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Assessing the Academic Performance of Turkish Universities in 2023: A MEREC-WEDBA Hybrid Methodology Approach

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ABSTRACT

Research and reporting on university rankings serve as valuable tools for students in evaluating universities and understanding their current performance status. Within academic literature, university rankings are established using diverse criteria across various domains, each carrying varying degrees of importance. This study adopts a multi-criteria decision-making (MCDM) perspective to analyze the academic performance ranking of Turkish universities in 2023. Data sourced from the 2023 reports of sixty-one universities from Times Higher Education (THE) serve as the basis for this research, with THE indicators—teaching, research, citations, industry income, and international outlook—considered as primary research criteria. The Method based on the Removal Effects of Criteria (MEREC) is employed to ascertain criterion weights, while the Weighted Euclidean Distance-Based Approach (WEDBA) is utilized for university ranking. The study identifies "citations" as the criterion of highest significance. Notably, the top-performing universities in the ranking include Çankaya University, Fırat University, and Bahçeşehir University. Furthermore, by comparing the rankings from this study with THE university rankings, the research offers tailored suggestions for universities. This study underscores the importance of deriving criterion weights from university performance datasets rather than relying on fixed weights, facilitating a more nuanced approach to university rankings. Moreover, it presents THE performance rankings for sixty-one Turkish universities, offering valuable insights for strategic planning within the university sector.

1. Introduction

Education plays a pivotal role in fostering social development, with universities representing the apex of the formal education continuum. The pivotal role of university education in equipping students for professional life incentivizes them to seek enrollment in institutions of higher quality. Thus,

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prospective students often contemplate the question of which university offers superior educational opportunities. This dynamic prompts universities to strive for enhanced standings within the academic landscape. In response, universities engage in rigorous assessments of their current performance levels to inform strategic planning aimed at bolstering their academic achievements. This scholarly discourse has engendered numerous investigations focused on university rankings [1].

Scholarly literature features numerous investigations examining university rankings through various lenses. Jabjaimoh *et al.*, [2] identifies five prominent studies on university rankings. Foremost among these is the "*US News and World Report Best Global University Ranking (USNWR)*" which regularly publishes rankings based on thirteen indicators [3]. The second is the "*Academic Ranking of World Universities (ARWU)*" established by Shanghai Ranking Consultancy in 2009, also utilizing six indicators [4]. Thirdly, the "*University Ranking by Academic Performance (URAP)*" issued by the Middle East Technical University Informatics Institute employs six indicators for its rankings [5]. Fourthly, the "*Quacquarelli Symonds World University Ranking (QS)*" provides rankings across various disciplines, utilizing six indicators [6]. Finally, the "T*imes Higher Education World University Ranking (THE)*" considers five indicators in its ranking methodology [7].

While there exist similarities in university rankings organized by various institutions, distinctions emerge in measurement criteria (indicators), alongside differing perspectives on the significance levels of these criteria. Fauzi *et al.* [8] critically analyze university ranking reports, highlighting the advantages and drawbacks associated with each ranking criterion. Notably, Fauzi *et al.* [8] underscore that the determination of criterion importance levels often lacks empirical grounding, instead relying on fixed rates across reports. Within academic discourse, performance evaluation challenges are addressed through multi-criteria decision-making (MCDM) methodologies based on criterion weights. These methodologies are also observed in the context of university ranking determination [9-14].

This study aims to ascertain the ranking of Turkish universities in 2023 utilizing MCDM methods. To achieve this objective, the decision was made to utilize the university scores and criteria from 2023 as reported by THE, given their currency and relevance. The Method Based on The Removal Effects of Criteria (MEREC) method was chosen to determine criterion weights, while the Weighted Euclidean Distance Based Approach (WEDBA) method was selected for university ranking. The rationale for adopting these hybrid methods lies in their recent development within academic literature [15]. In this context, three primary research questions are posited for this study:

i. *Research Question 1*: To what extent can the ranking of Turkish universities be determined utilizing THE data?
ii. *Research Question 2*: Is the hybrid MEREC and WEDBA method capable of generating university rankings effectively?
iii. *Research Question 3*: Can actionable recommendations for universities to enhance their performance be derived by contrasting the newly formulated Turkish university rankings with those established by THE?

1.1 Literature Review

To assess the contributions of this research topic and the applied methodologies within the existing literature, a structured literature review is conducted in three stages. Firstly, a comprehensive examination of studies focusing on university rankings is undertaken to establish a contextual framework aligned with this research. Secondly, a critical review of scientific research concerning the MEREC method, a criterion weighting approach, is presented to elucidate the method's theoretical and empirical underpinnings. Thirdly, an in-depth analysis of the WEDBA

method, utilized for alternative ranking, is conducted to ascertain its positioning within the literature concerning alternative ranking methodologies.

Diverse methodologies are evident in the examination of university rankings within academic research. Critiques have emerged against the methodologies employed in university ranking reports. Fauzi *et al.* [8] have provided a critical analysis of world university ranking reports, outlining both their merits and shortcomings. Noteworthy observations include the appreciation for subject and regional diversity in the QS reports juxtaposed with concerns regarding the 40% weight assigned to academic reputation. Similarly, while the inclusion of teaching metrics in THE reports is lauded, challenges related to normalizing subject disparities are noted. ARWU reports are commended for their emphasis on research aspects, although criticisms are directed at their reliance on Nobel prizes for ranking. The Leiden reports face criticism for limited university diversity, while Webometrics reports are scrutinized for their emphasis on marketability characteristics of universities, which is viewed as a drawback.

The literature review conducted within the domain of university ranking research yielded several significant findings. Aliyev *et al.* [12] investigated five United Kingdom universities using the fuzzy analytic hierarchy process (F-AHP) method to rank performance based on teaching, research, citations, and international outlook criteria. Teber and Karakaş [13] examined ten Turkish universities with Alternative Energy Resources Technology Programs, employing the AHP, simple multi-attribute rating technique (SMART), and technique for order preference by similarity to ideal solution (TOPSIS) methods across nine criteria. Salimi and Rezai [10] utilized the F-AHP method to rank universities based on criteria such as networking and knowledge exchange ability, general attractiveness, research ability, and commercialization ability. Ömürbek *et al.* [16] presented rankings of ten Turkish universities using AHP, TOPSIS, and VIKOR methods, with emphasis on criteria like international publications and project numbers. Ömürbek *et al.* [17] ranked fifty-three state universities in Türkiye using entropy and multi-attribute utility theory (MAUT) methods, with the number of databases being a pivotal criterion. Ömürbek and Karataş [9] applied the entropy method to rank entrepreneurial and innovative universities, focusing on criteria such as scientific and technological research competence, intellectual property rights, and entrepreneurship culture. Demir [14] utilized CRITIC and WEDBA methods for academic performance ranking in Turkish universities, emphasizing criteria like article score, citation score, and PhD score. Parlar and Palancı [18] evaluated country performances based on THE university ranking data using the Borda method and CRITIC and Entropy methods. Organ and Kaçaroğlu [19] ranked universities' performance using Entropy and TOPSIS methods across criteria like student numbers, URAP score, and library area. Ozdagoglu *et al.* [20] employed CoCoSo and MARCOS methods for performance ranking based on URAP data, while Birol and Ulutaş [11] used entropy and COPRAS methods for performance ranking based on financial criteria. These studies are summarized in Table 1.

A comprehensive review of studies adopting the MEREC method for criterion weighting reveals diverse applications across various domains. Ecer and Zolfani [21] conducted an economic freedom performance ranking of OPEC countries using the MEREC method for criterion weighting and the double normalization-based multiple aggregation (DNMA) method for ranking. Ecer and Aycin [22] employed the MEREC method to rank G-7 countries based on innovation performance using multiple MCDM methods. Ulutaş *et al.* [23] utilized the MEREC method in the pallet truck selection problem, employing the simple weighted sum product (WISP-S) method for ordering alternatives. Simic *et al.* [24] leveraged MEREC and MARCOS methods for sustainable policy selection to mitigate urban transport's impact on climate change. Haq *et al.* [25] applied the MEREC and MARCOS methods using single valued neutrosophic numbers for sustainable material selection.

