quartile ranking). Based on the ranking using the promethee method, Universitas Airlangga secured the first position with the highest Net Flow (1.415652), followed by Universitas Indonesia in second place (1.202783) and Universitas Gadjah Mada in third place (0.719385).

Conclusions: The application of the promethee method in scientific publication evaluation offers a more comprehensive multi-criteria approach. promethee can be applied in research to generate a more objective ranking, making it a valuable tool for stakeholders in Indonesia to effectively monitor scientific publications.

Keywords: Scientific Publications, Higher Education, Journal Metrics, Promethee, Ranking

INTRODUCTION

Scientific publications play a crucial role in assessing the academic performance of higher education institutions, particularly in Indonesia. As centers of education and research, universities are not only responsible for producing high-quality graduates but also for making significant contributions to the advancement of knowledge through research published in scientific journals [1]. The global reputation and ranking of a university are often determined by its research productivity and the quality of its scientific publications. High-quality publications not only reflect an institution's research capabilities but also serve as a benchmark for academic impact and relevance, contributing to the advancement of science and addressing societal challenges [2].

However, assessing the quality of scientific publications is not a simple task. The evaluation of scientific publication quality does not solely depend on the number of publications produced but must also consider various other, more complex indicators. Factors such as the number of citations and quartile ranking are essential elements in determining the quality of a scientific publication [3]. A university with a high number of publications does not necessarily have a significant impact in the academic world if those publications receive low citation counts or are predominantly published in journals that are not indexed in the Scimago Journal Rank, a portal for journal quality

ranking. Therefore, a more holistic approach to assessing scientific publications is essential to ensure that evaluations are not merely based on quantity but also on quality [4] .

In recent years, the number of scientific publications from higher education institutions in Indonesia has increased significantly. This phenomenon indicates a strong push from various higher education institutions to enhance their research productivity, however this surge in publications has not been accompanied by a comprehensive and thorough evaluation system for assessing the quality and impact of these scientific publications, so far, only a few metrics have been used to assess individual authors, but a comprehensive evaluation framework for scientific publications from Indonesian higher education institutions is still lacking. Current assessments mainly focus on quantitative aspects, while qualitative factors remain largely unexplored, consequently, the resulting publications do not fully capture their true academic impact and contribution [5] [6].

Without a clear mechanism for measuring scientific publications quality, higher education institutions risk focusing solely on increasing the number of publications without considering their substance and scientific impact. This could also lead to a lower level of international recognition for scientific publications from Indonesian higher education institutions and limit the contribution of national research on a global scale [7].

This study utilizes data on the number of scientific publications, quartile ranking and citation counts, to assess the quality of scientific publications in higher education institutions in Indonesia. A more comprehensive evaluation system would allow higher education institutions to gain a clearer understanding of their research performance and develop more effective strategies to improve the quality of their scientific publications [8] [9].

The next step in addressing this challenge is to develop an evaluation method that takes multiple factors into account when assessing the quality of scientific publications. A promising approach is the Preference Ranking Organization Method for Enrichment Evaluations (Promethee) [10]. This method enables comparisons between multiple alternatives based on different criteria, making it an effective tool for evaluating scientific publications from academic institutions and ranking them according to the quality of their research output [11].

By adopting a Promethee-based evaluation system, higher education institutions in Indonesia can develop a more objective, transparent, and data-driven assessment mechanism [12]. This approach will not only help higher education institutions enhance the quality of their scientific publications but also strengthen Indonesia's academic competitiveness on a global scale [13]. The implementation of this system is expected to serve as a solution for fostering a higher-quality research ecosystem that has a broader impact on scientific advancement and societal well-being.

OBJECTIVES

This study aims to develop a framework-based information system that can systematically and structurally evaluate the quality of scientific publications in higher education institutions in Indonesia. The system is designed to assess scientific publications based on various quality indicators, such as number of scientific publications, citation counts, and quartile rankings. Additionally, this study seeks to implement the Preference Ranking Organization Method for Enrichment Evaluations (Promethee) as a ranking assessment approach in the evaluation process, ensuring that the ranking and quality assessment of scientific publications are conducted more objectively and data-driven.

By developing this system, a more transparent and systematic evaluation mechanism is expected to be established, ensuring that scientific publication assessments are based on clear and objective criteria. Furthermore, this study aims to support the improvement of research in Indonesian higher education institutions by providing insights into the strengths and weaknesses of their scientific publications. With a better evaluation system, higher education institutions can develop more effective publication strategies to enhance their academic competitiveness on a global scale.

Moreover, with the implementation of a comprehensive data-driven evaluation system, higher education institutions can take a more strategic approach to improving their scientific publications, contributing to the advancement of knowledge and fostering a higher-quality academic development landscape in Indonesia.

