Assessing the Impact of Criterion Weights on the Ranking of the Top Ten Universities in Vietnam

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ABSTRACT

This study focuses on evaluating the influence of criterion weights on the ranking of the top ten universities in Vietnam. Criteria weights were determined using four different methods, including the equal weight method, the weights of the Vietnam University Rankings (VNUR) system, the entropy weight method, and the Logarithmic Percentage Change-driven Objective Weighting (LOPCOW) weight method. Four university ranking methods were applied: Proximity Indexed Value (PIV), Ranking of Alternatives with Weights of Criterion (RAWEC), Root Assessment Method (RAM), and Simple Ranking Process (SRP). The results indicate that the use of different weight calculation methods does not significantly affect university rankings. The four leading universities in Vietnam consistently maintain their position in the rankings, regardless of the weight calculation or ranking methods used.

Keywords-top ten universities in Vietnam; VNUR; weight method; MCDM method

I. INTRODUCTION

The ranking of universities within each country plays a crucial role in the development of the reputation and credibility of the education system, both domestically and internationally [1, 2]. It provides a clear reflection of the quality and development of higher education in a country, helping students and parents select institutions that align with their learning needs and goals [3, 4]. Additionally, rankings foster competition and encourage universities to enhance the quality of education, research, and innovation to maintain or improve their position within the international community [5]. Globally, there are various reputable university ranking systems, among which the Quacquarelli Symonds (QS) and Times Higher Education (THE) World University Rankings stand out and are widely used. The QS World University Rankings provide a comprehensive overview of the quality of education and research in universities worldwide, based on a range of criteria including academic data, independence, and feedback from the academic and business communities [6]. Meanwhile, the THE World University Rankings is one of the widely recognized systems, focusing on criteria such as teaching quality, research, international outlook, and access to resources [7]. Both systems provide valuable information for students, researchers, and the educational community to assess and select universities that match their learning and research goals. Global university ranking systems, such as QS and THE, provide an overall view of education and research quality worldwide. However, each country needs its own ranking system to reflect regional, cultural, and linguistic specificities, helping to shape local education development strategies and providing more specific information to domestic students and communities [8-10].

Education in Vietnam has unique characteristics compared to other educational systems around the world. The Vietnamese education system is undergoing reforms to adapt to the rapidly developing economic and technological environment in the modern era [11]. Therefore, in addition to inheriting the university rankings from global organizations, Vietnam has also developed its own ranking system, the VNUR. To date, VNUR is the first and only ranking system announced within Vietnam [12]. This system ranks universities according to six criteria: recognized quality (C1), teaching (C2), scientific publications (C3), tasks in science, technology and invention (C4), student quality (C5), and facilities (C6). VNUR assigns weights to these six criteria as 0.3, 0.25, 0.2, 0.1, 0.1, and 0.05, respectively [12]. Thus, in this system, criterion C1 is considered much more important than the others. This appears to be a significant difference compared to the rankings by THE and QS. According to THE, teaching criteria, research criteria, and citation rates are equally weighted, each at 30% [7], while according to QS, the two highest-weighted criteria are academic reputation (30%) and citations per faculty (20%) [6]. The difference in imposing weights on criteria in the VNUR system compared to the THE and QS systems is understood to be because Vietnamese universities have not achieved high rankings globally, so the country focuses more on evaluating teaching quality than research capacity. However, these differences in criteria weights between VNUR and THE/QS systems raise questions, such as how university rankings would be if criteria were assigned different weight values. This study

aimed to assess the impact of various weight calculation methods on university rankings in Vietnam. The motivation behind this study stems from the need to enhance the effectiveness of university rankings in Vietnam. Adjusting the weighting of criteria can potentially improve the accuracy in reflecting crucial aspects of domestic higher education, such as balancing teaching quality with research capacity, thus informing more targeted and efficient decisions in educational policy development. Four different methods were used to calculate the weights of the criteria. The first method, which is also the simplest, is the equal weight method [13, 14]. The second set of weights used is that determined by the VNUR system [15]. Entropy is the third method used to calculate criteria weights because it is a widely used and encouraged method [14, 16]. Finally, a recently emerged method, called LOPCOW, was also used [17].