Table 1
Literature review for university ranking.

Authors	Methods	Criteria
Ömürbek *et al.* [16]	AHP, TOPSIS and VIKOR	22 criteria for 10 universities.
Salimi and Rezai [10]	F-AHP	"Networking and knowledge exchanging ability, general attractiveness, research ability and commercialization ability (4 criteria)"
Ömürbek et al. [17]	Entropy and MAUT	"Indoor area, number of personnel, number of books, number of printed publications, number of electronic journals, year of establishment and number of databases (7 criteria)"
Ömürbek and Karataş [9]	Entropy, MAUT and SAW	"Scientific and technological research competence, intellectual property rights, cooperation and interaction, culture of entrepreneurship and innovation, economic contribution and commercialization (5 criteria)"
Birol and Ulutaş [11]	Entropy and CORPAS	"New year's allowance amount, year-end allowance amount and spending amount (3 criteria)"
Aliyev *et al.* [12]	F-AHP	"Teaching, research, citations, and international outlook (4 criteria)"
Teber and Karakaş [16]	AHP, SMART and TOPSIS	"Campus facilities and social life opportunities, a ranking of the university, the technological background and laboratories, the ratio of preference, the number and the title of faculties, the number of ERASMUS students, foreign language education, the number of program vacancy, the percentage of the province's power plants (9 criteria)"
Parlar and Palancı [18]	BORDA, CRITIC and Entropy	"Research, citation, industry revenues and international outlook (4 criteria)"
Organ and Kaçaroğlu [19]	Entropy and TOPSIS	"Total number of students, university ranking by academic performance score, number of lecturers, number of printed books, library area, area per student, project support amount and full scholarship score (8 criteria)"
Ozdagoglu *et al.* [20]	CoCoSo and MARCOS	"Number of articles, number of citations, number of scientific documents, number of Phd and number of academicians per student (5 criteria)"
Demir [16]	CRITIC and WEDBA	"Article score, citation score, scientific document score, Phd. score and academician score per student (5 criteria)"

Rani *et al.* [26] utilized MEREC and additive ratio assessment (ARAS) methods for food waste treatment technology selection. Shanmugasundar *et al.* [27] employed the MEREC method for optimal Spray-Painting Robot selection. Mishra *et al.* [28] utilized MEREC for criterion weighting in low-carbon tourism strategies selection, ranking strategies with the MULTIMOORA method. Ivanović *et al.* [29] applied the MEREC method for criterion weighting in truck mixer concrete pump selection, ranking alternatives with the DN-MARCOS method. Additionally, Toslak *et al.* [30] employed MEREC and WEDBA methods to evaluate a logistics company's performance, marking the hybrid application of these methods for the first time. A comprehensive literature review detailing the applications of the MEREC method is presented in Table 2.

A thorough examination of studies utilizing the WEDBA method for alternative ordering reveals diverse applications across various domains. Jain and Ajmera [31] utilized the WEDBA method to rank the flexibility performance of flexible manufacturing systems. Ulutaş [32] employed the WEDBA method for the selection of tackers following criterion weighting with the preference selection index (PSI) method. Al-Hawari *et al.* [33] introduced the F-WEDBA method, integrating fuzzy numbers into the WEDBA framework. Basar and Tolga [34] utilized the WEDBA method to evaluate smart systems. Işık [35] employed the WEDBA method for financial performance analysis following criterion weighting with the Analytic Hierarchy Process (AHP) and Criteria Importance Through Intercriteria Correlation (CRITIC) methods. Durak and Tolga [36] applied the WEDBA method in the selection of Robotic Process Automation solutions. Şimşek [37] utilized the WEDBA method to assess the financial performance of banks. Garg [38] calculated criterion weights using the AHP method for e-learning website selection, subsequently applying the WEDBA method for ranking. Ecemiş and Coşkun [39]

used the PSI method for criterion weighting and the WEDBA method for ranking regions in evaluating information and communication technologies. A comprehensive literature review detailing the applications of the WEDBA method is provided in Table 3.

Table 2
Literature review for MEREC method.

Authors	Weighting Method	Ranking method	Topic
Shanmugasundar *et al.* [27]	MEREC	5 methods	"Spray-Painting Robot selection"
Rani *et al.* [26]	MEREC	ARAS	"Food waste treatment technology selection"
Haq *et al.* [25]	MEREC	MARCOS	"Sustainable material selection"
Simic *et al.* [24]	MEREC	MARCOS	"Sustainable policy selection"
Ecer and Aycin [22]	MEREC	7 methods	"Innovation performance ranking of G-7 countries"
Ecer and Zolfani [21]	MEREC	DNMA	"Economic freedom performance ranking of OPEC countries"
Ulutaş *et al.* [23]	MEREC	WISP-S	"Pallet truck selection"
Mishra *et al.* [28]	MEREC	MULTIMOORA	"Low-carbon tourism strategies selection"
Ivanović *et al.* [29]	MEREC	DN-MARCOS	"Truck mixer concrete pump selection"
Toslak *et al.* [30]	MEREC	WEDBA	"Performance ranking of a logistics company"

Table 3
Literature review for WEDBA method.

Authors	Weighting Method	Ranking method	Topic
Garg [38]	AHP	WEDBA	"E-learning websites selection"
Al-Hawari *et al.* [33]	-	F-WEDBA	-
Jain and Ajmera [31]	Entropy and AHP	WEDBA	"Flexibility performance rankings of flexible manufacturing systems"
Ulutaş [32]	PSI	WEDBA	"Stacker selection"
Basar and Tolga [34]	-	F-WEDBA	"Evaluation of smart systems"
Durak and Tolga [36	WEDBA	WEDBA	"Robotic process automation selection"
Işık [35]	AHP, CRITIC	WEDBA	"Financial performance analysis ranking"
Şimşek [37]	AHP	WEDBA	"Financial performance ranking of banks"
Ecemiş and Coşkun [39]	PSI	WEDBA	"Ranking of the use of information and communication technologies"

This study is structured into five sections. Section-2 provides a detailed exposition of the MEREC and WEDBA methods, delineating their procedural steps. In Section-3, an empirical application is conducted to ascertain university rankings. Subsequently, Section-4 presents the results, grounded in the empirical findings. Section-5 offers actionable recommendations for universities and researchers, alongside a delineation of the study's limitations.

2. Methodology

2.1 Criteria Selection

To ascertain the rankings of Turkish universities in 2023, the study adopts five criteria outlined in THE (Times Higher Education) reports as the research criteria. These criteria encompass "Teaching (C1), Research (C2), Citations (C3), Industry Income (C4), and International Outlook (C5)."

i. The *Teaching* criterion encompasses aspects related to the learning environment within universities. Scores derived from metrics such as reputation surveys, staff to student ratios, doctorate to bachelor's ratios, doctorates awarded to academic staff ratios, and institutional income are utilized to determine university scores for this criterion.

ii. The *Research* criterion focuses on evaluating universities' research capacities. Scores for this criterion are determined based on factors such as reputation surveys, research income, and research productivity.
iii. The *Citations* criterion evaluates universities based on their citation levels. Scores for this criterion are derived from the citation averages of universities on a global scale.
iv. The *Industry Income* criterion assesses the income generated by universities through their industrial activities.
v. The *International Outlook* criterion gauges universities' international presence, including staff and student diversity. Scores for this criterion are determined using metrics such as international to domestic student ratios, international to domestic staff ratios, and international collaboration.

Further details regarding the research criteria and information about the research dataset are provided in Table 4 for reference.

Table 4
Selected criteria and universities.

