# Neutrosophic Credibility-based Uncertainty for Evaluating Teaching Quality in College Physical Education: Standards, Criteria, and Practices

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**Abstract**: College physical education (PE) programs must be evaluated for teaching quality to fulfill the dual objectives of encouraging physical fitness and supporting the overall development of students. The main standards, requirements, and procedures for evaluating physical education instruction at the collegiate level are examined in this paper. Learning outcomes and skill development, student involvement and participation, instructional efficacy, and assessment and feedback methods were the four main criteria that were determined. Each criteria covers several aspects, including the capacity to promote cooperation, educate flexibility, be inclusive, and administer assessments fairly. Analysis shows that effective physical education incorporates social, cognitive, and motivational learning objectives in addition to physical training. We use the neutrosophic credibility number (NCN) to overcome uncertainty in decision making process. The NCN operator is used to combine the decision matrix. Institutions may better link physical education courses with their larger educational goals and encourage students to develop lifetime fitness and health habits by methodically evaluating the quality of their teachers.

**Keywords**: Neutrosophic Credibility-based Uncertainty; Evaluating Teaching Quality; College Physical Education.

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## 1. Introduction

By combining truth, indeterminacy, and falsity components, neutrophilic sets expand on the idea of typical fuzzy sets and, as a result, more nuancedly express uncertain data. In real-world decision-making scenarios, particularly in engineering applications, this tri-component structure offers a more effective method of managing ambiguity, inconsistency, and uncertainty. In engineering applications including civil engineering, inventory management, and decision-making, neutrophilic sets offer a great deal of variety[1].

By offering more accuracy in the assessment of contradictory and unclear criteria, neutrophilic sets have significantly aided decision-making procedures in the engineering domains. For instance, they are widely used in predictive maintenance, problem diagnostics, and the design of buildings. By adding granular uncertainty, neutrophilic hyper soft sets are utilized to improve site selection procedures in infrastructure projects. In this sense, as outlined in the parametric reduction techniques, neutrosophic sets can manage ambiguity and uncertainty throughout the decision-making processes to simplify the intricate choice situations[2].

### 1.1 Main Contributions

The main conclusions of this study are outlined below.

- NCNs provide a three-dimensional viewpoint and credibility ratings for truth, indeterminacy, and falsehood as a method of uncertainty modeling.
- A unique approach for multi-attribute aggregation of data with varying degrees of believability and uncertainty is presented using the NCN operator.
- It is shown that NCNs and the NCN operator can optimize the d Evaluating Teaching Quality in College Physical Education and sustainable decision-making.

### 1.2 Structure of This paper

The rest of this study is organized as follows: Section 2 shows the literature review of this study. Section 3 shows the definitions of this study. Section 4 shows the main results of the basic definitions of this study. Section 5 shows the steps of the proposed approach. Section 6 shows the case study and results of this study. Section 7 shows the conclusions of this study.

## 2. Literature Review

Chen et al. [3] proposed a fuzzy analytic hierarchy process (FAHP) approach to assess the quality of physical education (PE) in colleges and universities. It then employs this method to conduct a thorough investigation of the P.E. teaching quality evaluation system. They first outline the present PE teaching quality assessment method and examine its flaws. They then discuss the analytic hierarchy process (AHP) and propose a new FAHP based on the features of physical education instruction and by using the pertinent fuzzy mathematics knowledge. Lastly, the assessment method for the quality of PE instruction in colleges and universities is examined using the new FAHP.

This research suggests a new comprehensive assessment model of teaching quality based on the features of public physical education in colleges and universities to effectively assess the quality of this type of instruction. Huang et al. [4]presented the current state of research on assessing the quality of physical education in colleges and universities. The purpose and instructional features of public physical education at colleges and universities are next examined. Lastly, it suggests a fresh, all-inclusive approach for assessing the quality of instruction in public physical education at colleges and universities. According to the survey, the methodology put out in their study can conduct a thorough assessment of the caliber of instruction provided by public physical education programs at colleges and universities.

It is crucial to create a set of thorough and scientific evaluation standards for overall quality to produce top-notch talent. Effective assessment has the potential to enhance student quality overall and support and direct instruction. To develop a system of evaluation criteria for the quality education of physical education lessons, this paper uses a variety of techniques, such as questionnaire surveys, Delphi's method, mathematical statistics, and logical analysis. The system that is suggested comprises four primary indices, ten secondary indices, and twenty-four tertiary indices. The criteria were made more scientific by using the Analytic Hierarchy Process (AHP) to calculate the weight of each indicator. The above criteria were empirically examined using a college's PE major as an example[5].

