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A Multi-Criteria Decision Making Approach for Evaluating Service Quality in Higher Education

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Abstract

The quality of the services provided strongly impacts the university's reputation, enrollment, and student happiness. This paper offers a thorough technique that integrates political, economic, social, technical, and environmental issues to assess the quality of university services. This study proposes a decision-making model for evaluating service quality in higher education. Various criteria are related to this evaluation, so the multi-criteria decision-making (MCDM) methodology deals with these criteria. The preference ranking organization (PROMETHEE) method is used as an MCDM methodology to rank the alternatives. The criteria weights are computed based on the average method. The results show the environment is of the utmost importance. The sensitivity analysis checks the rank of alternatives. There are 12 cases proposed for criteria weights. The comparative analysis is made using other MCDM methods such as TOPSIS, VIKOR, EDAS, and MABAC. The results show the rank is stable in different cases, and the proposed method is effective compared with other MCDM methods.

Keywords: Higher Education; Multi-Criteria Decision Making; Service Quality; Evaluation Problem; PROMETHEE.

1 | Introduction

A person's life is significantly impacted by higher education, which is a life-changing experience that develops their abilities and intellectual abilities while also creating lasting personal and professional relationships. Higher education acts as an engine of a nation's development and economic prosperity by ensuring technical improvement, encouraging industrial cooperation, and producing graduates who contribute to diverse sectors of the economy [1, 2]. Higher education institutions (HEIs) must be strategically managed and continuously developed to carry out their responsibilities. Robust methods are essential for a strategically managed higher education institution (HEI) to guarantee the quality of its research, academic programmes, and other services. These methods may be implemented using systematic system reviews, service quality assessments, accreditations, and sustainability considerations [3–5].

As educational institutions strive to provide a dynamic and supportive atmosphere for faculty, staff, and students, it is becoming increasingly clear that service quality evaluation and improvement are necessary [6, 7]. Service quality is critical for drawing in and keeping students, creating a healthy learning environment, and

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guaranteeing pleasure. Furthermore, in an era of intense competition among academic institutions, offering outstanding service quality sets institutions apart and enhances their standing and prosperity [8].

The assessment of university service quality has traditionally focused on specific components, including academic programmes, student support services, and infrastructure. However, given the intricacy and multifaceted nature of service quality, a more comprehensive strategy is needed, considering a more extensive variety of characteristics [9]. Research about university strategic management often includes qualitative evaluations of strategic management and provides suggestions for higher education that take certain stances when addressing strategic management. Seldom has a university's strategic management been statistically examined utilizing Multi-Criteria Decision-Making (MCDM) techniques. Additionally, this MCDM-based research looked at methods via a narrow range of subject-oriented criteria [10].

R. E. Bellman and L. A. Zadeh established the multi-criteria decision-making (MCDM) approach, which is extensively used in numerous sectors to help decision-makers evaluate and pick the ideal choice from various viewpoints. Effective decision-making is crucial for businesses in the firm industry to succeed and run smoothly [11]. MCDM techniques are critical in businesses that depend on factors like labour, raw materials, a steady supply of electricity, and a means of transportation. MCDM is crucial for managing these factors, and this introduction looks at how it helps with informed decision-making in the workplace [12].

In conventional MCDM methods, superiority ranking ranks choices according to their favourable attributes. However, in real-world decision-making situations, decision-makers must consider excellent and negative attributes to make well-informed judgments. Including negative attributes, often called inferiority rankings, makes evaluating the possibilities more thoroughly possible [13].

The contributions of this study are:

- This study used an MCDM model for service quality evaluation in the higher equation.
- The criteria of the service quality in the higher education are analyzed and ranked based on their importance.
- This study used a PROMETHEE MCDM method to rank the alternatives.

2 | Materials and Methods

Preference Ranking Organization Method for Enrichment Evaluation, or PROMETHEE, is a crucial MCDM technique meant to help decision-makers evaluate a range of options based on many criteria. The PROMETHEE method's basic components were first presented by Professor Jean-Pierre Brans in 1982. This method works particularly well when decision-makers have to compare a group of options based on a variety of criteria [14]. Figure 1 shows the steps of the PROMETHEE method.

Step 1. Build the decision matrix. The decision matrix is built based on a set of criteria and alternatives.