Criteria	Reports	Year	Universities
Teaching (C1) Research (C2) Citations (C3) Industry Income (C4) International Outlook (C5)	Times Higher Education (THE)	2022-2023	"Cankaya (A1), Koç (A2), Sabancı (A3), Middle East Technical (A4), Bahçeşehir (A5), Hacettepe (A6), Istanbul Technical (A7), Bilkent (A8), Boğaziçi (A9), Duzce (A10), First (A11), Istanbul Medeniyet (A12), Ozyegin (A13), Atılım (A14), Istanbul (A15), Istanbul Cerrahpaşa (A16), Necmettin Erbakan (A17), Sakarya (A18), Yıldız Technical (A19), Acıbadem (A20), Akdeniz (A21), Anadolu (A22), Ankara (A23), Atatürk (A24), Bezmiâlem (A25), Bozok (A26), Dokuz Eylül (A27), Ege (A28), Erciyes (A29), Gazi (A30), Gebze Technical (A31), Istanbul Medipol (A32), Karabük (A33), Marmara (A34), Selçuk (A35), TOBB (A36), Tokat Gaziosmanpaşa (A37), Aksaray (A38), Başkent (A39), Bolu Abant Izzet Baysal (A40), Bursa Uludağ (A41), Manisa Celal Bayar (A42), Cukurova (A43), Dicle (A44), Dumlupinar (A45), Erzincan Binali Yıldırım (A46), Eskişehir Osmangazi (A47), Gaziantep (A48), Inönü (A49), Izmir Institute of Technology (A50), Karadeniz Technical (A51), Kirikkale (A52), Kocaeli (A53), Ondokuz Mayis (A54), Recep Tayyip Erdoğan (A55), Sivas Cumhuriyet (A56), Süleyman Demirel (A57), Uşak (A58), Van Yüzüncü Yil (A59), Yeditepe (A60), Zonguldak Bülent Ecevit (A61)"

2.2 Method based on the Removal Effects of Criteria (MEREC) Method

The MEREC method, designed for criterion weighting, calculates based on the alterations in performance values among alternatives. This method was originally formulated by Keshavarz-Ghorabaee *et al.* [40] and has gained substantial traction in recent academic discourse. It has been implemented across various studies in literature, showcasing its widespread adoption. The method comprises six distinct steps, as delineated by Keshavarz-Ghorabaee *et al.* [40] and further expounded upon by Ulutaş *et al.* [23]. These steps are systematically elucidated in the following section:

Step 1-1: The decision matrix, denoted by m alternatives (i) and n criteria (j), is represented in Eq. (1).

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{i1} & \cdots & x_{ij} & \ldots & x_{in} \\ \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{m1} & \cdots & x_{mj} & \ldots & x_{mn} \end{bmatrix} \quad (1)$$

Step 1-2: The decision matrix undergoes normalization as per Eq. (2).

$$n_{ij}^{x} = \begin{cases} \frac{\min_k x_{kj}}{x_{ij}}, & for\ benefical\ criteria \\ \frac{x_{ij}}{\max_k x_{kj}}, & for\ cost\ criteria \end{cases} \quad (2)$$

Step 1-3: The comprehensive performance values of the alternatives (S_i) are computed according to Eq. (3).

$$S_i = ln\left(1 + \left(\frac{1}{n}\sum_{j=1}^{n}\left|ln\left(n_{ij}^{x}\right)\right|\right)\right) \quad (3)$$

Step 1-4: The alterations in the performance values of the alternatives $\left(S'_{ij}\right)$ are determined using Eq. (4), achieved through the subtraction of each criterion.

$$S'_{ij} = ln\left(1 + \left(\frac{1}{n}\sum_{k,k\neq j}^{n}\left|ln\left(n_{ij}^{x}\right)\right|\right)\right) \quad (4)$$

Step 1-5: The summation of absolute deviations $\left(E_j\right)$ is derived through Eq. (5).

$$E_j = \sum_{i=1}^{m}\left|S'_{ij} - S_i\right| \quad (5)$$

Step 1-6: The criterion weights $\left(w_j\right)$ are determined using Eq. (6).

$$w_j = \frac{E_j}{\sum_{j=1}^{n} E_j} \quad (6)$$

2.3 Weighted Euclidean Distance Based Approach (WEDBA) Method

The WEDBA method, a prominent MCDM technique, is employed for ranking the alternatives. This method consists of six sequential steps, each meticulously detailed as per the works of Rao and Singh [41] and Jain and Ajmera [31]:

Step 2-1: The decision matrix is formulated according to Step 1-1 of the MEREC method.

Step 2-2: The decision matrix is standardized using Eq. (7) in the normalization process.

$$t_{ij}^{x} = \begin{cases} \frac{\min_k x_{kj}}{x_{ij}}, & for\ cost\ criteria \\ \frac{x_{ij}}{\max_k x_{kj}}, & for\ benefical\ criteria \end{cases} \quad (7)$$

Step 2-3: The normalized decision matrix is further standardized utilizing Eq. (8) and Eq. (9) in the standardization procedure.

$$t_{ij} = \frac{t_{ij}^{x} - \mu_j}{\sigma_j} \quad (8)$$

$$\mu_j = \frac{\sum_{i=1}^{m} t_{ij}^{x}}{m} \; and \; \sigma_j = \sqrt{\frac{\sum_{i=1}^{m} \left(t_{ij}^{x} - \mu_j\right)^2}{m}} \tag{9}$$

Step 2-4: The ideal and anti-ideal values are determined using Eq. (10) and Eq. (11) in the calculation process.

$$t_{ij}{}^{+} = max\,(t_{ij}) \tag{10}$$

$$t_{ij}{}^{-} = min\,(t_{ij}) \tag{11}$$

Step 2-5: The weighted Euclidean distances among the alternatives are computed using Eq. (12) and Eq. (13) as part of the calculation process.

$$WED_i{}^{+} = \sqrt{\sum_{j=1}^{n} \left\{w_j \left(t_{ij} - t_{ij}{}^{+}\right)\right\}^2} \tag{12}$$

$$WED_i{}^{-} = \sqrt{\sum_{j=1}^{n} \left\{w_j \left(t_{ij} - t_{ij}{}^{-}\right)\right\}^2} \tag{13}$$

Step 2-6: The index scores for each alternative are determined using Eq. (14). The alternative exhibiting the highest index score is considered the optimal choice or best alternative within the context of the analysis.

$$IS_i = \frac{WED_i{}^{-}}{WED_i{}^{-} + WED_i{}^{+}} \tag{14}$$

3. Application

In this study focusing on the performance ranking of Turkish universities in 2023, five criteria were employed: "Teaching (C1), Research (C2), Citations (C3), Industry Income (C4), and International Outlook (C5)," as outlined in the methodology section. The scores for these criteria were sourced from THE (Times Higher Education) reports, specifically THE 2023 report that encompassed sixty-one Turkish universities. Consequently, all sixty-one universities (A1, A2, ..., A61) featured in THE 2023 report were included in this study and are listed in the criteria selection section within the methodology.

The research application unfolded in two distinct stages. Initially, criterion weights were determined using the MEREC method in the first stage. Subsequently, in the second stage, the universities were ranked employing the WEDBA method. The chronological sequence and detailed steps of this application are systematically elucidated throughout the methodology section.

Step 1-1: The decision matrix, comprising sixty-one alternatives and five criteria, is presented in Table 5. These data were sourced from THE 2023 report, serving as the foundation for the analysis in this study.

Table 5
The decision matrix.

