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New Approach Single Valued Neutrosophic Sets for Teaching Quality Challenges Evaluation in College Public English Broad Impacts

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Abstract

Previous research on teaching quality challenges in college public English has relied on methods that accept vague or fuzzy inputs. Single-valued neutrosophic Sets (SVNSs) are used to handle uncertain or unclear expert assessments by allowing both precise and imprecise data to be analyzed together. This approach ensures that valuable information is not lost during the evaluation process. To improve decision-making in multi-criteria decision-making (MCDM) problems, this study introduces a new integrated framework that combines the EDAS method with the MEREC method for criteria weight computation under the SVNS environment. The MEREC method is applied to determine the importance of each criterion, while the EDAS method ranks the alternatives. A case study on evaluating teaching quality challenges in college public English is conducted to demonstrate the effectiveness of the proposed framework. In this study, three experts evaluated 11 criteria and 7 alternatives. Sensitivity analysis was also performed to test the stability of the rankings under different criteria weight variations. The results show that the ranking of alternatives remains stable, confirming the reliability of the proposed approach.

Keywords: Single Valued Neutrosophic Sets; MEREC; EDAS Approach; Teaching Quality challenges in College Public English; Uncertainty.

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1. Introduction

The two most important elements in researchers' typical procedural steps for effective and efficient ranking alternatives are screening and ranking. Multi-criteria decision-making (MCDM) techniques are frequently used to systematically assess complex and interdependent situations with numerous actors, criteria, and conflicting objectives and are used to screen alternatives with superior qualities[1], [2]. In the framework of ranking the alternatives incorporating quantitative and qualitative criteria employing clear, basic inputs, previous researchers have thoroughly examined the importance and application of the MCDM approaches[3], [4].

Experts encounter issues when decision-makers judgments must be relied upon when inputs are not clearly defined. Depending on the decision-makers' perspectives, the complexity of the situation, and their differing levels of knowledge, the decisions may produce inaccurate or ambiguous information[5], [6]. In these situations, theories that handle uncertainties during the decision-making process include fuzzy sets (FSs), intuitionistic fuzzy sets (IFSs), and neutrosophic sets (NSs). Single-valued neutrosophic sets (SVNSs), a subset of NS created by Wang et al. and based on the basic idea of combining several inputs from several decision-makers into a single value, are used in this work[7], [7].

Since SVNSs also address ambiguities or inconsistencies, they have gained a great deal of relevance for solving problems in real-time. Real-time problem-solving with SVNSs has produced practical and helpful solutions for a variety of applications[8], [9].

Objective, subjective, or a combination of both methods are used to evaluate the relative importance of criteria for a particular application. The objective weighting techniques most frequently employed in real-time applications are entropy and CRITIC[10], [11]. A criterion is given more weight when its removal has a substantial impact on the overall performance, according to MEREC, a novel objective weighing method proposed by Keshavarz-Ghorabaee et al. that evaluates the criteria weighting from the exclusion perspective. Therefore, to derive criteria weights, MEREC is integrated into an MCDM issue for the first time under the SVNS environment[12], [13].

This study provides a novel integrated framework that combines a method based on the removal impacts of criteria (MEREC), measurement alternatives, and EDAS in the context of SVNSs. This builds on previous work.

The study's main aims and objectives are as follows:

[1] To offer a novel framework that examines both accurate and imprecise or undecided input parameters at the same time, offering a more practical method of addressing a multi-criteria problem.

[2] To use a unique integrated SVN-MEREC-EDAS approach compute the criteria weights and rank the alternatives.

[3] To employ MEREC, a novel criterion-weighing technique in SVNSs that evaluates the impact of removing criteria on alternative performances.

[4] The sensitivity analysis is conducted to show the stability of the rank of alternatives under different criteria weights.

The following describes the scope of this work. The initial definitions and mathematical procedures for solving SVNSs are given in Section 2, and Section 3 then presents the suggested methodology. A sensitivity study of the proposed method's application to compute the criteria weights and rank the alternatives is provided in Section 4. Lastly, Section 5 concludes the research project.

2. Preliminaries

This section shows the operations of the single valued neutrosophic sets (SVNSs) such as[14], [15], [16], [17]:

Definition 1.

Neutrosophic sets can be defined as:

$$N = \{(T_N(q_i), I_N(q_i), F_N(q_i))|q_i \in Q\} \quad (1)$$

Where Q refers to the universal set with q_i elements and three functions of truth, indeterminacy, and falsity of $T_N(q_i), I_N(q_i), andF_N(q_i)$

$$-0 \leq T_N(q_i) + I_N(q_i) + F_N(q_i) \leq 3+ \quad (2)$$

Definition 2.

The sum of the membership functions of SVNS between 0 and 3 such as:

$$0 \leq t_N(q_i) + i_N(q_i) + f_N(q_i) \leq 3 \quad (3)$$

Definition 3.