## 3. Preliminaries

Some fundamental concepts related to this topic have been introduced in this part, including the idea of fuzzy credibility number (FCNs), which represent the reliability of evaluations, and neutrosophic sets, which are extensions of conventional fuzzy sets due to their true, false, and indeterminate components. Based on this, neutrosophic credibility numbers (NCNs) are suggested, which use credibility metrics and the idea of neutrosophic theory to provide a versatile approach to integrating uncertainty into decision-making[6].

**Definition 3.1**

A neutrosophic set is defined as follows:

$$K = \{(x, T_K(x), I_K(x), F_K(x)) | x \in X\}$$

**Definition 3.2**

Neutrosophic fuzzy credibility is defined as follows:

$$K_C = \{(x, T_K(V, C)(x), I_K(V, C)(x), F_K(V, C)(x)) | x \in X\}$$

$$T_K(V, C)(x): k \to [0,1]^2$$

$$I_K(V, C)(x): k \to [0,1]^2$$

$$F_K(V, C)(x): k \to [0,1]^2$$

$$0 \leq T_V(x) + I_V(x) + F_V(x) \leq 3$$

$$0 \leq T_C(x) + I_C(x) + F_C(x) \leq 3$$

The neutrosophic credibility number (NCN) is defined as:

$$K_C = (T_K(V, C)(x), I_K(V, C)(x), F_K(V, C)) = ((T_V, T_C), (I_V, I_C), (F_V, F_C))$$

**Definition 3.3**

If $K_{C_1}=\left(T_1(V,C),I_1(V,C),F_1(V,C)\right)=\left(\left(T_{V_1},T_{C_1}\right),\left(I_{V_1},I_{C_1}\right),\left(F_{V_1},F_{C_1}\right)\right)$ and

$K_{C_2}=\left(T_2(V,C),I_2(V,C),F_2(V,C)\right)=\left(\left(T_{V_2},T_{C_2}\right),\left(I_{V_2},I_{C_2}\right),\left(F_{V_2},F_{C_2}\right)\right)$ two NCNs

$$K_{C_1}\cup K_{C_2}=\begin{pmatrix}\left(T_{V_1}\vee T_{V_2},T_{C_1}\vee T_{C_2}\right),\\ \left(I_{V_1}\wedge I_{V_2},I_{C_1}\wedge I_{C_2}\right),\\ \left(F_{V_1}\wedge F_{V_2},F_{C_1}\wedge F_{C_2}\right)\end{pmatrix}$$

$$K_{C_1}\cap K_{C_2}=\begin{pmatrix}\left(T_{V_1}\wedge T_{V_2},T_{C_1}\wedge T_{C_2}\right),\\ \left(I_{V_1}\vee I_{V_2},I_{C_1}\vee I_{C_2}\right),\\ \left(F_{V_1}\vee F_{V_2},F_{C_1}\vee F_{C_2}\right)\end{pmatrix}$$

$$\left(K_{C_1}\right)^c=\begin{pmatrix}\left(F_{V_1},F_{C_1}\right),\\ \left(1-I_{V_1},1-I_{C_1}\right),\\ \left(T_{V_1},T_{C_1}\right)\end{pmatrix}$$

$$K_{C_1}\oplus K_{C_2}=\begin{pmatrix}\left(T_{V_1}+T_{V_2}-T_{V_1}T_{V_2},T_{C_1}+T_{C_2}-T_{C_1}T_{C_2}\right),\\ \left(I_{V_1}I_{V_2},I_{C_1}I_{C_2}\right),\\ \left(F_{V_1}F_{V_2},F_{C_1}F_{C_2}\right)\end{pmatrix}$$

$$K_{C_1}\otimes K_{C_2}=\begin{pmatrix}\left(T_{V_1}T_{V_2},T_{C_1}T_{C_2}\right),\\ \left(I_{V_1}+I_{V_2}-I_{V_1}I_{V_2},I_{C_1}+I_{C_2}-I_{C_1}I_{C_2}\right),\\ \left(F_{V_1}+F_{V_2}-F_{V_1}F_{V_2},F_{C_1}+F_{C_2}-F_{C_1}F_{C_2}\right)\end{pmatrix}$$