METHODS

This study employs an information system-based approach combined with multi-criteria analysis to evaluate the quality of scientific publications from higher education institutions in Indonesia. The data used in this research was

obtained from Scopus and Scimago Journal Rank (SJR) using Application Programming Interface (API) Method to retrieve scientific publication data from the Scopus database which are databases that provide information on scientific publications [14] [15]. The Scopus API model is shown in Figure 1.

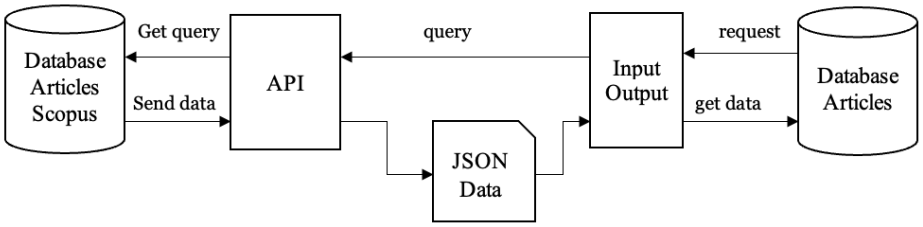

Figure 1. Scopus API Process

Figure 1 shown the data retrieval flow from the Scopus article database into the system's article database using an API and JSON Data format as an intermediary. The Scopus Articles Database serves as the primary source that stores scientific article data. When a query is made by the system, this database retrieves and transmits the requested data through Application Programming Interface (API), The (API) acts as an intermediary between the Scopus database and the system's database, API receives queries from the system and forwards them to the Scopus database. Once the data is retrieved from the Scopus database, API returns the information to the system in JSON Data format, JSON Data serves as the standard format for data exchange between the API and the system [16]. The data retrieval results provide information on the number of scientific publications and citation counts for each higher education institution, we stored the data in the database, next, we label scientific articles to determine their journal quartile ranking, this process is carried out by integrating data from Scimago Journal Rank (SJR), allowing each article to be classified into Q1, Q2, Q3, Q4, or non-Q categories. ISSN or EISSN data used to identify the quartile ranking label for each article, the integration and labeling process for scientific articles is shown in Figure 2.

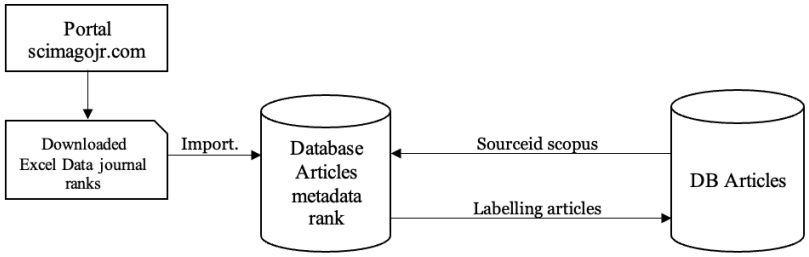

Figure 2 Labelling Quartile Rank on Articles

Figure 2 explains the data integration process between Scimago Journal Rank (SJR) and the Scopus article database for labeling journal rankings based on quartile classification (Q1, Q2, Q3, Q4, or Non-Q), journal ranking data is downloaded from the ScimagoJR.com portal in Excel format, containing Scopus article source IDs and their corresponding quartile rankings. The Excel file, which includes metadata, is then imported into the Articles Metadata Rank Database for use in the matching process between the sourceid in the articles database and the source ID in the articles metadata rank database, once a matching sourceid is found, the system labels the articles in the articles database based on their journal rankings, each article categorized into Q1, Q2, Q3, Q4, for Non-Q label if the journal article is not indexed in the Scimago Journal Rank database.

After the data retrieval and labeling process is completed, the next step is to develop an evaluation framework for assessing the quality of scientific publications using the Promethee method, we normalize the data first using the Min-Max Normalization method, we use a scale ranging from 0 to 1. The purpose of this normalization is to standardize the variable scales so the differences in units or value ranges do not affect the analysis results. The formula we used for data normalization with Min-Max Normalization is:

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}}$$

X' represents the original value of an indicator, while X_{min} and X_{max} are the minimum and maximum values within the dataset. X' is the normalized value, which falls within the range of 0 to 1. after normalized data is obtained, we proceed with the ranking assessment using the Promethee method, we determine the weights for each criterion, as shown in Table 1.