Let two single valued neutrosophic numbers (SVNNs) such as:

$a_1 = t_{a_1}(q), i_{a_1}(q), f_{a_1}(q)$ and $a_2 = t_{a_2}(q), i_{a_3}(q), f_{a_4}(q)$

$$a_1^c = \left(f_{a_1}(q), 1 - i_{a_1}(q), t_{a_1}(q)\right)$$

$$a_1 \cup a_2 = \begin{pmatrix} \max\{t_{a_1}(q), t_{a_2}(q)\}, \\ \min\{i_{a_1}(q), i_{a_2}(q)\}, \\ \min\{f_{a_1}(q), f_{a_2}(q)\} \end{pmatrix} \quad (4)$$

$$a_1 \cap a_2 = \begin{pmatrix} \min\{t_{a_1}(q), t_{a_2}(q)\}, \\ \max\{i_{a_1}(q), i_{a_2}(q)\}, \\ \max\{f_{a_1}(q), f_{a_2}(q)\} \end{pmatrix} \quad (5)$$

$$a_1 + a_2 = \begin{pmatrix} t_{a_1}(q) + t_{a_2}(q) - t_{a_1}(q)t_{a_2}(q), \\ i_{a_1}(q)i_{a_2}(q), \\ f_{a_1}(q)f_{a_2}(q) \end{pmatrix} \quad (6)$$

$$a_1 a_2 = \begin{pmatrix} t_{a_1}(q)t_{a_2}(q), \\ i_{a_1}(q) + i_{a_2}(q) - i_{a_1}(q)i_{a_2}(q), \\ f_{a_1}(q) + f_{a_2}(q) - f_{a_1}(q)f_{a_2}(q) \end{pmatrix} \quad (7)$$

$$ha_1 = \begin{pmatrix} 1-\left(1-t_{a_1}(q)\right)^h, \\ \left(i_{a_1}(q)\right)^h, \\ \left(f_{a_1}(q)\right)^h \end{pmatrix} \quad (8)$$

$$a_1^h = \begin{pmatrix} \left(t_{a_1}(q)\right)^h, \\ 1-\left(1-i_{a_1}(q)\right)^h, \\ 1-\left(1-f_{a_1}(q)\right)^h \end{pmatrix} \quad (9)$$

Definition 4.

The score function of the SVNSs is obtained by:

$$s(a_1) = \frac{2+t_{a_1}(q)-i_{a_1}(q)-f_{a_1}(q)}{3} \quad (10)$$

2.1 Research Gap

Despite extensive research on evaluating teaching quality in College Public English, many existing methods rely on traditional decision-making approaches that struggle with handling uncertainty and ambiguity in expert assessments. Most previous studies have used fuzzy logic, intuitionistic fuzzy sets, or conventional multi-criteria decision-making (MCDM) techniques, which, while effective in structured decision environments, often fail to capture the complexity of human judgment in uncertain conditions. These methods either oversimplify expert opinions or lack the flexibility to integrate both qualitative and quantitative data seamlessly.

This research fills this gap by introducing a novel framework that integrates Single Valued Neutrosophic Sets (SVNSs) with the MEREC and EDAS methods. The strength of SVNSs lies in their ability to preserve uncertainty without discarding valuable information, allowing for a more precise and adaptable evaluation process. The combination of MEREC for criteria weighing and EDAS for ranking alternatives provides a structured yet flexible solution that ensures reliable decision-making. This study offers a new perspective on handling imprecise and uncertain educational evaluations while enhancing the accuracy of ranking alternatives in multi-criteria decision-making problems.

3. Proposed method

A novel and comprehensive framework is introduced that integrates the MEREC and EDAS methods within the context of SVNSs to systematically evaluate the challenges affecting teaching quality in College Public English. In this framework, the MEREC method is meticulously employed to compute the weights of the evaluation criteria, ensuring that each factor is objectively assessed for its relative importance. Simultaneously, the EDAS method is utilized to rank the alternatives, thereby establishing a clear hierarchy of potential solutions based on their overall performance. The integration of these two methods under the SVNSs paradigm effectively addresses the inherent uncertainties and ambiguities of the evaluation process, resulting in a robust and reliable analytical approach. The following sections detail the organized steps of the proposed methodology:

Step 1. – Construct the combined Crisp-Decision Matrix (C-DM) and SVN-Decision Matrix (SVN-DM)

The decision matrix is built based on a set of criteria such as $C_1, \dots, C_n$ and alternatives $A_1, \dots, A_m$. Then we invited a set of experts and decision makers to evaluate the criteria and alternatives. Then we used the SVNNs to evaluate the criteria and alternatives. Then we applied the score function to obtain crisp values. Then we combine the decision matrices into a single matrix.

Step 2. – Compute the criteria weights by the MEREC method

We start with the decision matrix. Then we normalize the decision matrix such as:

$$\left(N_{ij}\right)_{m\times n} = \begin{cases} \dfrac{\min x_{ij}}{x_{ij}} \; for\ positive\ criteria \\ \dfrac{x_{ij}}{\max x_{ij}} \; for\ negative\ criteria \end{cases} \tag{11}$$

Compute the overall performance

The MEREC method uses the non-linear function to compute the overall performance values of each alternative.

$$S_i = \ln\left(1 + \left(\frac{1}{m}\sum_j \left|\ln\left(N_{ij}\right)\right|\right)\right) \tag{12}$$

Assess the performance based on removing criteria

$$S_{ij}^{*} = \ln\left(1 + \left(\frac{1}{m}\sum_{k,k\neq j} \left|\ln(N_{ik})\right|\right)\right) \tag{13}$$

Compute the absolute deviations for criteria.

$$Q_j = \sum_i \left|S_{ij}^{*} - S_i\right| \tag{14}$$

Compute the final weights.

$$w_j = \frac{Q_j}{\sum_j Q_j} \tag{15}$$

Step 3. – Rank the alternatives using the EDAS method[18], [19] This step ranks the alternatives using the EDAS method under the SVNSs.