$$\aleph K_{C_1}=\begin{pmatrix}\left(1-\left(1-T_{V_1}\right)^{\aleph},\left(1-\left(1-T_{C_1}\right)^{\aleph}\right)\right),\\ \left(\left(I_{V_1}\right)^{\aleph},\left(\left(I_{C_1}\right)^{\aleph}\right)\right),\\ \left(\left(F_{V_1}\right)^{\aleph},\left(\left(F_{C_1}\right)^{\aleph}\right)\right)\end{pmatrix}$$

$$K_{C_1}^{\aleph}=\begin{pmatrix}\left(\left(T_{V_1}\right)^{\aleph},\left(\left(T_{C_1}\right)^{\aleph}\right)\right),\\ \left(1-\left(1-I_{V_1}\right)^{\aleph},\left(1-\left(1-I_{C_1}\right)^{\aleph}\right)\right),\\ \left(1-\left(1-F_{V_1}\right)^{\aleph},\left(1-\left(1-F_{C_1}\right)^{\aleph}\right)\right)\end{pmatrix}$$

**Definition 3.4**

The score function is defined as:

$$S\left(K_{C_1}\right)=\frac{\left(2+T_{V_i}T_{C_i}-I_{V_i}I_{C_i}-F_{V_i}F_{C_i}\right)}{3}$$

## 4. Main results

This section shows the NFCN weighted aggregation operations such as:

$$NFCN = \left( \begin{array}{c} \left( \left( 1 - \prod_{j=1}^{n} \left( 1 - T_{V_j}^{w_j} \right)^{q_j} \right)^{\frac{1}{w_j}}, \left( 1 - \prod_{j=1}^{n} \left( 1 - T_{C_j}^{w_j} \right)^{q_j} \right)^{\frac{1}{w_j}} \right), \\ \left( 1 - \left( 1 - \prod_{j=1}^{n} \left( 1 - I_{V_j}^{w_j} \right)^{q_j} \right)^{\frac{1}{w_j}}, 1 - \left( 1 - \prod_{j=1}^{n} \left( 1 - I_{C_j}^{w_j} \right)^{q_j} \right)^{\frac{1}{w_j}} \right), \\ \left( 1 - \left( 1 - \prod_{j=1}^{n} \left( 1 - T_{V_j}^{w_j} \right)^{q_j} \right)^{\frac{1}{w_j}}, 1 - \left( 1 - \prod_{j=1}^{n} \left( 1 - I_{C_j}^{w_j} \right)^{q_j} \right)^{\frac{1}{w_j}} \right) \end{array} \right)$$

Where $w_j > 0$ and $q_j \in [0,1]$

## 5. Algorithm for Evaluating Teaching Quality in College Physical Education

To address uncertainty and inconsistency in decision making processes, we now offer a decision-making algorithm in the form of NCNs and the NCN operator. It ranks options using a scoring function, incorporates expert preferences, and aggregates various assessments of alternatives using the NCN operator. The suggested method makes use of the NCN operator's and NCNs' advantages to enable trustworthy, fair, and useful decision-making in challenging situations.

- **Stage 1 (Data gathered from decision makers)**

We gather the data from experts and decision makers to create the decision matrix. Experts and decision makers use NCN to evaluate the criteria and alternatives. Every criterion and alternative are evaluated by different experts and decision makers. NCN shows the truth, indeterminacy, and falsity with credibility values to show the complexity of used data.

- **Stage 2 (Combine the NCN using the operator of NCN)**

We use the NCN operator to combine the opinions of experts and decision makers into a single matrix. We obtain the final decision matrix to compute the criteria weights and ranking the alternatives.

- **Stage 3 (Score function)**

This stage uses score function to convert the NCN to crisp values. The aim of this stage to reduce the complexity of the data in the decision matrix.

- **Stage 4 (Compute the criteria weights)**

The criteria weights are computed using the average method to show the importance of each criterion.

- **Stage 5 (Rank the alternatives)**

In this stage, we rank the alternatives based on the sum of each crisp values in each row. This stage aims to select the best one from different alternatives. Figure 1 shows the stages of this proposed methodology.