Step 2. Compute the beneficial and non-beneficial criteria. Determine the positive and negative criteria, then compute the beneficial and non-beneficial criteria as:

$$R_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \tag{1}$$

$$R_{ij} = \frac{\min(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \tag{2}$$

Where $i = 1,2, \dots m\ (alternative); j = 1,2, \dots n\ (criteria)$

Step 3. Compute the evaluate difference of i_{th} option with other options.

Step 4. Compute the preference function. The preference function is computed as:

$$P_i(y,z) = \begin{cases} (R_{yj} - R_{zj}) & if\ R_{yj} > R_{zj} \\ 0 & if\ R_{yj} \leq R_{zj} \end{cases} \quad (3)$$

Step 5. Combine the preference function.

$$F(y,z) = \sum_{j=1}^{n} P_i(y,z) \quad (4)$$

Step 6. Compute the leaving and entering outranking flow. The flow of outranking for leaving and entering can be computed as:

$$u^{+} = \frac{1}{m-1}\sum_{y=1}^{m} F(y,z) \quad (5)$$

$$u^{-} = \frac{1}{m-1}\sum_{b=1}^{m} F(y,z) \quad (6)$$

Step 7. Compute the net out ranking flow. The flow of ne out ranking is computed as:

$$u = u^{+}(y) - u^{-}(y) \quad (7)$$

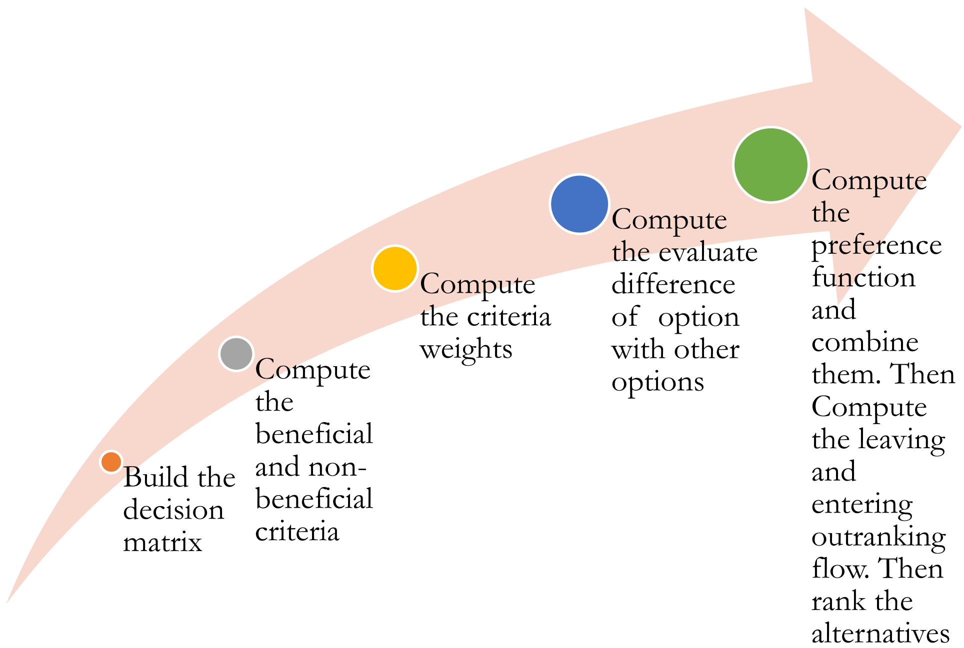

Figure 1. The steps of the proposed methodology.

3 | Application

This study proposed a decision-making model for evaluating service quality in higher education. This section introduces the results of the proposed methodology to rank the alternatives and the criteria.

Step 1. Build the decision matrix. The decision matrix is built based on a set of criteria and alternatives. This study used eleven criteria and ten alternatives.

Step 2. Compute the beneficial and non-beneficial criteria. Determine the beneficial and non-beneficial criteria by using Eqs. (1) and (2) as shown in Table 2. All criteria are positive except the financial criterion is negative criterion.

Table 1. The main criteria of this study.

Symbol	Criterion
SQC_1	Political
SQC_2	Financial
SQC_3	Value of Time
SQC_4	Social Events
SQC_5	Social Infrastructure
SQC_6	Access to technology
SQC_7	Technological Infrastructure
SQC_8	Waste Management
SQC_9	Green Campus
SQC_{10}	Ecological Factors
SQC_{11}	Safety

Table 2. The beneficial and non-beneficial criteria.