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A1	15.5	13.2	100	37.7	46.7	*A32*	14.1	9.5	28.2	38	34.8
A2	30.7	42.3	56.1	100	49.3	*A33*	13.1	8.8	37.2	37.2	42.6
A3	25.5	37.7	57	73.4	59.7	*A34*	18.3	10	24.1	40.4	26.3
A4	37.5	42.4	35.4	99.9	44.6	*A35*	17.9	13	32.5	78	28.6
A5	19.3	20.9	62.3	51.9	49.5	*A36*	19	11.4	30.3	39	27.6
A6	29	26.1	51.9	89.1	25.7	*A37*	15.7	8	30.5	37.3	28.5
A7	31.9	35.5	29.1	100	42.6	*A38*	12.7	8.5	22.2	37.2	24.8
A8	23.4	24.2	43.5	55.3	63.7	*A39*	16.7	11.2	6	36.9	22.3
A9	24.4	24.6	39.8	54.1	41.8	*A40*	15.6	8.5	23.2	37.1	23
A10	20.4	14.6	56.7	83.5	26.6	*A41*	16.3	10.1	15	43.1	28.3
A11	15.6	9	74.6	37	25.1	*A42*	14.2	7.8	24.4	36.9	18.2
A12	17.7	9.9	66.4	37	22.7	*A43*	17.3	9.8	18.9	39.9	23.3
A13	17.2	20.1	46.6	41.2	48.8	*A44*	19.5	8.4	10.9	37.1	17.7
A14	17	9	52.7	37.3	40.7	*A45*	12	8.9	31	40.1	23.4
A15	22.1	20.8	32.4	48.3	31.5	*A46*	13.6	8.2	31.5	36.9	18.3
A16	17.1	12.1	52.6	45.3	21.3	*A47*	17.4	14.8	17.1	37.2	19.8
A17	33.7	12.7	26.9	39.6	31.5	*A48*	16.6	9.8	21.5	36.9	31.1
A18	21.2	11.3	46.2	54.2	27.3	*A49*	24.6	8.4	15.5	36.9	17.6
A19	25.7	26.7	29.3	100	32	*A50*	17.2	10.9	15.5	40.6	29.5
A20	22.4	11.4	18	38.7	24.9	*A51*	14.3	9.5	19.7	40	19.6
A21	15.5	10.8	27.8	38.1	19.7	*A52*	17.4	17.6	16.2	36.9	17.1
A22	23.1	11.3	32.9	40.5	22.9	*A53*	13.4	8.8	14.4	39.2	22.4
A23	18.8	11	25.6	37.7	27.4	*A54*	16.1	10.5	16.9	43.8	33.6
A24	18.8	14	37.2	37.3	20.4	*A55*	15.6	8.8	16.9	37.1	20.1
A25	27.7	10.7	27.2	41	24.3	*A56*	18.2	9.3	17.8	37.3	21.1
A26	13.8	8.7	30.2	38.4	27.7	*A57*	15.8	9.1	23.2	37.3	22.9
A27	18.4	13.3	20.9	95.8	21.7	*A58*	12.3	10	10.5	39.1	28.2
A28	21.8	13.3	19	46.7	24.1	*A59*	17.4	22.7	10.4	61	19.4
A29	20	14.1	23.7	68.9	24.1	*A60*	18.8	12.2	10.5	65.7	29.6
A30	27.5	16.2	23	92.7	18.9	*A61*	13.2	8.2	23.5	38.9	23.1
A31	20.5	14.4	22.1	44.1	25.5						

Step 1-2: The decision matrix is standardized using Eq. (2) and is displayed in Table 6 as part of the normalization process.

Table 6
The normalized decision matrix (MEREC Method).

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A1	0.774	0.591	0.060	0.979	0.366	*A32*	0.851	0.821	0.213	0.971	0.491
A2	0.391	0.184	0.107	0.369	0.347	*A33*	0.916	0.886	0.161	0.992	0.401
A3	0.471	0.207	0.105	0.503	0.286	*A34*	0.656	0.780	0.249	0.913	0.650
A4	0.320	0.184	0.169	0.369	0.383	*A35*	0.670	0.600	0.185	0.473	0.598
A5	0.622	0.373	0.096	0.711	0.345	*A36*	0.632	0.684	0.198	0.946	0.620
A6	0.414	0.299	0.116	0.414	0.665	*A37*	0.764	0.975	0.197	0.989	0.600
A7	0.376	0.220	0.206	0.369	0.401	*A38*	0.945	0.918	0.270	0.992	0.690
A8	0.513	0.322	0.138	0.667	0.268	*A39*	0.719	0.696	1.000	1.000	0.767
A9	0.492	0.317	0.151	0.682	0.409	*A40*	0.769	0.918	0.259	0.995	0.743
A10	0.588	0.534	0.106	0.442	0.643	*A41*	0.736	0.772	0.400	0.856	0.604
A11	0.769	0.867	0.080	0.997	0.681	*A42*	0.845	1.000	0.246	1.000	0.940
A12	0.678	0.788	0.090	0.997	0.753	*A43*	0.694	0.796	0.317	0.925	0.734
A13	0.698	0.388	0.129	0.896	0.350	*A44*	0.615	0.929	0.550	0.995	0.966

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A14	0.706	0.867	0.114	0.989	0.420	*A45*	1.000	0.876	0.194	0.920	0.731
A15	0.543	0.375	0.185	0.764	0.543	*A46*	0.882	0.951	0.190	1.000	0.934
A16	0.702	0.645	0.114	0.815	0.803	*A47*	0.690	0.527	0.351	0.992	0.864
A17	0.356	0.614	0.223	0.932	0.543	*A48*	0.723	0.796	0.279	1.000	0.550
A18	0.566	0.690	0.130	0.681	0.626	*A49*	0.488	0.929	0.387	1.000	0.972
A19	0.467	0.292	0.205	0.369	0.534	*A50*	0.698	0.716	0.387	0.909	0.580
A20	0.536	0.684	0.333	0.953	0.687	*A51*	0.839	0.821	0.305	0.923	0.872
A21	0.774	0.722	0.216	0.969	0.868	*A52*	0.690	0.443	0.370	1.000	1.000
A22	0.519	0.690	0.182	0.911	0.747	*A53*	0.896	0.886	0.417	0.941	0.763
A23	0.638	0.709	0.234	0.979	0.624	*A54*	0.745	0.743	0.355	0.842	0.509
A24	0.638	0.557	0.161	0.989	0.838	*A55*	0.769	0.886	0.355	0.995	0.851
A25	0.433	0.729	0.221	0.900	0.704	*A56*	0.659	0.839	0.337	0.989	0.810
A26	0.870	0.897	0.199	0.961	0.617	*A57*	0.759	0.857	0.259	0.989	0.747
A27	0.652	0.586	0.287	0.385	0.788	*A58*	0.976	0.780	0.571	0.944	0.606
A28	0.550	0.586	0.316	0.790	0.710	*A59*	0.690	0.344	0.577	0.605	0.881
A29	0.600	0.553	0.253	0.536	0.710	*A60*	0.638	0.639	0.571	0.562	0.578
A30	0.436	0.481	0.261	0.398	0.905	*A61*	0.909	0.951	0.255	0.949	0.740
A31	0.585	0.542	0.271	0.837	0.671						

Step 1-3: The S_i values are computed according to Eq. (3) and are presented in Table 7 as part of the calculation process.

Table 7
The S_i values.

Alternatives	S_i	Alternatives	S_i	Alternatives	S_i	Alternatives	S_i
A1	0.65	*A17*	0.55	*A32*	0.42	*A47*	0.37
A2	0.87	*A18*	0.57	*A33*	0.46	*A48*	0.40
A3	0.83	*A19*	0.71	*A34*	0.42	*A49*	0.30
A4	0.84	*A20*	0.41	*A35*	0.57	*A50*	0.38
A5	0.71	*A21*	0.38	*A36*	0.47	*A51*	0.30
A6	0.75	*A22*	0.48	*A37*	0.40	*A52*	0.36
A7	0.79	*A23*	0.44	*A38*	0.31	*A53*	0.25
A8	0.74	*A24*	0.48	*A39*	0.18	*A54*	0.40
A9	0.70	*A25*	0.48	*A40*	0.34	*A55*	0.28
A10	0.66	*A26*	0.39	*A41*	0.36	*A56*	0.32
A11	0.51	*A27*	0.52	*A42*	0.28	*A57*	0.35
A12	0.51	*A28*	0.45	*A43*	0.35	*A58*	0.25
A13	0.64	*A29*	0.52	*A44*	0.21	*A59*	0.42
A14	0.54	*A30*	0.58	*A45*	0.36	*A60*	0.42
A15	0.61	*A31*	0.47	*A46*	0.32	*A61*	0.32
A16	0.52						

Step 1-4: The S'_{ij} values are determined using Eq. (4) and are displayed in Table 8 as part of the calculation procedure.