This study used four different ranking methods to rank universities: PIV, RAWEC, RAM, and SRP. All of these methods rank alternatives based on multiple criteria, also known as Multiple Criteria Decision Making (MCDM) methods. It's also important to emphasize that MCDM methods have been widely applied across various fields, including medicine, mechanical engineering, education, economics, and engineering disciplines in general [18-21]. PIV is a method known for its advantage in reducing the phenomenon of rank reversal [22, 23]. The remaining three methods are all recently proposed methods. RAWEC was proposed in February 2024 [24], RAM was proposed in September 2023 [25], and SRP was proposed in May 2023 [26]. Using the PIV method with the three newly proposed methods (RAWEC, RAM, and SRP) has the advantage of objectively evaluating the influence of criterion weights on university rankings.

II. MATERIALS AND METHODS

A. Weight Calculation Methods

The equal weight method is the simplest method, where all criteria have equal weights [13, 14]. The second set of weights used is those determined by the VNUR system [15]. To calculate criteria weights using Entropy and LOPCOW methods, it is necessary to first construct a decision matrix with m rows and n columns, where m and n represent the number of options (universities to be ranked) and the number of criteria, respectively. Profit-type criteria are denoted as criterion B, while cost-type criteria are denoted as criterion C.

Let x_{ij} denote the value of criterion j for option i, where j ranges from 1 to n, and i ranges from 1 to m. To calculate the criteria weights using the entropy method, formulas (1) to (3) are applied sequentially [14, 16]:

$$r_{ij} = \frac{x_{ij}}{m + \sum_{i=1}^{m} x_{ij}^2} \qquad (1)$$

$$e_j = \sum_{i=1}^{m} \left[r_{ij} \times \ln\left(r_{ij}\right) \right] - \left(1 - \sum_{i=1}^{m} r_{ij} \right) \times \ln\left(1 - \sum_{i=1}^{m} r_{ij} \right) \qquad (2)$$

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{m} (1 - e_j)} \qquad (3)$$

Formulas from (4) to (7) are applied sequentially to calculate the criteria weights using the LOPCOW method [17]. The quantity σ in (6) represents the standard deviation.

$$r_{ij} = \frac{x_{ij} - min(x_{ij})}{max(x_{ij}) - min(x_{ij})}, \quad \text{if } j \in B \qquad (4)$$

$$r_{ij} = \frac{max(x_{ij}) - x_{ij}}{max(x_{ij}) - min(x_{ij})}, \quad \text{if } j \in C \qquad (5)$$

$$PV_{ij} = \left| ln\frac{\sqrt{\frac{\sum_{i=1}^{m} r_{ij}^2}{m}}}{\sigma} \right| \cdot 100 \qquad (6)$$

$$w_j = \frac{PV_{ij}}{\sum_{j=1}^{n} PV_{ij}} \qquad (7)$$

B. Multi-Criteria Decision Making (MCDM) Methods

Once the decision matrix is constructed, ranking universities according to each method is carried out as follows. For the PIV method, university ranking is determined by sequentially applying (8) to (12). The university with the smallest d_i is considered the best [22, 23].

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \qquad (8)$$

$$v_{ij} = w_j \times n_{ij} \qquad (9)$$

$$u_i = v_{max} - v_i, \quad \text{if } j \in B \qquad (10)$$

$$u_i = v_i - v_{min}, \quad \text{if } j \in C \qquad (11)$$

$$d_i = \sum_{j=1}^{n} u_i \qquad (12)$$

For the RAWEC method, university ranking is performed by applying formulas from (13) to (17) sequentially. The university ranked first is the one with the highest Q_i value [24].