	SQC_1	SQC_2	SQC_3	SQC_4	SQC_5	SQC_6	SQC_7	SQC_8	SQC_9	SQC_{10}	SQC_{11}
SQA_1	0	0.5	0.857143	0.6	0	1	1	0.8	0.5	0.8	0.571429
SQA_2	0	0	0	0.4	0.2	0.28571429	0	1	0.5	0.8	0.714286
SQA_3	0.428571429	0	0.142857	0.4	1	0.85714286	0.857143	0.2	0.5	0	0.857143
SQA_4	0.571428571	0.5	0.857143	0.2	0.4	0	0.285714	0.4	0.625	0.6	1
SQA_5	1	0.333333	0.714286	1	0.4	0	0.142857	0.2	0.5	0.8	0.285714
SQA_6	0.428571429	0.166667	0.857143	0.8	1	0.42857143	0.714286	0.4	0.375	0.2	0.428571
SQA_7	0.857142857	0.666667	1	0.8	0.6	0.28571429	0.571429	0.6	0	0.6	0.571429
SQA_8	0.285714286	0.833333	0.571429	0	0.2	0.57142857	0.142857	0	0.125	0.4	0
SQA_9	0.714285714	1	0.714286	0	0.2	0.57142857	0.857143	1	1	1	0.142857
SQA_{10}	0.857142857	1	0.857143	0.2	0.4	1	1	0.8	0.375	0.6	0.428571

Step 3. Compute the evaluate difference of i_{th} option with other options. Compute the criteria weights by the mean method as shown in Figure 2.

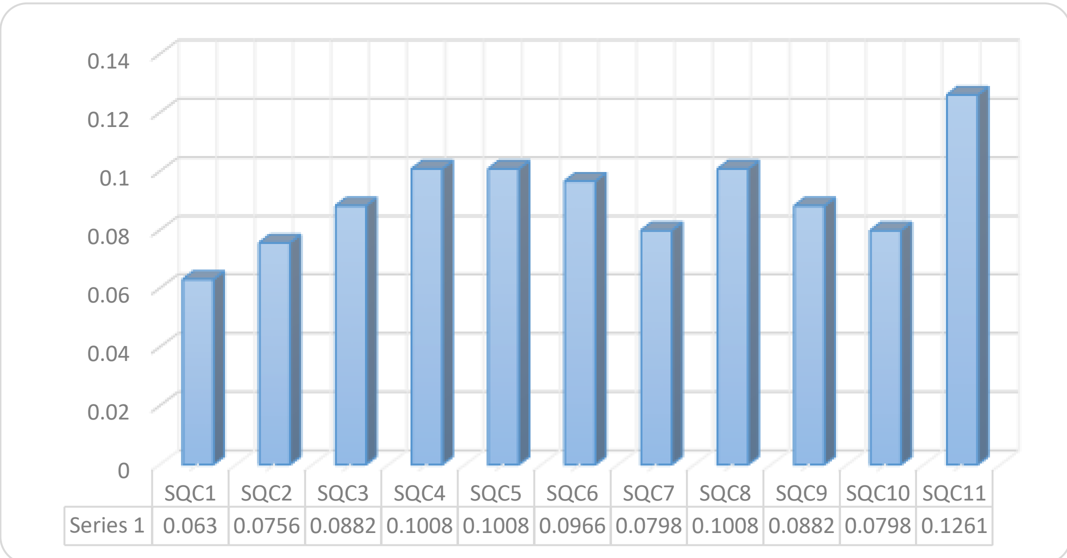

Figure 2. The criteria weights.

Step 4. Compute the preference function by using Eq. (3) as shown in Table 3.

Step 5. Combine the preference function by Eq. (4) as shown in Table 4.

Step 6. Compute the leaving and entering outranking flow by using Eqs. (5) and (6).

Step 7. Compute the net out ranking flow by using Eq. (7) as shown in Figure 3. The alternative 8 is the best and alternative 10 is the worst.

Table 3. The preference function.