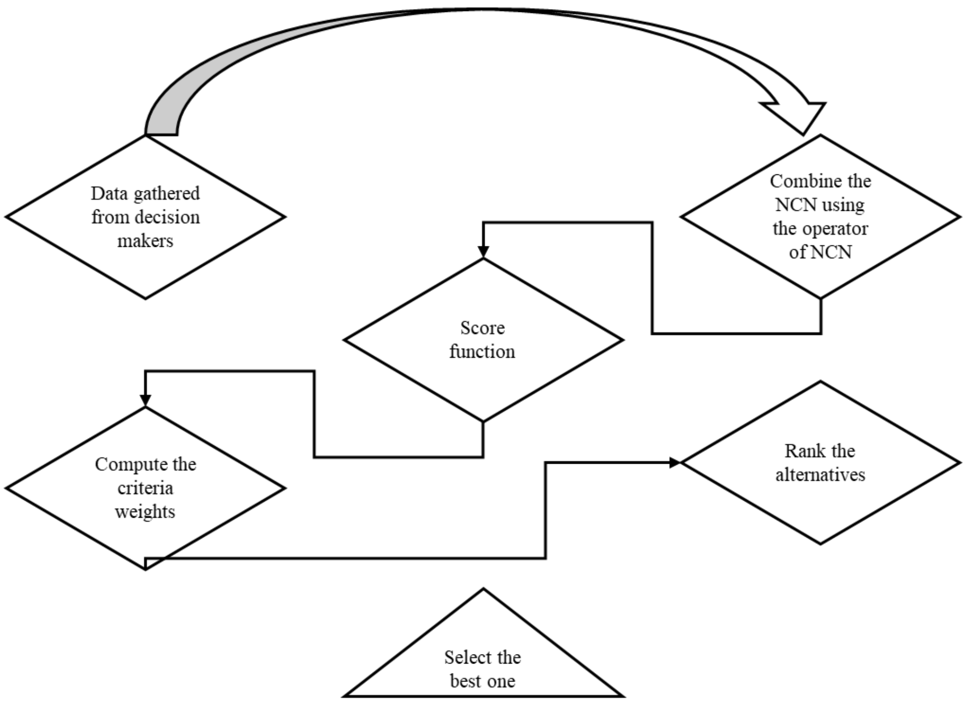


Figure 1. Visualization of proposed methodology.

## 6. Results of Proposed Approach

Evaluating Teaching Quality in College Physical Education dealing with ambiguity and conflicting data is a difficult task. This decision-making process is complicated by the unpredictability of Teaching Quality of the data gathered from various sources. Such issues can be methodically resolved by integrating indeterminacy, ambiguity, and data believability using NCNs and the NCN operator.

### 6.1 Case Study

As a fundamental aspect of education, school physical education is essential for fostering students' holistic growth as well as their inventiveness and practical skills. In addition to successfully regulating the implementation and reform of physical education instruction, the assessment of physical education teaching quality may also be utilized in the recruitment, training, and selection of physical education instructors. To raise the standard of instruction in schools and prepare athletes, scientific methods and systems for evaluating the quality of instruction are crucial. Some scholars have concentrated on assessing the quality of physical education instruction.

An essential component of the advancement of education is physical education. It seeks to generate more outstanding all-around skills for the nation and serves as a crucial pillar to encourage the rapid growth of numerous projects. The below displays the physical education teaching quality evaluation criterion system.

i. Instructional Effectiveness
ii. Student Engagement & Participation
iii. Learning Outcomes & Skill Development
iv. Evaluation & Feedback Mechanisms
I. Effective use of diverse teaching methods
II. Clear communication and demonstration of techniques
III. Adaptability to students' skill levels
IV. Encouraging active participation
V. Inclusive teaching for students of different fitness levels
VI. Building teamwork and collaboration through sports
VII. Improvement in physical fitness and endurance
VIII. Enhancement of motor skills and sports techniques
IX. Fair and transparent grading standards
X. Timely feedback and guidance for student improvement

Due to the inherent ambiguities and inconsistencies of the data provided by decision-makers, the evaluation of such disparate options, which correspond to the four important criteria, presented significant challenges. Disagreements, inadequate information, and varying degrees of data trustworthiness complicate this review process. As a result, engineers concluded that conventional approaches were unable to address this complexity in a methodical manner. However, they used the suggested technique, which combines NCNs and the NCN operator, to overcome these two issues. This approach meticulously integrates pertinent findings, employs a fair measure of credibility as the foundation for decision-making, and methodically investigates truth, indeterminacy, falsehood, and data credibility about each option.