Compute the average solution

$$V_j = \frac{\sum_{i=1}^{m} x_{ij}}{m} \tag{16}$$

Compute the positive and negative distances from average solution

$$Y_{ij} = \frac{\max\left(0, \left(x_{ij} - V_j\right)\right)}{V_j} \tag{17}$$

$$Z_{ij} = \frac{\max\left(0, \left(V_j - x_{ij}\right)\right)}{V_j} \tag{18}$$

For negative criteria

$$Y_{ij} = \frac{\max\left(0, \left(V_j - x_{ij}\right)\right)}{V_j} \tag{19}$$

$$Z_{ij} = \frac{\max\left(0, \left(x_{ij} - V_j\right)\right)}{V_j} \tag{20}$$

Compute the weighted Y_{ij} and Z_{ij}

$$SY_i = \sum_{j=1}^{n} Y_{ij} w_j \tag{21}$$

$$SZ_i = \sum_{j=1}^{n} Z_{ij} w_j \tag{22}$$

Compute the weighted normalized Y_{ij} and Z_{ij}

$$NSY_i = \frac{SY_i}{\max(SY_i)} \tag{23}$$

$$NSZ_i = \frac{SZ_i}{\max(SZ_i)} \tag{24}$$

Compute the appraisal value

$$AS_i = 0.5 * (NSY_i + NSZ_i) \tag{25}$$

Rank the alternatives.

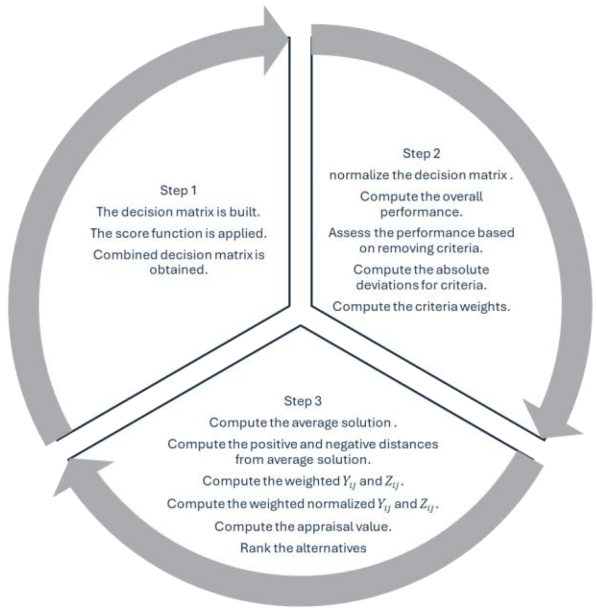

Fig 1. A Comprehensive Illustration of the Research Framework and Its Underlying Components

4. Case study: Challenge Areas in College Public English Teaching Quality Evaluation

This section presents the results of our proposed approach. Figure 1 shows the steps of the SVN-MEREC-EDAS method, which we use to calculate the criteria and rank the alternatives. We began by collecting the opinions of experts and decision-makers, which helped us gather the list of criteria and alternatives (see Figure 2).

Step 1, To start, we invited three experts who each have over 20 years of experience in this field to evaluate the criteria and alternatives. We used Single-Valued Neutrosophic Numbers (SVNNs) to assess them, as detailed in Table 1. Next, we applied a score function to reduce the three values from the SVNNs into a single value for each evaluation. Finally, we averaged these values to determine the criteria weights and to rank the alternatives. This step-by-step process allowed us to identify the importance of each criterion and determine the best alternative simply and reliably.

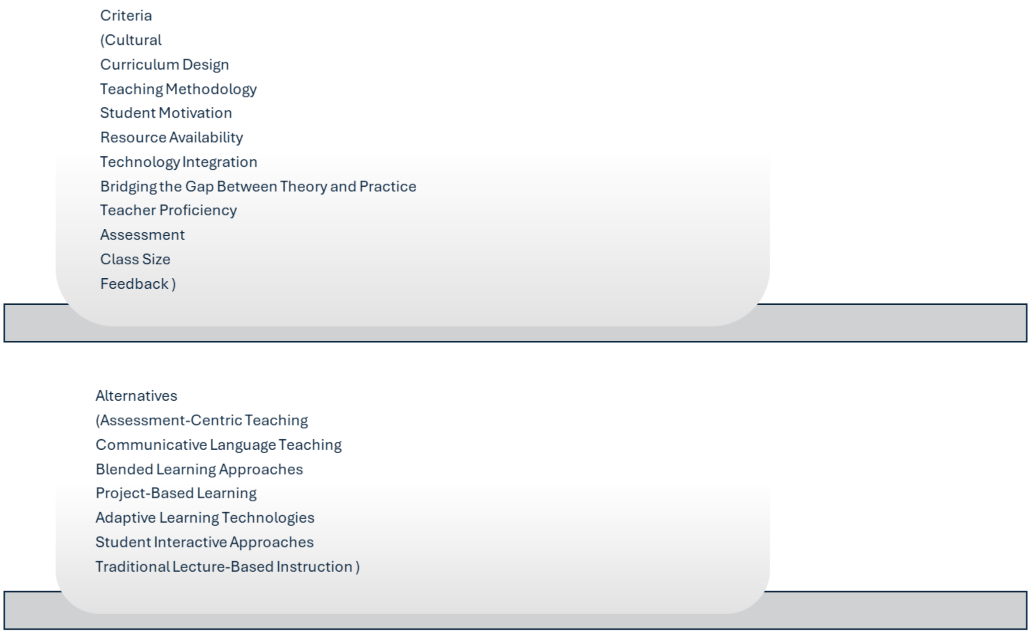

Fig. 2. A Comprehensive Illustration of the Complete Set of Criteria and the Spectrum of Alternative Options.