	SQC_1	SQC_2	SQC_3	SQC_4	SQC_5	SQC_6	SQC_7	SQC_8	SQC_9	SQC_{10}	SQC_{11}
SQA_1	0.06302521	-0.4243	-0.76891	-0.49915966	0.10084034	-0.9033613	-0.92017	-0.6991	-0.41176	-0.72017	-0.4453
SQA_2	0.06302521	0.07563	0.088235	-0.29915966	-0.0991597	-0.1890756	0.079832	-0.8991	-0.41176	-0.72017	-0.5882
SQA_3	-0.3655462	0.07563	-0.05462	-0.29915966	-0.8991597	-0.7605042	-0.77731	-0.0991	-0.41176	0.079832	-0.7310
SQA_4	-0.5084033	-0.4243	-0.76891	-0.09915966	-0.2991597	0.09663866	-0.20588	-0.2991	-0.53676	-0.52017	-0.8739
SQA_5	-0.9369747	-0.2577	-0.62605	-0.89915966	-0.2991597	0.09663866	-0.06303	-0.0991	-0.41176	-0.72017	-0.1596
SQA_6	-0.3655462	-0.0910	-0.76891	-0.69915966	-0.8991597	-0.3319327	-0.63445	-0.2991	-0.28676	-0.12017	-0.3025
SQA_7	-0.7941176	-0.5910	-0.91176	-0.69915966	-0.4991597	-0.1890756	-0.4916	-0.4991	0.088235	-0.52017	-0.4453
SQA_8	-0.2226890	-0.7577	-0.48319	0.100840336	-0.0991597	-0.4747899	-0.06303	0.10084	-0.03676	-0.32017	0.12605
SQA_9	-0.6512605	-0.9243	-0.62605	0.100840336	-0.0991597	-0.4747899	-0.77731	-0.8991	-0.91176	-0.92017	-0.0168
SQA_{10}	-0.7941176	-0.9243	-0.76891	-0.09915966	-0.2991597	-0.9033613	-0.92017	-0.6991	-0.28676	-0.52017	-0.3025

Table 4. Aggregated preference function.

	SQC_1	SQC_2	SQC_3	SQC_4	SQC_5	SQC_6	SQC_7	SQC_8	SQC_9	SQC_{10}	SQC_{11}
SQA_1	0.0039721	-0.0321	-0.06784	-0.050335	0.010168	-0.08729	-0.07346	-0.0705	-0.03633	-0.05749	-0.05614
SQA_2	0.0039721	0.00572	0.007785	-0.03016	-0.00999	-0.018272	0.006373	-0.09067	-0.03633	-0.05749	-0.07415
SQA_3	-0.023038	0.00572	-0.00482	-0.030166	-0.09061	-0.073494	-0.06205	-0.01	-0.03633	0.006373	-0.09215
SQA_4	-0.032042	-0.0321	-0.06784	-0.009999	-0.030167	0.0093390	-0.01644	-0.03017	-0.04736	-0.04153	-0.11016
SQA_5	-0.059053	-0.0194	-0.05524	-0.090676	-0.03017	0.0093390	-0.00503	-0.01	-0.03633	-0.05749	-0.02013
SQA_6	-0.023038	-0.0068	-0.06784	-0.070505	-0.09061	-0.032077	-0.05065	-0.03017	-0.0253	-0.00959	-0.03813
SQA_7	-0.050049	-0.0447	-0.08045	-0.070503	-0.05035	-0.018272	-0.03925	-0.05034	0.007785	-0.04153	-0.05614
SQA_8	-0.014035	-0.0573	-0.04263	0.0101687	-0.00999	-0.045883	-0.00503	0.010169	-0.00324	-0.02556	0.015889
SQA_9	-0.041045	-0.0699	-0.05524	0.0101673	-0.00999	-0.045883	-0.06205	-0.09067	-0.08045	-0.07346	-0.00212
SQA_{10}	-0.050049	-0.0699	-0.06784	-0.009929	-0.03017	-0.087299	-0.07346	-0.0705	-0.0253	-0.04153	-0.03813

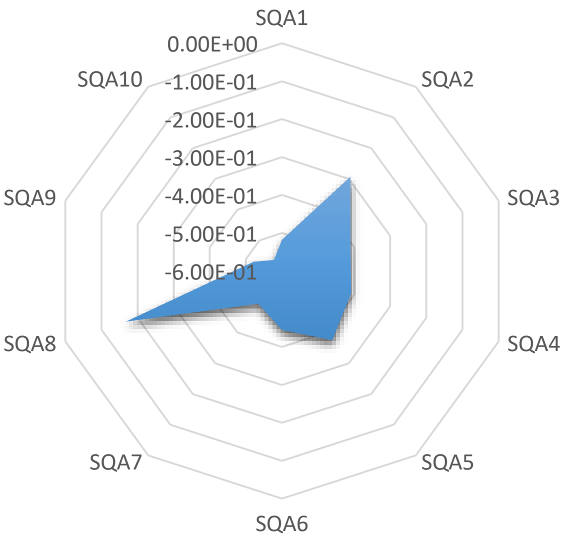

Figure 3. The net out ranking flow.