Table 8
The S'_{ij} values.

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A1	0.63	0.60	0.31	0.65	0.54	*A32*	0.40	0.40	0.20	0.42	0.33
A2	0.79	0.72	0.66	0.78	0.78	*A33*	0.45	0.45	0.20	0.46	0.34
A3	0.77	0.69	0.62	0.77	0.72	*A34*	0.36	0.38	0.21	0.40	0.36
A4	0.73	0.68	0.67	0.75	0.75	*A35*	0.53	0.51	0.36	0.48	0.51
A5	0.67	0.61	0.45	0.68	0.60	*A36*	0.41	0.42	0.24	0.46	0.41
A6	0.66	0.62	0.52	0.66	0.71	*A37*	0.36	0.39	0.15	0.40	0.33
A7	0.69	0.64	0.63	0.69	0.70	*A38*	0.30	0.30	0.10	0.31	0.26
A8	0.68	0.63	0.53	0.70	0.61	*A39*	0.12	0.11	0.18	0.18	0.13
A9	0.62	0.57	0.49	0.66	0.60	*A40*	0.30	0.32	0.12	0.34	0.29
A10	0.60	0.59	0.39	0.57	0.61	*A41*	0.31	0.32	0.22	0.33	0.28
A11	0.48	0.49	0.15	0.51	0.46	*A42*	0.26	0.28	0.05	0.28	0.27
A12	0.46	0.48	0.17	0.51	0.47	*A43*	0.30	0.32	0.18	0.34	0.31
A13	0.60	0.54	0.40	0.63	0.53	*A44*	0.13	0.20	0.11	0.21	0.21
A14	0.49	0.52	0.24	0.53	0.43	*A45*	0.36	0.34	0.10	0.35	0.32
A15	0.54	0.49	0.40	0.58	0.54	*A46*	0.30	0.31	0.05	0.32	0.31
A16	0.47	0.46	0.22	0.49	0.49	*A47*	0.31	0.27	0.21	0.37	0.35
A17	0.43	0.50	0.36	0.55	0.48	*A48*	0.35	0.36	0.21	0.40	0.31
A18	0.50	0.53	0.31	0.52	0.51	*A49*	0.19	0.29	0.15	0.30	0.30
A19	0.64	0.58	0.54	0.61	0.65	*A50*	0.33	0.33	0.24	0.36	0.30
A20	0.32	0.36	0.25	0.40	0.36	*A51*	0.28	0.27	0.11	0.29	0.28
A21	0.34	0.33	0.14	0.37	0.36	*A52*	0.31	0.24	0.21	0.36	0.36
A22	0.40	0.44	0.25	0.47	0.45	*A53*	0.24	0.23	0.11	0.24	0.21
A23	0.38	0.39	0.23	0.43	0.37	*A54*	0.36	0.36	0.25	0.38	0.31
A24	0.42	0.40	0.22	0.47	0.45	*A55*	0.23	0.26	0.10	0.27	0.25
A25	0.38	0.45	0.28	0.47	0.44	*A56*	0.26	0.30	0.15	0.32	0.29
A26	0.37	0.38	0.14	0.38	0.32	*A57*	0.31	0.33	0.14	0.35	0.31
A27	0.47	0.45	0.36	0.40	0.49	*A58*	0.24	0.21	0.15	0.24	0.16
A28	0.37	0.38	0.29	0.42	0.41	*A59*	0.37	0.27	0.35	0.35	0.40
A29	0.46	0.45	0.35	0.45	0.48	*A60*	0.36	0.36	0.34	0.34	0.34
A30	0.48	0.49	0.42	0.47	0.57	*A61*	0.30	0.31	0.10	0.31	0.27
A31	0.40	0.39	0.30	0.45	0.42						

Step 1-5: The E_j values are computed using Eq. (5) and are presented in Table 9 as part of the calculation process.

Table 9
The E_j values.

	C1	C2	C3	C4	C5
E_j	3.285	3.544	12.292	1.640	3.451

Step 1-6*:* The criterion weights w_j were determined using Eq. (6) and are displayed in Table 10 as part of the calculation process.

Table 10
The criterion weights w_j.

	C1	C2	C3	C4	C5
w_j	0.1357	0.1464	0.5077	0.0677	0.1425

Step 2-1: In the application of the WEDBA method, the decision matrix presented in Table 5 is utilized.

Step 2-2: The decision matrix undergoes normalization using Eq. (7) and is depicted in Table 11 as part of the normalization process.

Table 11
The normalized decision matrix (WEDBA Method).

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A1	0.4133	0.3113	1.0000	0.3770	0.7331	*A32*	0.3760	0.2241	0.2820	0.3800	0.5463
A2	0.8187	0.9976	0.5610	1.0000	0.7739	*A33*	0.3493	0.2075	0.3720	0.3720	0.6688
A3	0.6800	0.8892	0.5700	0.7340	0.9372	*A34*	0.4880	0.2358	0.2410	0.4040	0.4129
A4	1.0000	1.0000	0.3540	0.9990	0.7002	*A35*	0.4773	0.3066	0.3250	0.7800	0.4490
A5	0.5147	0.4929	0.6230	0.5190	0.7771	*A36*	0.5067	0.2689	0.3030	0.3900	0.4333
A6	0.7733	0.6156	0.5190	0.8910	0.4035	*A37*	0.4187	0.1887	0.3050	0.3730	0.4474
A7	0.8507	0.8373	0.2910	1.0000	0.6688	*A38*	0.3387	0.2005	0.2220	0.3720	0.3893
A8	0.6240	0.5708	0.4350	0.5530	1.0000	*A39*	0.4453	0.2642	0.0600	0.3690	0.3501
A9	0.6507	0.5802	0.3980	0.5410	0.6562	*A40*	0.4160	0.2005	0.2320	0.3710	0.3611
A10	0.5440	0.3443	0.5670	0.8350	0.4176	*A41*	0.4347	0.2382	0.1500	0.4310	0.4443
A11	0.4160	0.2123	0.7460	0.3700	0.3940	*A42*	0.3787	0.1840	0.2440	0.3690	0.2857
A12	0.4720	0.2335	0.6640	0.3700	0.3564	*A43*	0.4613	0.2311	0.1890	0.3990	0.3658
A13	0.4587	0.4741	0.4660	0.4120	0.7661	*A44*	0.5200	0.1981	0.1090	0.3710	0.2779
A14	0.4533	0.2123	0.5270	0.3730	0.6389	*A45*	0.3200	0.2099	0.3100	0.4010	0.3673
A15	0.5893	0.4906	0.3240	0.4830	0.4945	*A46*	0.3627	0.1934	0.3150	0.3690	0.2873
A16	0.4560	0.2854	0.5260	0.4530	0.3344	*A47*	0.4640	0.3491	0.1710	0.3720	0.3108
A17	0.8987	0.2995	0.2690	0.3960	0.4945	*A48*	0.4427	0.2311	0.2150	0.3690	0.4882
A18	0.5653	0.2665	0.4620	0.5420	0.4286	*A49*	0.6560	0.1981	0.1550	0.3690	0.2763
A19	0.6853	0.6297	0.2930	1.0000	0.5024	*A50*	0.4587	0.2571	0.1550	0.4060	0.4631
A20	0.5973	0.2689	0.1800	0.3870	0.3909	*A51*	0.3813	0.2241	0.1970	0.4000	0.3077
A21	0.4133	0.2547	0.2780	0.3810	0.3093	*A52*	0.4640	0.4151	0.1620	0.3690	0.2684
A22	0.6160	0.2665	0.3290	0.4050	0.3595	*A53*	0.3573	0.2075	0.1440	0.3920	0.3516
A23	0.5013	0.2594	0.2560	0.3770	0.4301	*A54*	0.4293	0.2476	0.1690	0.4380	0.5275
A24	0.5013	0.3302	0.3720	0.3730	0.3203	*A55*	0.4160	0.2075	0.1690	0.3710	0.3155
A25	0.7387	0.2524	0.2720	0.4100	0.3815	*A56*	0.4853	0.2193	0.1780	0.3730	0.3312
A26	0.3680	0.2052	0.3020	0.3840	0.4349	*A57*	0.4213	0.2146	0.2320	0.3730	0.3595
A27	0.4907	0.3137	0.2090	0.9580	0.3407	*A58*	0.3280	0.2358	0.1050	0.3910	0.4427
A28	0.5813	0.3137	0.1900	0.4670	0.3783	*A59*	0.4640	0.5354	0.1040	0.6100	0.3046
A29	0.5333	0.3325	0.2370	0.6890	0.3783	*A60*	0.5013	0.2877	0.1050	0.6570	0.4647
A30	0.7333	0.3821	0.2300	0.9270	0.2967	*A61*	0.3520	0.1934	0.2350	0.3890	0.3626
A31	0.5467	0.3396	0.2210	0.4410	0.4003						