Table 1. A Detailed Overview of the SVNNs Matrix and Its Constituent Elements.

	A_1	A_2	A_3	A_4	A_5	A_6	A_7
C_1	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.2,0.7,0.8)	(0.3,0.6,0.7)	(0.4,0.5,0.6)	(0.5,0.5,0.5)	(0.6,0.4,0.5)
C_2	(0.8,0.2,0.3)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.8,0.2,0.3)	(0.7,0.3,0.4)
C_3	(0.7,0.3,0.4)	(0.4,0.5,0.6)	(0.9,0.1,0.2)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.7,0.3,0.4)	(0.8,0.2,0.3)
C_4	(0.6,0.4,0.5)	(0.5,0.5,0.5)	(0.8,0.2,0.3)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)
C_5	(0.5,0.5,0.5)	(0.6,0.4,0.5)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.3,0.6,0.7)	(0.5,0.5,0.5)	(0.4,0.5,0.6)
C_6	(0.4,0.5,0.6)	(0.7,0.3,0.4)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.2,0.7,0.8)	(0.4,0.5,0.6)	(0.5,0.5,0.5)
C_7	(0.3,0.6,0.7)	(0.8,0.2,0.3)	(0.5,0.5,0.5)	(0.2,0.7,0.8)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)
C_8	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.4,0.5,0.6)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.2,0.7,0.8)	(0.7,0.3,0.4)
C_9	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.3,0.6,0.7)	(0.4,0.5,0.6)	(0.7,0.3,0.4)	(0.9,0.1,0.2)	(0.8,0.2,0.3)
C_{10}	(0.8,0.2,0.3)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.8,0.2,0.3)	(0.9,0.1,0.2)
C_{11}	(0.7,0.3,0.4)	(0.4,0.5,0.6)	(0.9,0.1,0.2)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.7,0.3,0.4)	(0.2,0.7,0.8)
	A_1	A_2	A_3	A_4	A_5	A_6	A_7
C_1	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.5,0.5,0.5)	(0.6,0.4,0.5)
C_2	(0.8,0.2,0.3)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.4,0.5,0.6)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)
C_3	(0.7,0.3,0.4)	(0.4,0.5,0.6)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.8,0.2,0.3)
C_4	(0.6,0.4,0.5)	(0.4,0.5,0.6)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)
C_5	(0.5,0.5,0.5)	(0.4,0.5,0.6)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.5,0.5,0.5)	(0.4,0.5,0.6)
C_6	(0.4,0.5,0.6)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.2,0.7,0.8)	(0.4,0.5,0.6)	(0.5,0.5,0.5)
C_7	(0.3,0.6,0.7)	(0.4,0.5,0.6)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.3,0.6,0.7)	(0.6,0.4,0.5)
C_8	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.4,0.5,0.6)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.7,0.3,0.4)
C_9	(0.9,0.1,0.2)	(0.2,0.7,0.8)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)
C_{10}	(0.8,0.2,0.3)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)	(0.9,0.1,0.2)

C_{11}	(0.7,0.3,0.4)	(0.4,0.5,0.6)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.9,0.1,0.2)
	A_1	A_2	A_3	A_4	A_5	A_6	A_7
C_1	(0.4,0.5,0.6)	(0.7,0.3,0.4)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.4,0.5,0.6)	(0.5,0.5,0.5)	(0.6,0.4,0.5)
C_2	(0.8,0.2,0.3)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.8,0.2,0.3)	(0.7,0.3,0.4)
C_3	(0.7,0.3,0.4)	(0.4,0.5,0.6)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.8,0.2,0.3)
C_4	(0.6,0.4,0.5)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.9,0.1,0.2)
C_5	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.5,0.5,0.5)	(0.4,0.5,0.6)
C_6	(0.4,0.5,0.6)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.2,0.7,0.8)	(0.4,0.5,0.6)	(0.5,0.5,0.5)
C_7	(0.3,0.6,0.7)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.6,0.4,0.5)
C_8	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.8,0.2,0.3)	(0.2,0.7,0.8)	(0.7,0.3,0.4)
C_9	(0.9,0.1,0.2)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.9,0.1,0.2)	(0.8,0.2,0.3)
C_{10}	(0.8,0.2,0.3)	(0.3,0.6,0.7)	(0.4,0.5,0.6)	(0.7,0.3,0.4)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.9,0.1,0.2)
C_{11}	(0.7,0.3,0.4)	(0.2,0.7,0.8)	(0.1,0.8,0.9)	(0.6,0.4,0.5)	(0.9,0.1,0.2)	(0.7,0.3,0.4)	(0.2,0.7,0.8)

Step 2, In this step, we use the MEREC method to calculate the criteria weights for our study. First, we normalize the decision matrix using Eq. (11), as shown in Table 2.

Next, we apply Eq. (12) to determine the overall performance. After that, we evaluate the performance when each criterion is removed using Eq. (13) (refer to Table 3).

Then, we compute the absolute deviations for each criterion with Eq. (14).

Finally, we derive the criteria weights, which are illustrated in Fig. 3.

Table 2. Normalized Decision Matrix.