4 | Sensitivity Analysis

In this section, the criteria weights are changed to show the rank of alternatives in different cases. There are 12 cases in which criteria weights are computed, as shown in Figure 4. In case 1, we gave all criteria equal weight. In the second case, we put the first criterion at 0.12, and the other criteria are equal. Then, we compute the net out-ranking flow values of 12 cases, as shown in Figure 5. The rank shows that all cases are equal, and the results are stable in different cases.

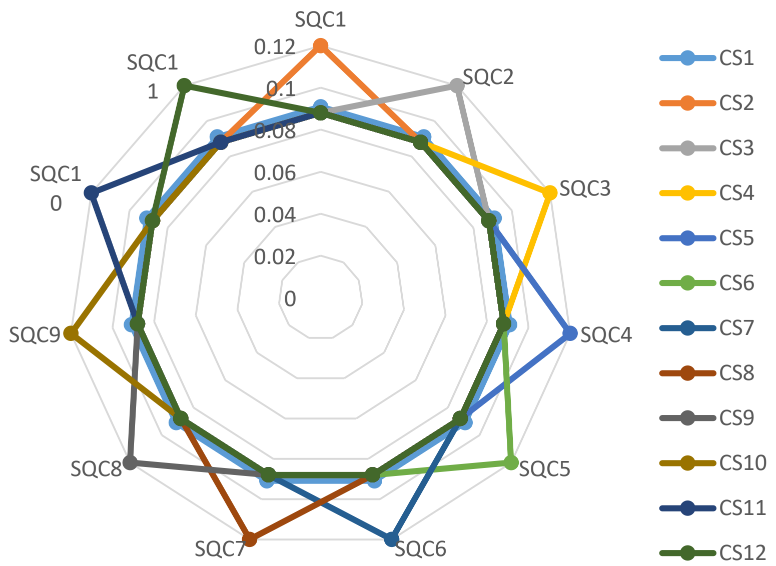

Figure 4. The different cases in the criteria weights.

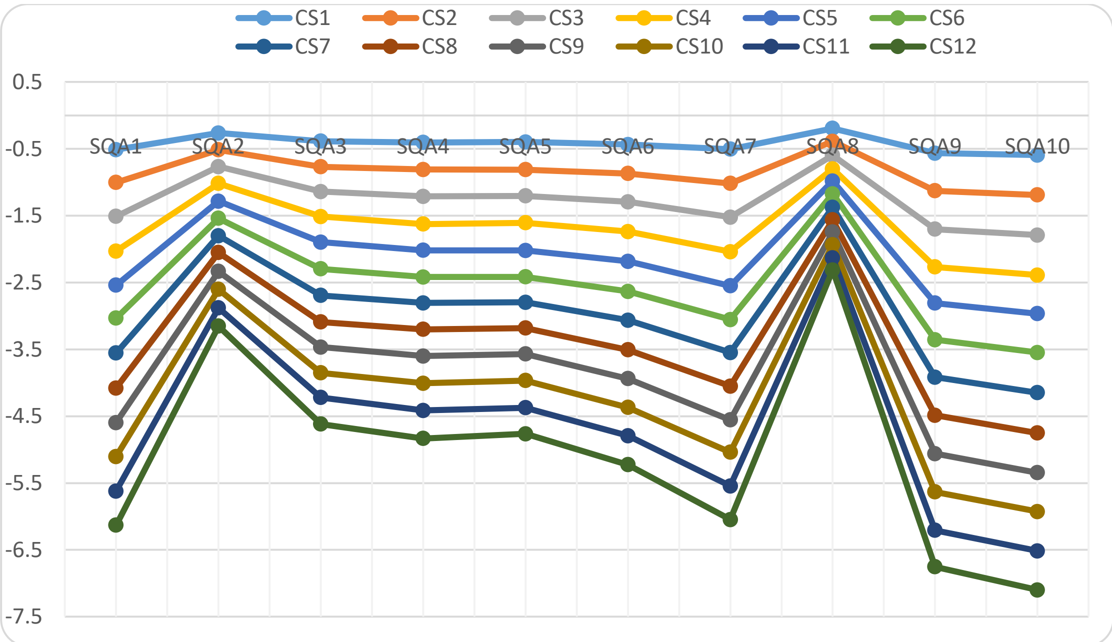

Figure 5. The values of net out ranking flow under different cases.