Table 1. Criteria Weight

Criteria	Weight
Number of articles	0,30
Citations	0,40
Quartile Rank	0,30

We assigned these weights by considering the relevance and contribution of each indicator in assessing the quality of scientific publications, in this process, we balanced research productivity, represented by the number of scientific publications, and academic impact, measured through citation counts and journal rankings based on quartile classification, a higher weight was assigned to citations because its reflect the impact of scientific publications and indicate the extent to which a study is cited in other research, scientific publications with a high number of citations indicate a greater influence on a research, meanwhile, the number of publications remains an essential factor, as it represents the level of research productivity within a higher education institution.The quartile ranking weight was set equal to the number of publications to balance publication quantity and quality. With this approach, the applied weights aim to produce a more objective ranking assessment [17], after the weights are determined, we rank the scientific publications by applying the Promethee method, This process begins with integrating the data that has already been normalized using the Min-Max Normalization method [18] [19], each publication is compared against others based on the number of publications, citation counts, and journal quartile rankings. The ranking process starts by calculating the preference value using the following formula:

$$d_{ij} = X'_{ij} - X'_{bj}$$

The variable d_{ij} represents the preference difference between alternative i and alternative b for criterion j. The term X'_{ij} denotes the normalized value of alternative i for criterion j, while $X'_{ij} - X'_{bj}$ refers to the normalized value of alternative b for the same criterion, this formula is used in the Promethee method to calculate the preference difference between two alternatives based on a specific criterion [20] [21], After computing the preference for each criterion, aggregation is performed by considering the weights assigned to each criterion. The formula used is:

$$\pi(A,B) = \sum_{j=1}^{m} w_j \,.\, p_j(A,B)$$

Where $\pi(A,B)$ represents the global preference index between alternatives A and B, w_j is the weight for criterion j, and $p_j(A,B)$ is the preference value for criterion j. After that, we calculate the positive flow and negative flow using the following formula:

$$\text{positive flow}: \ \phi^+(A) = \frac{1}{n-1} \sum_{B \neq A} \pi(A,B)$$

$$\text{negative flow}: \ \phi^-(A) = \frac{1}{n-1} \sum_{B \neq A} \pi(B,A)$$

The positive flowϕ^+measures how much an alternative outperforms other alternatives, while the negative flow ϕ^- measures how much an alternative is dominated by others. After that, the ranking is determined using the net flow value. The formula used is:

$$\phi(A) = \phi^+(A) - \phi^-(A)$$

An alternative with the highest ϕ value has a better ranking. A high positive ϕ indicates that the alternative outperforms others, while a low negative ϕ shows that the alternative is less dominated by others. By applying the Promethee methodthe ranking process becomes more structured, objective, and accurate [22] [23].

RESULTS

The processed data on scientific publications from the top 10 higher education institutions in Indonesia between 2020 and 2024 shows a total of 83,601 scientific publications. Among these, 19,921 publications fall into the Q1 category, 18,745 in Q2, 25,573 in Q3, and 11,125 in Q4. Additionally, 8,237 publications do not belong to any quartile category (Non-Q), the distribution of publications per year as shown in Figure 3.

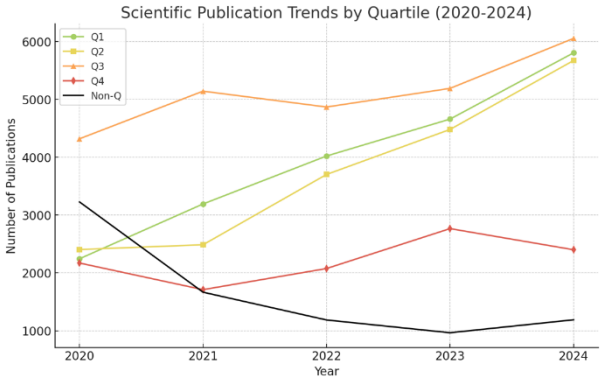

Figure 3 Scientific Publications Trends in Quartile

Figure 3 shows trend indicates a positive shift towards higher-quality publications, with researchers increasingly focusing on journals indexed in the Scimago Journal Rank. The decrease in Non-Q publications suggests an improvement in journal selection. This trend highlights a growing emphasis on publishing in high-impact journals, contributing to a stronger academic and research reputation.

After completing the analysis of scientific publication trends, we proceeded with the normalization calculation. The results of the calculation ranking assessment of these top 10 universities begins with data normalization, which we have compiled in Table 2.