	A_1	A_2	A_3	A_4	A_5	A_6	A_7
C_1	0.777778	0.75	0.875	1	0.403846	0.466667	0.411765
C_2	0.173913	0.571429	1	0.324324	0.193548	0.226415	0.181818
C_3	0.25	0.384615	0.375	1	0.535714	0.208333	0.217391
C_4	0.490196	0.714286	0.675676	0.735294	1	0.416667	0.320513
C_5	0.756757	0.823529	0.756757	1	0.451613	0.622222	0.717949
C_6	0.538462	0.42	0.677419	0.617647	1	0.538462	0.466667
C_7	0.966667	0.674419	1	0.852941	0.58	0.725	0.568627
C_8	1	0.375	0.488372	0.488372	0.617647	0.525	0.35
C_9	0.305085	1	0.857143	0.529412	0.321429	0.305085	0.25
C_{10}	0.347826	0.888889	1	0.705882	0.585366	0.32	0.307692
C_{11}	0.466667	0.848485	0.756757	1	0.7	0.595745	0.7

Table 3. Performance Post Criteria Removal.

	A_1	A_2	A_3	A_4	A_5	A_6	A_7
C_1	0.535188	0.347456	0.254684	0.295066	0.442063	0.589475	0.646537
C_2	0.452093	0.329836	0.26405	0.215797	0.398138	0.552327	0.60683
C_3	0.472868	0.303617	0.193119	0.295066	0.458438	0.547962	0.615645
C_4	0.510307	0.344317	0.236299	0.274036	0.493685	0.583744	0.634534
C_5	0.533728	0.353444	0.2444	0.295066	0.448573	0.603875	0.672669

C6	0.515419	0.309505	0.236484	0.261912	0.493685	0.596664	0.65248
C7	0.546695	0.34061	0.26405	0.284243	0.462993	0.611444	0.661792
C8	0.548477	0.301916	0.212722	0.245346	0.466585	0.595396	0.638767
C9	0.484086	0.365764	0.25323	0.251069	0.428636	0.567812	0.622487
C10	0.491405	0.358308	0.26405	0.271211	0.46352	0.570268	0.632565
C11	0.507619	0.355348	0.2444	0.295066	0.473695	0.601712	0.671493

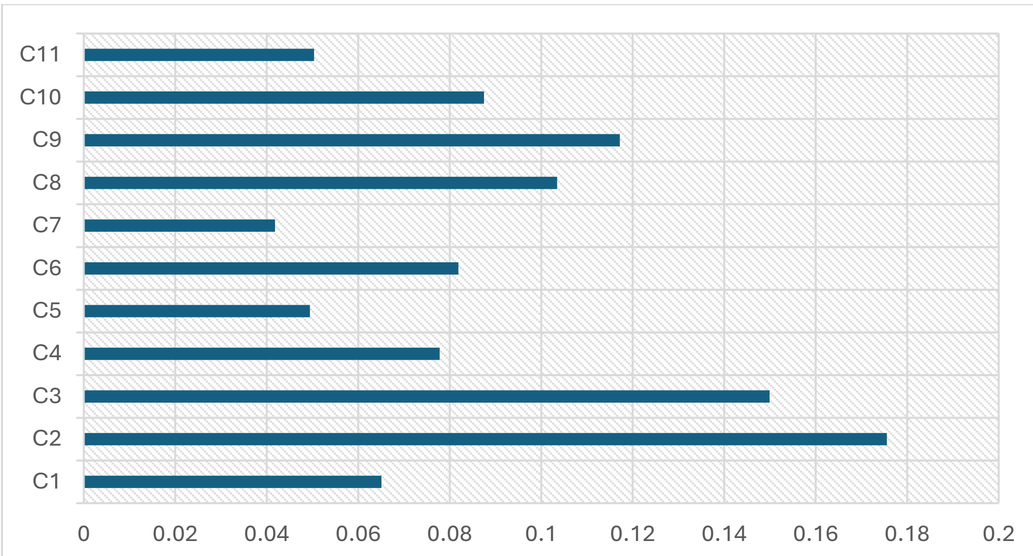

Fig.3. Criteria weight.

Step 3, In this step, we rank the alternatives using the EDAS method. First, we calculate the positive and negative distances of each alternative from the average solution using Equations (17) and (18), as shown in Tables 4 and 5. Since all criteria are positive, this calculation is straightforward. Next, we use Equations (21) and (22) to compute the weighted values. Y_{ij} and Z_{ij} , with the results displayed in Tables 6 and 7. After that, we obtain the weighted normalized values (see Table 8) and then calculate an overall appraisal value for each alternative. Finally, based on these appraisal values, we rank the alternatives, as illustrated in Figure 4.

Table 4. Positive Distances for Alternatives.

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
C1	0	0	0	0	0.467742	0.270161	0.439516
C2	0.509375	0	0	0	0.35625	0.159375	0.44375
C3	0.30031	0	0	0	0	0.560372	0.495356
C4	0.115625	0	0	0	0	0.3125	0.70625
C5	0	0	0	0	0.539007	0.117021	0
C6	0.054054	0.351351	0	0	0	0.054054	0.216216
C7	0	0.086643	0	0	0.263538	0.01083	0.288809
C8	0	0.319865	0.013468	0.013468	0	0	0.414141
C9	0.294671	0	0	0	0.22884	0.294671	0.579937
C10	0.387931	0	0	0	0	0.508621	0.568966

C11	0.473684	0	0	0	0	0.154386	0

Table 5. Negative Distances for Alternatives.