Step 2-3: The normalized decision matrix is standardized using Eq. (8) and is presented in Table 12 as part of the standardization process.

Table 12
The standardized decision matrix.

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A1	-0.6959	-0.1394	3.9439	-0.6160	1.7239	A32	-0.9520	-0.5902	-0.1519	-0.6009	0.5792
A2	2.0852	3.4061	1.4397	2.5136	1.9740	A33	-1.1350	-0.6755	0.3615	-0.6411	1.3295
A3	1.1338	2.8457	1.4910	1.1774	2.9744	A34	-0.1836	-0.5293	-0.3858	-0.4804	-0.2384
A4	3.3294	3.4183	0.2589	2.5086	1.5219	A35	-0.2568	-0.1638	0.0934	1.4084	-0.0172
A5	-0.0006	0.7988	1.7934	0.0973	1.9932	A36	-0.0555	-0.3587	-0.0321	-0.5507	-0.1134
A6	1.7742	1.4323	1.2001	1.9660	-0.2961	A37	-0.6593	-0.7730	-0.0207	-0.6361	-0.0268
A7	2.3048	2.5776	-0.1005	2.5136	1.3295	A38	-1.2082	-0.7121	-0.4941	-0.6411	-0.3827
A8	0.7496	1.2008	0.7209	0.2681	3.3591	A39	-0.4763	-0.3831	-1.4183	-0.6562	-0.6232
A9	0.9325	1.2496	0.5098	0.2079	1.2525	A40	-0.6776	-0.7121	-0.4371	-0.6461	-0.5559
A10	0.2007	0.0312	1.4739	1.6847	-0.2096	A41	-0.5495	-0.5171	-0.9049	-0.3447	-0.0460
A11	-0.6776	-0.6511	2.4950	-0.6511	-0.3539	A42	-0.9337	-0.7974	-0.3686	-0.6562	-1.0176
A12	-0.2933	-0.5415	2.0272	-0.6511	-0.5847	A43	-0.3665	-0.5537	-0.6824	-0.5055	-0.5270
A13	-0.3848	0.7013	0.8978	-0.4402	1.9259	A44	0.0360	-0.7242	-1.1387	-0.6461	-1.0657

Alternatives	Criteria					Alternatives	Criteria				
	C1	C2	C3	C4	C5		C1	C2	C3	C4	C5
A14	-0.4214	-0.6511	1.2457	-0.6361	1.1467	A45	-1.3363	-0.6633	0.0079	-0.4954	-0.5174
A15	0.5117	0.7866	0.0877	-0.0835	0.2618	A46	-1.0435	-0.7486	0.0364	-0.6562	-1.0080
A16	-0.4031	-0.2734	1.2400	-0.2342	-0.7194	A47	-0.3482	0.0555	-0.7851	-0.6411	-0.8637
A17	2.6341	-0.2003	-0.2260	-0.5205	0.2618	A48	-0.4946	-0.5537	-0.5341	-0.6562	0.2233
A18	0.3470	-0.3709	0.8749	0.2129	-0.1422	A49	0.9691	-0.7242	-0.8763	-0.6562	-1.0753
A19	1.1704	1.5054	-0.0891	2.5136	0.3099	A50	-0.3848	-0.4196	-0.8763	-0.4703	0.0694
A20	0.5666	-0.3587	-0.7337	-0.5657	-0.3731	A51	-0.9154	-0.5902	-0.6367	-0.5004	-0.8829
A21	-0.6959	-0.4318	-0.1747	-0.5959	-0.8733	A52	-0.3482	0.3967	-0.8364	-0.6562	-1.1234
A22	0.6947	-0.3709	0.1162	-0.4753	-0.5655	A53	-1.0801	-0.6755	-0.9391	-0.5406	-0.6136
A23	-0.0921	-0.4075	-0.3002	-0.6160	-0.1326	A54	-0.5861	-0.4684	-0.7965	-0.3096	0.4638
A24	-0.0921	-0.0419	0.3615	-0.6361	-0.8060	A55	-0.6776	-0.6755	-0.7965	-0.6461	-0.8348
A25	1.5363	-0.4440	-0.2089	-0.4502	-0.4308	A56	-0.2019	-0.6146	-0.7451	-0.6361	-0.7386
A26	-1.0069	-0.6877	-0.0378	-0.5808	-0.1038	A57	-0.6410	-0.6390	-0.4371	-0.6361	-0.5655
A27	-0.1653	-0.1272	-0.5683	2.3026	-0.6809	A58	-1.2814	-0.5293	-1.1616	-0.5457	-0.0557
A28	0.4568	-0.1272	-0.6767	-0.1639	-0.4500	A59	-0.3482	1.0181	-1.1673	0.5545	-0.9021
A29	0.1275	-0.0298	-0.4086	0.9513	-0.4500	A60	-0.0921	-0.2613	-1.1616	0.7906	0.0790
A30	1.4997	0.2261	-0.4485	2.1469	-0.9502	A61	-1.1167	-0.7486	-0.4200	-0.5557	-0.5462
A31	0.2190	0.0068	-0.4998	-0.2945	-0.3154						

Step 2-4: The ideal and anti-ideal values are computed using Eq. (10) and Eq. (11), respectively. These values are displayed in Table 13 as part of the calculation process.

Table 13
Ideal and anti-ideal values.

	C1	C2	C3	C4	C5
t_{ij}^{+}	3.3294	3.4183	3.9439	2.5136	3.3591
t_{ij}^{-}	-1.3363	-0.7974	-1.4183	-0.6562	-1.1234

Step 2-5: The weighted Euclidean distances among the alternatives are calculated using Eq. (12) and Eq. (13) as part of the calculation process. These distances are presented in Table 14 for reference.

Table 14
The weighted Euclidean distances.