5 | Comparative Analysis

To show its robustness, we compare the proposed methodology with other MCDM methods, such as TOPSIS, VIKOR, MABAC, and EDAS methods. Figure 6 shows the rank of the comparative method. Then, we show the correlation coefficient between the proposed method and other MCDM methods, as shown in Figure 7. The correlation is strong between the proposed method and other MCDM methods.

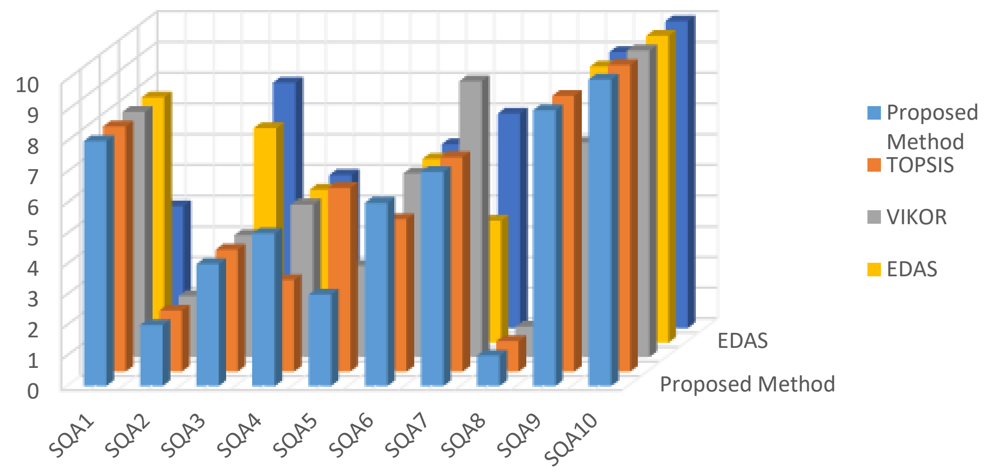

Figure 6. The comparative analysis.

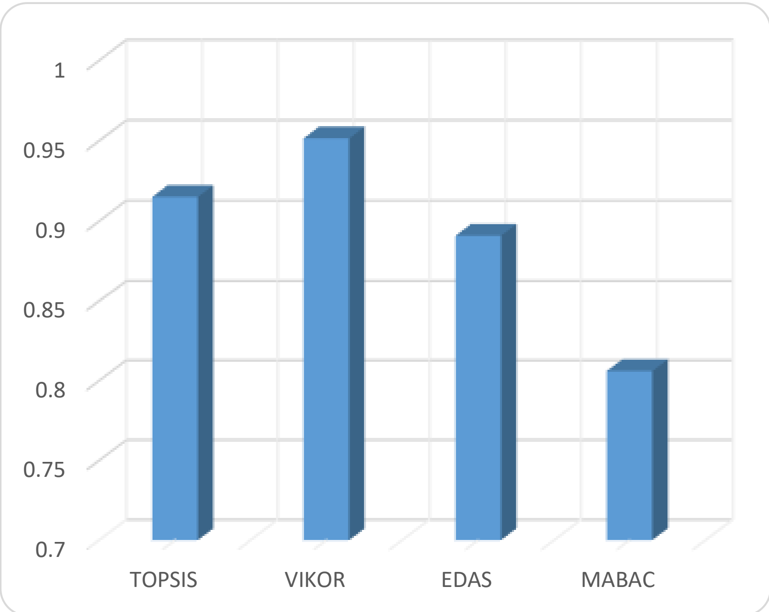

Figure 7. The correlation coefficient between proposed method and comparative method.

6 | Conclusions

This study proposed a decision-making model for evaluating service quality in higher education. The MCDM method is used to rank the alternatives. This study used 11 criteria and 10 alternatives. The experts and decision-makers used the crisp value to evaluate the requirements and alternatives to build the decision matrix. Then, these values are used to compute the criteria weights using the average method. The PROMETHEE method is used as an MCDM methodology to rank the alternatives. The results show that alternative 8 is the best and alternative 10 is the worst. There are 12 cases in which criteria weights are proposed to show the stability of the rank. The sensitivity analysis shows the rank of alternatives is stable. This study compared the proposed method with other MCDM methods such as TOPSIS, MABAC, VIKOR, and EDAS. The results of the comparative analysis show the proposed method is robust.

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Author Contributaion

All authors contributed equally to this work.

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Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to the privacy-preserving nature of the data but are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there is no conflict of interest in the research.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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