Table 2 Min-max normalization

Institutions	N of Publications	Citations	Total Quartile
Institut Pertanian Bogor	0,169256	0,070686	1,06322
Institut Teknologi Bandung	0,183907	0,23354	0,988678
Universitas Airlangga	1	0,924322	4,431463
Universitas Brawijaya	0,164262	0	1,077513
Universitas Diponegoro	0,076804	0,022157	0,709689
Universitas Gadjah Mada	0,753829	0,430028	3,292006
Universitas Hasanudin	0,110655	0,078655	0,826301
Universitas Indonesia	0,907436	1	3,873601
Universitas Padjajaran	0,353163	0,239395	1,772625
Universitas Sebelas Maret	0	0,172084	0,409959

The results of Min-Max normalization were used to calculate university rankings in the evaluation of scientific publications based on the number of publications, citation counts, and total quartile rankings. These normalized values were applied in the Promethee method to obtain a more objective comparison, we incorporated the normalized data into the Promethee calculation to determine the rankings. The final ranking results are shown in Table 3.

Table 3 Result Ranking

Institutions	Positive Flow (Φ^+)	Negative Flow (Φ^-)	Net Flow (Φ)
Universitas Airlangga	1,999168	-0,99917	2,998335
Universitas Indonesia	1,834311	-0,83431	2,668622

Universitas Gadjah Mada	1,385762	-0,38576	1,771523
Universitas Padjajaran	0,733494	0,266506	0,466989
Institut Teknologi Bandung	0,445192	0,554809	-0,10962
Institut Pertanian Bogor	0,398017	0,601983	-0,20397
Universitas Brawijaya	0,372533	0,627468	-0,25494
Universitas Hasanudin	0,312549	0,687451	-0,3749
Universitas Diponegoro	0,244811	0,755189	-0,51038
Universitas Sebelas Maret	0,191821	0,808179	-0,61636

Based on the assessment results using the Promethee method, Universitas Airlangga secured the first rank with the highest Net Flow of 2.998335, indicating its dominant advantage in scientific publication quality compared to other universities in this analysis. Universitas Indonesia followed in second place with a Net Flow of 2.668622, demonstrating strong competitiveness in both the number and quality of publications. Meanwhile, Universitas Gadjah Mada ranked third with a Net Flow of 1.771523.In the middle ranks, Universitas Padjajaran obtained a Net Flow of 0.466989, indicating that while it remains competitive, there is still a need to improve publication quality to compete with UI and UNAIR. On the other hand, Institut Teknologi Bandung (ITB), Institut Pertanian Bogor (IPB), and Universitas Brawijaya recorded negative Net Flow, showing that their scientific publications are less dominant compared to other universities. Universitas Sebelas Maret (UNS) had a Net Flow of -0.61636, suggesting that UNS still needs to improve its publications and their impact to be more competitive at the national level. Overall, the ranking results indicate that Universitas Airlangga, Universitas Indonesia, and Universitas Gadjah Mada have the strongest performance in scientific publications based on publication quantity, citations, and quartile ranking.

DISCUSSION

This study attempts to apply the Promethee method in evaluating the quality of scientific publications in higher education institutions. The primary goal of implementing the Promethee method in publication evaluation is to introduce a multi-criteria decision-making (MCDM) approach that not only considers the number of publications but also takes into citation impact and journal quartile rankings. This ensures a more comprehensive and objective assessment of research quality. In this study, we have developed a methodology that demonstrates the application of the Promethee method in ranking higher education institutions in Indonesia based on their scientific publication performance. The proposed model provides a structured ranking process by integrating data from Scopus and Scimago Journal Rank. The scientific publications data is then normalized based on the number of scientific publications, citation counts, and quartile rankings within the ranking evaluation framework, ensuring a more balanced and objective evaluation. The findings of this study indicate that the Promethee method can be effectively adapted for evaluating the quality of scientific publications in Indonesian universities. As far as we know this study is among the first in Indonesia to apply a multi-criteria decision-making (MCDM) method in the context of scientific publication evaluation. Previously, most studies relied more on bibliometric indicators at the individual author level rather than at the institutional level, which did not allow for direct higher education institutions comparisons. In this study, we utilized scientific publication data from Indonesian higher education institutions and generated rankings using the Promethee method provide a more objective, robust, and comparative ranking approach, offering a clearer picture of the scientific publication performance of each higher education institutions. Furthermore, the Promethee method enables a better ranking weight allocation, taking into citation impact and journal rankings, rather than just the number of publications. By considering citation counts and quartile rankings, this method ensures that research with greater academic impact receives higher scores, providing a more in-depth ranking system that evaluates not only productivity but also research impact.

This study has several limitations that can be improved in future research. One of the main limitations is in determining the weight of criteria. In this study, the approach used was still subjective, and a more objective weighting method should be considered to achieve more accurate and data-driven weight assignments, making the ranking process more representative. Future research could incorporate additional metrics to enhance the existing indicators and develop a more objective evaluation model with stronger assessment indicators.

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