Alt.	WED_i^{+}	WED_i^{-}	Alt.	WED_i^{+}	WED_i^{-}	Alt.	WED_i^{+}	WED_i^{-}
A1	0.8178	2.7554	*A22*	2.1367	0.8326	*A42*	2.4380	0.5359
A2	1.2976	1.7147	*A23*	2.3376	0.6115	*A43*	2.5405	0.4068
A3	1.2875	1.7131	*A24*	2.0439	0.9269	*A44*	2.7693	0.2345
A4	1.8891	1.3017	*A25*	2.2706	0.7358	*A45*	2.2578	0.7295
A5	1.2680	1.7163	*A26*	2.2541	0.7173	*A46*	2.2567	0.7398
A6	1.5304	1.4481	*A27*	2.4644	0.5150	*A47*	2.5813	0.3718
A7	2.0818	1.0507	*A28*	2.5003	0.4700	*A48*	2.4538	0.5026
A8	1.7112	1.3256	*A29*	2.3732	0.5795	*A49*	2.6276	0.4167
A9	1.8332	1.1228	*A30*	2.3729	0.6705	*A50*	2.6113	0.3528
A10	1.5035	1.5020	*A31*	2.4140	0.5382	*A51*	2.5478	0.4036
A11	1.2319	1.9918	*A32*	2.2818	0.6898	*A52*	2.6055	0.3685
A12	1.3735	1.7570	*A33*	2.0403	0.9694	*A53*	2.6881	0.2570
A13	1.6987	1.2792	*A34*	2.3868	0.5629	*A54*	2.5699	0.4050
A14	1.6233	1.3963	*A35*	2.1378	0.8145	*A55*	2.6171	0.3311
A15	2.0864	0.8612	*A36*	2.2089	0.7418	*A56*	2.5752	0.3797
A16	1.6749	1.3591	*A37*	2.2358	0.7323	*A57*	2.4389	0.5137
A17	2.2379	0.8386	*A38*	2.4801	0.4814	*A58*	2.7790	0.2044
A18	1.7811	1.1977	*A39*	2.8905	0.1496	*A59*	2.7372	0.3355
A19	2.1320	0.8789	*A40*	2.4423	0.5126	*A60*	2.7305	0.3010
A20	2.5322	0.4506	*A41*	2.6346	0.3241	*A61*	2.4489	0.5144
A21	2.3229	0.6405						

Step 2-6: The index scores for each alternative are computed using Eq. (14). The resulting university rankings are displayed in Table 15 as part of the analysis.

Table 15
The rankings of the universities.

Alt.	IS_i	Rankings	Alt.	IS_i	Rankings	Alt.	IS_i	Rankings
A1	0.7711	1	*A22*	0.2804	21	*A42*	0.1802	37
A2	0.5692	5	*A23*	0.2073	33	*A43*	0.1380	46
A3	0.5709	4	*A24*	0.3120	18	*A44*	0.0781	59
A4	0.4080	13	*A25*	0.2447	27	*A45*	0.2442	28
A5	0.5751	3	*A26*	0.2414	29	*A46*	0.2469	25
A6	0.4862	8	*A27*	0.1728	41	*A47*	0.1259	51
A7	0.3354	16	*A28*	0.1582	44	*A48*	0.1700	42
A8	0.4365	11	*A29*	0.1963	34	*A49*	0.1369	47
A9	0.3799	15	*A30*	0.2203	31	*A50*	0.1190	53
A10	0.4998	7	*A31*	0.1823	36	*A51*	0.1367	48
A11	0.6179	2	*A32*	0.2321	30	*A52*	0.1239	52
A12	0.5613	6	*A33*	0.3221	17	*A53*	0.0873	58
A13	0.4296	12	*A34*	0.1908	35	*A54*	0.1361	49
A14	0.4624	9	*A35*	0.2759	22	*A55*	0.1123	54
A15	0.2922	19	*A36*	0.2514	24	*A56*	0.1285	50
A16	0.4480	10	*A37*	0.2467	26	*A57*	0.1740	38
A17	0.2726	23	*A38*	0.1625	43	*A58*	0.0685	60
A18	0.4021	14	*A39*	0.0492	61	*A59*	0.1092	56
A19	0.2919	20	*A40*	0.1735	40	*A60*	0.0993	57
A20	0.1511	45	*A41*	0.1095	55	*A61*	0.1736	39
A21	0.2161	32						

4. Results

University rankings serve as a valuable tool for students, offering insights into a university's standing relative to others and the performance levels across various criteria. Extensive literature exists focusing on university rankings, with evaluations conducted using diverse criteria. In this study, the discussion centers on sixty-one Turkish universities included in THE university ranking. The primary objective is to recalibrate the criteria weights based on THE ranking data and subsequently organize the 2023 Turkish university rankings using these revised weights. Notably, the MEREC method was employed for criterion weighting, while the WEDBA method facilitated the ranking of universities. This study adopts a unique approach in obtaining criteria weights, diverging from the established THE criteria weights.

As per THE reports, the weight attributed to the *Teaching (C1)* criterion stands at 30%. However, in this research, the weight assigned to the Teaching criterion was determined to be 13.57%. Similarly, while the *Research (C2)* criterion carries a weight of 30% in THE reports, it was found to be 14.64% in this study. Conversely, the weight of the *Citations (C3)* criterion in THE reports is 30%, but it was calculated as 50.77% in this research. The Industry *Income (C4)* criterion, originally set at 2.5% in THE reports, was determined to be 6.77% in this study. Moreover, the *International Outlook (C5)* criterion, initially at 7.5% according to THE reports, was calculated as 14.25% in this research.

Based on these findings and the dataset pertaining to Turkish universities, there is a notable decrease in the weights assigned to the Teaching and Research criteria. Conversely, there is an increase in the weights allocated to the Citations, Industry Income, and International Outlook criteria. These adjustments reflect the nuanced performance and emphasis of Turkish universities across these criteria, as indicated by the study's methodology.

The 2023 performance ranking of Turkish universities was established through the WEDBA. Table 16 provides an overview of the rankings derived from WEDBA findings alongside THE rankings.

Table 16
Comparison of Turkish Universities ranking between MEREC-WEDBA and THE.

Universities	Ranking		Universities	Ranking	
	MEREC-WEDBA	THE		MEREC-WEDBA	THE
Cankaya University	1	1	Akdeniz University	32	21
Firat University	2	11	Ankara University	33	23
Bahçeşehir University	3	5	Erciyes University	34	29
Sabancı University	4	3	Marmara University	35	34
Koç University	5	2	Gebze Technical University	36	31
Istanbul Medeniyet University	6	12	Manisa Celal Bayar University	37	42
Duzce University	7	10	Süleyman Demirel University	38	57
Hacettepe University	8	6	Zonguldak Bülent Ecevit	39	61
Atılım University	9	14	Bolu Abant Izzet Baysal University	40	40
Istanbul University-Cerrahpaşa	10	16	Dokuz Eylül University	41	27
Bilkent University	11	8	Gaziantep University	42	48
Ozyegin University	12	13	Aksaray University	43	38
Middle East Technical University	13	4	Ege University	44	28
Sakarya University	14	18	Acıbadem University	45	20
Boğaziçi University	15	9	Cukurova University	46	43
Istanbul Technical University	16	7	Inönü University	47	49
Karabük University	17	33	Karadeniz Technical University	48	51
Atatürk University	18	24	Ondokuz Mayis University	49	54
Istanbul University	19	15	Sivas Cumhuriyet University	50	56
Yıldız Technical University	20	19	Eskişehir Osmangazi University	51	47
Anadolu University	21	22	Kirikkale University	52	52
Selçuk University	22	35	Izmir Institute of Technology	53	50
Necmettin Erbakan University	23	17	Recep Tayyip Erdoğan University	54	55
TOBB University	24	36	Bursa Uludağ University	55	41
Erzincan Binali Yıldırım	25	46	Van Yüzüncü Yil University	56	59
Tokat Gaziosmanpaşa University	26	37	Yeditepe University	57	60
Bezmiâlem Vakif University	27	25	Kocaeli University	58	53
Dumlupinar University	28	45	Dicle University	59	44
Bozok University	29	26	Uşak University	60	58
Istanbul Medipol University	30	32	Başkent University	61	39
Gazi University	31	30			