$$n_{ij} = \frac{x_{ij}}{max(x_{ij})}, n'_{ij} = \frac{min(x_{ij})}{x_{ij}}, \text{if } j \in B \qquad (13)$$

$$n_{ij} = \frac{min(x_{ij})}{x_{ij}}, n'_{ij} = \frac{x_{ij}}{max(x_{ij})}, \text{if } j \in C \qquad (14)$$

$$v_{ij} = \sum_{j=1}^{n} w_j \cdot \left(1 - n_{ij} \right) \qquad (15)$$

$$v'_{ij} = \sum_{j=1}^{n} w_j \cdot \left(1 - n'_{ij} \right) \qquad (16)$$

$$Q_i = \frac{v'_{ij} - v_{ij}}{v'_{ij} + v_{ij}} \qquad (17)$$

To rank universities using the RAM method, the formulas from (18) to (22) are sequentially applied. The university ranked first is the one with the highest RI_i score [25].

$$n_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \qquad (18)$$

$$y_{ij} = w_j \cdot n_{ij} \qquad (19)$$

$$S_{+i} = \sum_{j=1}^{n} y_{+ij} \quad \text{if } j \in B \qquad (20)$$

$$S_{-i} = \sum_{j=1}^{n} y_{-ij} \quad \text{if } j \in C \qquad (21)$$

$$RI_i = {}^{2+S_{-i}}\sqrt{2 + S_{+i}} \qquad (22)$$

For the SRP method, university ranking is conducted as follows [26]:

- Internally rank universities, i.e., rank them for each criterion using natural numbers. For criterion j, the ranking of university i is denoted as r_{ij}. The best university is ranked by 1 (i.e., $r_{ij} = 1$), and vice versa. If two universities are equal, they have the same rank.

- Calculate the scores for each university according to (23). The university with the smallest S_i is ranked first.

$$S_i = \sum_{j=1}^{n} r_{ij} \cdot w_j \qquad (23)$$

C. Top Ten Universities in Vietnam

The VNUR system ranks more than 100 universities in Vietnam. However, this study considers only the top ten universities, including Vietnam National University (VNU), Vietnam National University, Ho Chi Minh City (VNU-HCM), Ton Duc Thang University (TDTU), Hanoi University of Science and Technology (HUST), Duy Tan University (DTU), University of Economics Ho Chi Minh City (UEH), Can Tho University (CTU), Hanoi National University of Education (HNUE), The University of Da Nang (UDN), and Hue University (HU). Table I shows the ranking results of the VNUR system of the top ten universities. C1 evaluates the reputation and prestige of the university, C2 evaluates the quality of the teaching and learning process, C3 evaluates the research capacity and publication of research results, C4 assesses the ability to apply and transfer technology and research products, C5 evaluates the development and achievements of students, and C6 assesses the physical conditions and infrastructure of the university.

TABLE I.   RANKING OF THE TOP TEN UNIVERSITIES IN VIETNAM ACCORDING TO THE VNUR SYSTEM [15]

University	C1	C2	C3	C4	C5	C6	Score	Rank by VNUR system
VNU	1	14	6	2	12	63	100	1
VNU-HCM	2	10	4	3	34	94	95	2
TDTU	4	20	1	37	57	8	89.8	3
HUST	3	1	7	1	10	181	86.9	4
DTU	7	21	2	96	123	141	79.7	5
UEH	14	42	3	53	35	88	70.3	6
CTU	10	4	20	5	53	133	69.2	7
HNUE	9	9	25	9	30	77	68.2	8
UDN	6	24	18	62	55	66	67.9	9
HU	5	43	30	10	64	104	67.5	10

III. RESULTS AND DISCUSSION

The weight calculation methods were applied to calculate the weights for the six criteria, resulting in Table II, which vary significantly when calculated using different methods. For example, for criterion C6, the difference in its weight when calculated using the LOPCOW method compared to using the values determined by the VNUR system is over 4.5 times. Figure 1 shows the results of using the four sets of weights calculated in Table II combined with the four MCDM methods to rank the universities. In this figure, the combination of each MCDM method with a weight calculation method is denoted by &. For example, *PIV & W3* represents ranking universities using the PIV method when the weights of the criteria are calculated using the Entropy method (W3). This figure also shows the ranking results according to the VNUR system.