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
C1	0.237903	0.209677	0.322581	0.407258	0	0	0
C2	0	0.540625	0.7375	0.190625	0	0	0
C3	0	0.154799	0.133127	0.674923	0.393189	0	0
C4	0	0.234375	0.190625	0.25625	0.453125	0	0
C5	0.08156	0.156028	0.08156	0.304965	0	0	0.031915
C6	0	0	0.162162	0.081081	0.432432	0	0
C7	0.241877	0	0.267148	0.140794	0	0	0
C8	0.505051	0	0	0	0.198653	0.057239	0
C9	0	0.605016	0.539185	0.253918	0	0	0
C10	0	0.456897	0.517241	0.316092	0.175287	0	0
C11	0	0.189474	0.091228	0.312281	0.017544	0	0.017544

Table 6. The positive weighted matrix.

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
C1	0	0	0	0	0.030443	0.017584	0.028606
C2	0.089424	0	0	0	0.062542	0.027979	0.077903
C3	0.04502	0	0	0	0	0.084006	0.07426
C4	0.008996	0	0	0	0	0.024313	0.054948
C5	0	0	0	0	0.026645	0.005785	0
C6	0.004426	0.028771	0	0	0	0.004426	0.017705
C7	0	0.003624	0	0	0.011022	0.000453	0.012079
C8	0	0.033098	0.001394	0.001394	0	0	0.042853
C9	0.034526	0	0	0	0.026813	0.034526	0.067951
C10	0.033946	0	0	0	0	0.044508	0.049788
C11	0.02385	0	0	0	0	0.007773	0

Table 7. The negative weighted matrix.

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**
C1	0.015484	0.013647	0.020995	0.026507	0	0	0
C2	0	0.09491	0.129473	0.033465	0	0	0
C3	0	0.023206	0.019957	0.101179	0.058944	0	0
C4	0	0.018235	0.014831	0.019937	0.035254	0	0
C5	0.004032	0.007713	0.004032	0.015075	0	0	0.001578
C6	0	0	0.013279	0.006639	0.035411	0	0
C7	0.010116	0	0.011173	0.005889	0	0	0
C8	0.052259	0	0	0	0.020555	0.005923	0
C9	0	0.070889	0.063176	0.029751	0	0	0
C10	0	0.039981	0.045262	0.02766	0.015339	0	0
C11	0	0.00954	0.004593	0.015724	0.000883	0	0.000883

Table 8. The EDAS values.

	SY_i	SZ_i	NSY_i	NSZ_i	AS_i
A1	0.240189	0.081891	0.563702	0.250607	0.407155
A2	0.065493	0.278122	0.153705	0.85112	0.502412
A3	0.001394	0.326772	0.003271	1	0.501635
A4	0.001394	0.281826	0.003271	0.862456	0.432863
A5	0.157465	0.166386	0.369555	0.509182	0.439368
A6	0.251354	0.005923	0.589904	0.018125	0.304014
A7	0.426093	0.002461	1	0.007531	0.503766

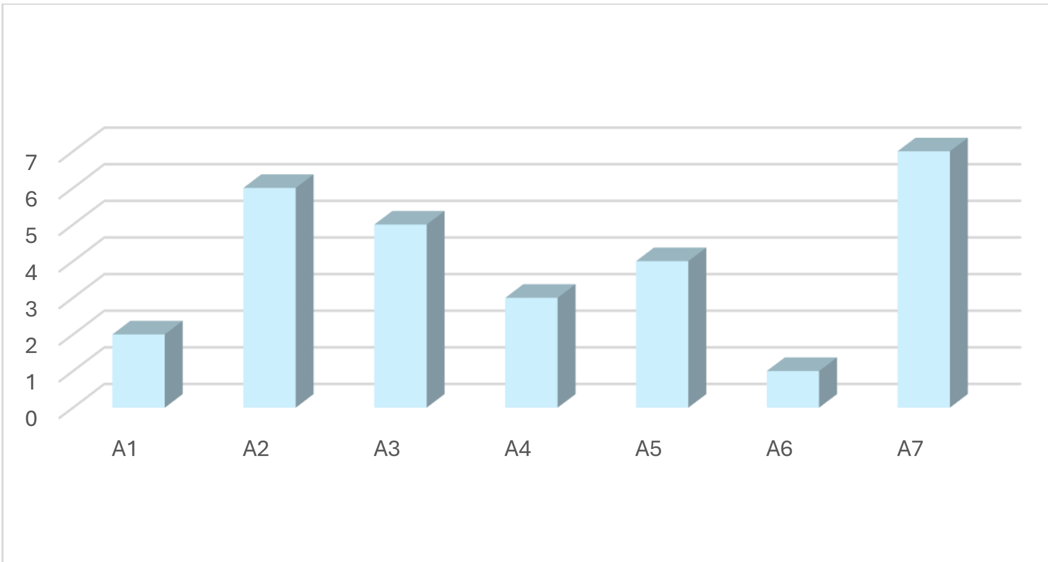

Fig. 4. The rank of alternatives.

We performed a sensitivity analysis to see how changes in criteria weights affect the ranking of the alternatives. In this study, we considered 12 different cases for assigning criteria weights (see Fig. 5). In the first case, all criteria were given equal weights. In the second case, we increased the weight of the first criterion by 12% while keeping the other criteria unchanged. In the third case, we increased the weight of the second criterion by 12%, and we continued this pattern for the remaining cases.