The outcomes derived from this analysis are presented as follows:

i. According to the 2023 THE report, the top three universities in Türkiye are Çankaya University, Koç University, and Sabancı University. However, in the context of this research, the three universities ranking highest are Çankaya University, Fırat University, and Bahçeşehir University.

ii. When comparing the rankings between THE and the research findings, several universities experienced a decline in their rankings. These universities include Koç University, Sabancı University, Middle East Technical University, Hacettepe University, Istanbul Technical University, Bilkent University, Boğaziçi University, Istanbul University, Necmettin Erbakan University, Yıldız Technical University, Acıbadem University, Akdeniz University, Ankara University, Bezmiâlem Vakif University, Bozok University, Dokuz Eylül University, Ege University, Erciyes University, Gazi University, Gebze Technical University, Marmara University, Aksaray University, Başkent University, Bursa Uludağ University, Cukurova

University, Dicle University, Eskişehir Osmangazi University, Izmir Institute of Technology, Kocaeli University, and Uşak University. These universities collectively represent a decrease in ranking among the top 30 universities.

iii. Upon comparison between THE ranking and the research findings, several universities demonstrated an improvement in their rankings. These universities include Bahçeşehir University, Duzce University, Firat University, Istanbul Medeniyet University, Ozyegin University, Atılım University, Istanbul University-Cerrahpaşa, Sakarya University, Anadolu University, Atatürk University, Istanbul Medipol University, Karabük University, Selçuk University, TOBB University of Economics and Technology, Tokat Gaziosmanpaşa University, Manisa Celal Bayar University, Dumlupinar University, Erzincan Binali Yıldırım University, Gaziantep University, Inönü University, Karadeniz Technical University, Ondokuz Mayis University, Recep Tayyip Erdoğan University, Sivas Cumhuriyet University, Süleyman Demirel University, Van Yüzüncü Yil University, Yeditepe University, and Zonguldak Bülent Ecevit University. Collectively, these universities experienced an increase in ranking among the top 28 universities.

iv. Upon comparing the rankings between THE and the research findings, it was noted that Cankaya University, Bolu Abant Izzet Baysal University, and Kirikkale University maintained the same ranking in both assessments.

v. The universities that experienced the most significant drops in their rankings were Acıbadem University, which moved from the 20^{th} position to the 45^{th} place, Başkent University, which fell from the 39th to the 61^{st} place, and Ege University, which declined from the 28^{th} to the 44^{th} position.

vi. The universities that experienced the most significant improvements in their rankings were Zonguldak Bülent Ecevit University, which rose from the 61^{st} to the 39^{th} position, Erzincan Binali Yıldırım University, which climbed from the 46^{th} to the 25^{th} place, and Süleyman Demirel University, which ascended from the 57^{th} to the 38^{th} position.

5. Conclusion

In this study, a hybrid method of MEREC-WEDMA was proposed and applied to determine the success rankings of Turkish universities. THE reports regularly rank universities based on their performance, and these rankings are based on predefined criteria. However, in this research, a newly proposed MEREC-WEDMA hybrid method was analyzed based on the success performance criteria of Turkish universities in 2023. The results of this analysis indicate changes in the rankings of Turkish universities as reported in THE reports.

Primarily, these changes stem from the differences in the weights of criteria compared to those accepted in THE reports. This directly impacts the creation of rankings for universities in Türkiye. Particularly noteworthy is that, despite changes in the importance levels of criteria, Çankaya University was identified as the best university. Furthermore, examinations conducted in the research show changes in rankings across a significant portion of universities.

These striking results play a crucial role in evaluating the positions of Turkish universities in global rankings and in differentiating universities within Türkiye. Ultimately, this study provides a new methodological approach for ranking universities in Türkiye, offering in-depth insights into university success rankings.

Based on the findings of this research, which focused on the 2023 Turkish university rankings, several suggestions have been developed for universities, researchers, and THE institution. The suggestions for universities are outlined as follows:

i. Given the importance of the citation criterion in the 2023 Turkish university rankings, universities should prioritize increasing their citation averages globally. This can be achieved through research endeavors focused on high-quality and globally relevant topics.
ii. Dumlupinar University, Uşak University, and Aksaray University exhibit the lowest success in the teaching criteria. It is recommended that these universities implement strategies aimed at improving their teaching criterion performance.
iii. Manisa Celal Bayar University, Tokat Gaziosmanpaşa University, and Zonguldak Bülent Ecevit University rank lowest in the research criteria. These universities are advised to adopt strategies to enhance their research criterion performance.
iv. For the citation criterion, Başkent University, Van Yüzüncü Yil University, and Uşak University show the lowest success. These universities should implement strategies to bolster their citations criterion performance.
v. The industry income criteria indicate the lowest success for Başkent University, Inönü University, Kirikkale University, Gaziantep University, Manisa Celal Bayar University, and Erzincan Binali Yıldırım University. These universities are recommended to devise strategies to enhance their industry income criterion performance.
vi. Kirikkale University, Inönü University, and Dicle University exhibit the lowest success in the international outlook criteria. These universities are encouraged to implement strategies aimed at developing their international outlook criterion performance.
vii. Universities in Türkiye that are not currently included in THE reports are advised to actively pursue inclusion in world rankings and share their university data to enhance visibility and participation in global assessments.

The suggestions for researchers are outlined as follows:

i. Researchers can broaden the scope of their analysis by utilizing data and research criteria from various reports that present university rankings, not limited to THE reports as done in this research.
ii. Researchers can explore the variability of Turkish university rankings by employing different criteria weighting and ranking methods using the same data set. Comparing these results with the outcomes of this research can provide valuable insights.
iii. Researchers can conduct longitudinal studies by analyzing THE report data from previous years to track changes in the rankings of Turkish universities over time.

The proposal for THE organization is presented as follows: In the process of determining university rankings globally, it is suggested that THE organization adopt a methodology where criteria weights are derived directly from the collected data, rather than using predetermined criterion weights. This approach can lead to more dynamic and data-driven university rankings.

There are also several key limitations in this study:

i. The research relied solely on data and criteria from THE reports. Variations in data and criteria across different ranking reports could potentially yield different results.
ii. The study only ranked sixty-one universities due to data limitations. This restricted sample size may not fully represent the entire spectrum of universities in the region.
iii. The rankings were specifically conducted for the year 2023. Therefore, the study does not encompass rankings from other years, limiting the longitudinal analysis of university performance.
iv. The scope of the research was confined to Turkish universities, excluding universities from other regions or countries.

In conclusion, this study presents the 2023 performance ranking of sixty-one Turkish universities. While it provides valuable insights, it is important to acknowledge these limitations, particularly regarding data sources, sample size, temporal scope, and regional focus. These limitations should be considered when interpreting the results, and future research could address these aspects to provide a more comprehensive understanding of university rankings.

Author Contributions

Conceptualization, K.K., G.C.Y., E.G.K. and S.E.; methodology, K.K., G.C.Y., E.G.K. and S.E.; software, K.K., G.C.Y., E.G.K. and S.E.; validation, K.K., G.C.Y., E.G.K. and S.E.; formal analysis, K.K., G.C.Y., E.G.K. and S.E.; investigation, K.K., G.C.Y., E.G.K. and S.E.; resources, K.K., G.C.Y., E.G.K. and S.E.; data curation, K.K., G.C.Y., E.G.K. and S.E.; writing—original draft preparation, K.K., G.C.Y., E.G.K. and S.E.; writing—review and editing, K.K., G.C.Y., E.G.K. and S.E.; visualization, K.K., G.C.Y., E.G.K. and S.E.; supervision, K.K., G.C.Y., E.G.K. and S.E.; project administration, K.K., G.C.Y., E.G.K. and S.E.; All authors have read and agreed to the published version of the manuscript.

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Data will be made available on request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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