TABLE I.   WEIGHTS OF THE CRITERIA

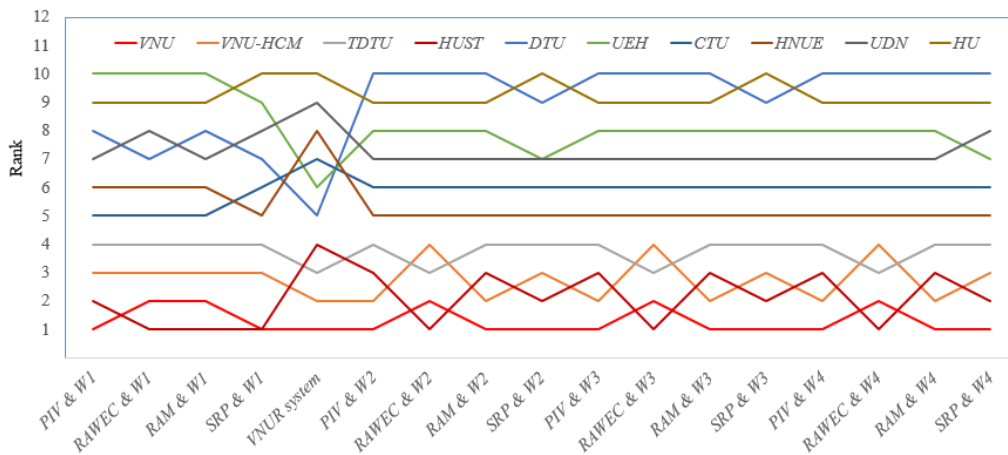| Weight method	Sign	C1	C2	C3	C4	C5	C6
Equal	W1	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667
VNUR system	W2	0.3000	0.2500	0.2000	0.1000	0.1000	0.0500
Entropy	W3	0.1950	0.1670	0.1725	0.1563	0.1566	0.1525
LOPCOW	W4	0.0900	0.1577	0.1371	0.1912	0.1951	0.2289
Max/Min		3.3330	1.5851	1.4591	1.9124	1.9507	4.5778

Fig. 1.   Ranking of universities.

Using different MCDM methods to rank universities results in changes in their rankings. Moreover, even using a single MCDM method, university rankings will change when using different sets of weights. This is a common issue when using MCDM methods and has been highlighted in many previous studies [27, 28]. Among the universities examined, it seems that the ranking using different methods particularly affects the DTU. The reason could be explained by its C1 and C3 criteria standing at a very high level, while C4, C5, and C6 are low. Therefore, variations in the weights of the criteria may significantly affect its ranking. However, it can be easily observed that the ranking variations of the remaining universities are not significant when using combinations of different MCDM methods and weights. The top four universities are identified as consistent when applying different methods. This result is crucial not only for students' university choices, but also for influencing educational policy decisions by governing bodies. Furthermore, it can be noticed that eleven combinations, including PIV & W1, SRP & W1, PIV & W2, RAM & W2, SRP & W2, PIV & W3, RAM & W3, SRP & W3, PIV & W4, RAM & W4, and SRP & W4, indicate that VNU is the leading university. This result is also consistent with the ranking of the VNUR system. In the remaining scenarios, VNU is identified as the second-ranked university. This demonstrates consistency in ranking universities using different methods and compared to the VNUR system.

IV. CONCLUSION

This study investigated the impact of criteria weights on the ranking of the top ten universities in Vietnam. Despite the significant variations in the criteria weights when using different calculation methods, university rankings do not change much. The top four universities consistently maintained their positions, regardless of the weighting method or the ranking method applied. The ranking results also align closely with the VNUR system. This study provides a transparent and accurate ranking table of universities, helping student decision-making and motivating universities to improve their positions. Additionally, it serves as a basis for rational educational policy decisions by governing bodies. This study sheds light on the impact of criteria weighting on university rankings in Vietnam, although it has limitations. Focusing solely on the top ten universities may not reflect the broader higher education landscape, and reliance on specific methodologies could restrict its applicability. Future research could broaden the scope to include more institutions and explore alternative methodologies to enhance the study's comprehensiveness and utility for policy-making and institutional development. Further research should focus on proposing specific solutions for universities to improve their ranking in national and international rankings. Moreover, recommendations should be made for governing bodies to develop appropriate policies to enhance the positions of Vietnam's top universities in rankings by organizations such as the THE and QS.

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