After adjusting the weights, we applied the EDAS method to calculate the appraisal values and rank the alternatives. In cases 2, 3, 4, 8, and 11, the analysis showed that alternative 7 was the best option and alternative 6 was the worst. In cases 1, 5, 6, 7, 9, 10, and 12, alternative 2 came out on top, with alternative 6 still being the worst option. This approach helps us understand how different weighting schemes can change the ranking, providing a clearer representation of the decision-making process.

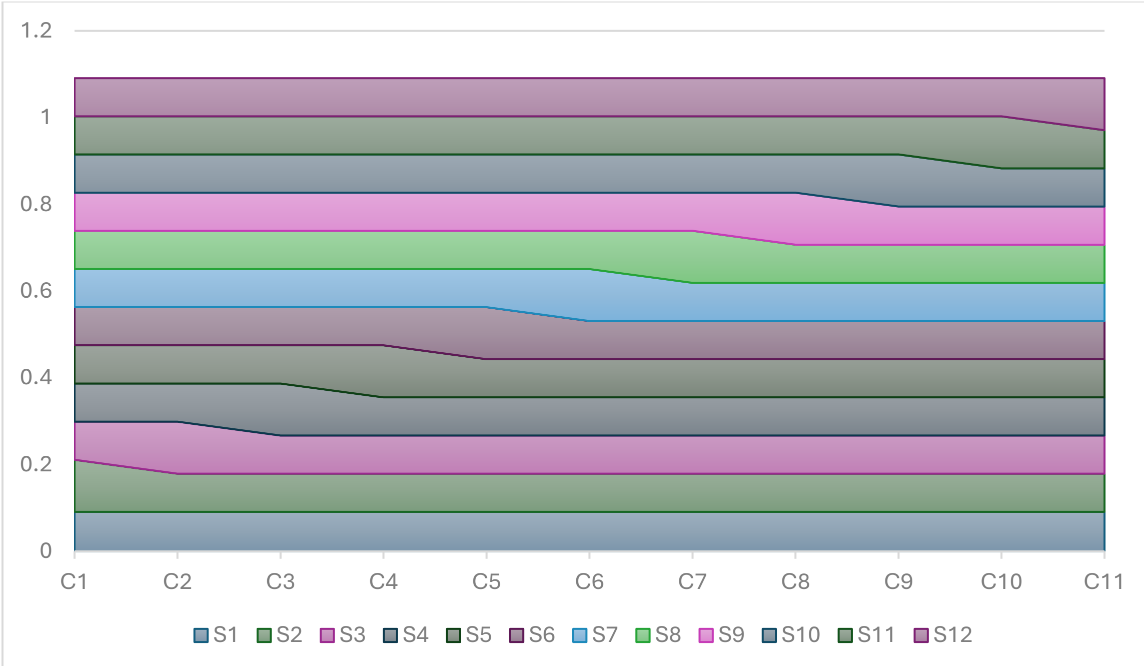

Fig 5. The different criteria weights.

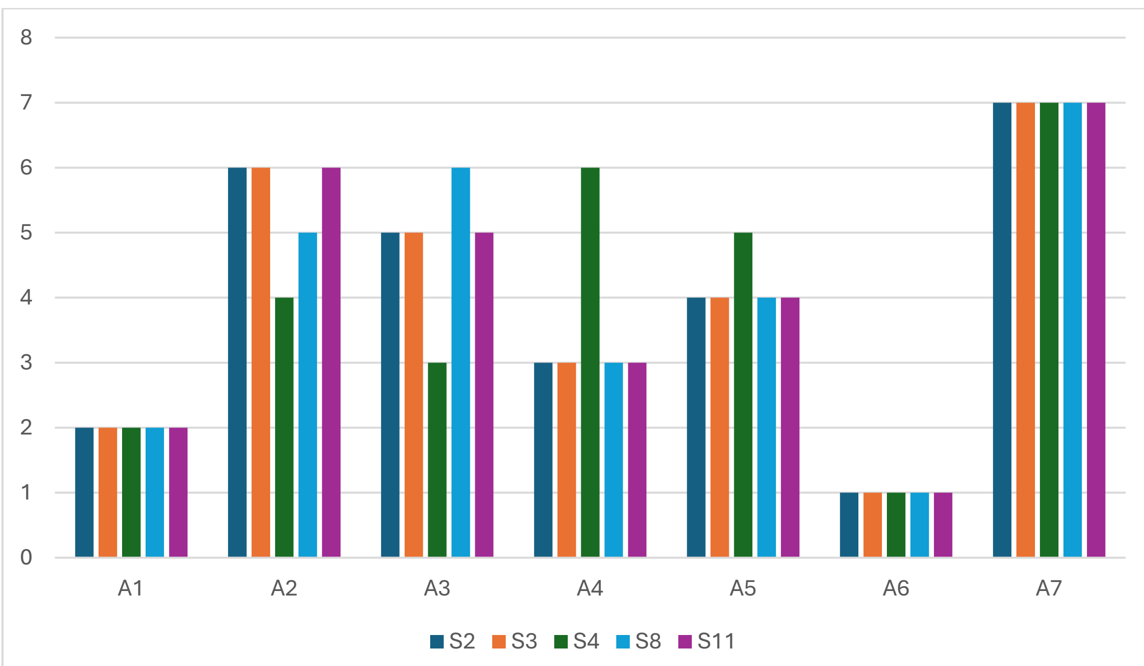

Fig. 6. Ranking of Cases 2, 3, 4, 8, and 11.

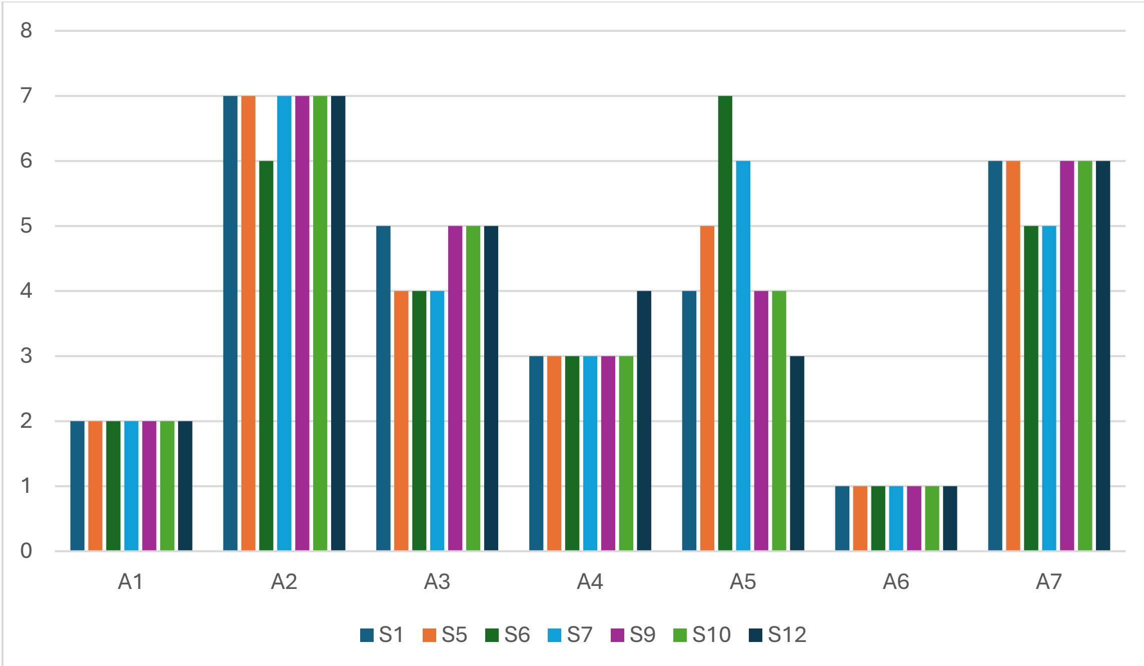

Fig. 7. The rank of cases 1,5,6,7,9,10 and 12.

4.1 Applications of the Proposed Framework

The proposed SVN-MEREC-EDAS framework is not limited to evaluating teaching quality; it has the potential to be applied in various fields that require decision-making under uncertainty.

[1] Beyond teaching quality evaluation, the framework can be used to assess faculty performance, curriculum effectiveness, and institutional ranking based on multiple uncertain and subjective criteria.

[2] Hospitals and medical institutions can use this approach to rank treatment plans, evaluate patient care quality, and optimize resource allocation based on expert assessments that involve uncertainty.

[3] Companies can apply this framework to select suppliers, manage risk in procurement decisions, and optimize logistics operations where uncertainty is a key factor.

[4] The method can assist in evaluating green energy solutions, sustainability initiatives, and environmental impact assessments, where conflicting criteria and uncertain data are common.

[5] Governments and policymakers can use this framework to rank urban development projects, allocate resources to public services, and assess policy impacts with uncertain expert input.

5. Conclusions

The purpose of this research study is to use a new framework to solve the issues surrounding the teaching of structures in college public English. After determining the objective criterion weights using MEREC in an SVN environment, the alternatives are ranked using EDAS. To create the decision matrix, SVNSs are used to combine the views of three different experts. These views are then de-neutrosophied to produce clear values. By applying the concept to a case study on college public English teaching, its applicability is illustrated. The purpose of the sensitivity analysis is to show how much better the framework is than other MCDM techniques. Additionally, MEREC's advantages are demonstrated by contrasting its outcomes with those of other objective weighting techniques. This study also aims to assist decision-makers in making appropriate and accurate choices. Furthermore, this approach addresses the uncertainties and indeterminacies in the data acquired while enabling group aggregation to integrate the viewpoints of several decision-makers to get the final findings.

5.1 Future Work

While this research establishes a strong methodological foundation for evaluating teaching quality using SVNSs, there are several opportunities for future development and enhancement. One promising direction is the integration of machine learning techniques to refine criteria weighing and ranking processes. By analyzing expert historical decisions and identifying patterns, machine learning can improve the accuracy and efficiency of the decision-making framework. Another area for improvement is the incorporation of real-time data implementation. Currently, the framework relies on expert assessments, but integrating real-time student feedback, automated teaching performance analytics, and live tracking of educational outcomes could make the evaluation process more dynamic and responsive to changing conditions.

To validate the framework's effectiveness, future studies should also focus on broader case studies, applying the method across different educational institutions, academic subjects, and even beyond the education sector. This would help assess its adaptability and refine the model for more general applications. Additionally, integrating hybrid decision-making models by combining SVN-MEREC-EDAS with other established techniques, such as TOPSIS, VIKOR, or AHP, could provide a comparative analysis, offering more robust validation and strengthening the reliability of ranking results. Another key area for future work is dynamic criteria weighting, where the importance of each criterion could adjust over time in response to external influences, such as changes in educational policies, institutional priorities, or evolving teaching methodologies. By developing an adaptive model, the framework would remain relevant and applicable in long-term educational decision-making.

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