**5.2 Numerical Example**

We now provide a numerical demonstration to show how to apply the suggested technique to address ambiguity and inconsistency in decision-making. These procedures describe how the provided framework uses NCNs and the NCNs operator to systematically and reliably resolve the uncertainty present in each scenario, ensuring outcomes that are both balanced and trustworthy.

- **Stage 1 (Data gathered from decision makers)**

In this stage the data is collected from different experts. Three experts are invited to create the decision matrix as shown in Tables 1-3.

Table 1. NCN values by E1

| | $\xi_1$ | $\xi_2$ | $\xi_3$ | $\xi_4$ |
|---|---|---|---|---|
| $\zeta_1$ | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) |
| $\zeta_2$ | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) |
| $\zeta_3$ | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) |
| $\zeta_4$ | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) |
| $\zeta_5$ | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) |
| $\zeta_6$ | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) |
| $\zeta_7$ | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) |
| $\zeta_8$ | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) |
| $\zeta_9$ | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) |
| $\zeta_{10}$ | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) |

Table 2. NCN values by E2

| | $\xi_1$ | $\xi_2$ | $\xi_3$ | $\xi_4$ |
|---|---|---|---|---|
| $\zeta_1$ | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) |
| $\zeta_2$ | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) |
| $\zeta_3$ | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) |
| $\zeta_4$ | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) |
| $\zeta_5$ | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) |
| $\zeta_6$ | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) |
| $\zeta_7$ | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) |
| $\zeta_8$ | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) |
| $\zeta_9$ | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) |
| $\zeta_{10}$ | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) |

Table 3. NCN values by E3

| | $\xi_1$ | $\xi_2$ | $\xi_3$ | $\xi_4$ |
|---|---|---|---|---|
| $\zeta_1$ | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) |
| $\zeta_2$ | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) |
| $\zeta_3$ | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) |
| $\zeta_4$ | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) |
| $\zeta_5$ | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) |
| $\zeta_6$ | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) |
| $\zeta_7$ | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) |
| $\zeta_8$ | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) |
| $\zeta_9$ | ((0.5,0.6),(0.8,0.3),(0.7,0.6)) | ((0.4,0.6),(0.7,0.5),(0.8,0.6)) | ((0.7,0.8),(0.5,0.7),(0.4,0.6)) | ((0.6,0.9),(0.4,0.7),(0.5,0.5)) |
| $\zeta_{10}$ | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.3,0.9),(0.7,0.5),(0.6,0.4)) | ((0.8,0.7),(0.3,0.9),(0.5,0.6)) | ((0.9,0.6),(0.5,0.8),(0.4,0.5)) |

Every table reflects the viewpoint of a single decision maker who has chosen how to evaluate options based on the specified criteria. In further phases, the assessments are aggregated using these tables as the basis.

- **Stage 2 (Combine the NCN using the operator of NCN)**

The NCN operator is applied to the three tables of NCN assessments of the decision makers that were supplied in the preceding step. To ensure that the truth, indeterminacy, and falsity components, as well as the corresponding credibility values, are consistently integrated, the information from each decision maker is aggregated independently using this aggregator operator.

It preserves the multifaceted character of NCNs while providing a comprehensive assessment for every decision maker. As a result, three additional tables of aggregated NCN values have been made. Each table shows the whole assessment from a single decision maker following the use of the NCNs operator. The information supplied by decision-makers was aggregated using the NCNs operator, and the results are shown in Tables 4, 5, and 6, accordingly.

Table 4. Combined values from Criterion 1.

| | $\xi_1$ |
|---|---|
| $\zeta_1$ | (0.394704792797074,0.320459823765333,0.922598992086664,0.694908457345052,0.964107452481993,0.878557185816379) |
| $\zeta_2$ | (0.238807149419677,0.267609015220765,0.863956606439743,0.715018856006836,0.89093421962461,0.853849579671415) |
| $\zeta_3$ | (0.0874838495649329,0.638581138847919,0.909061736509843,0.812113921242193,0.901570517848714,0.938115078549459) |
| $\zeta_4$ | (0.305091542654948,0.230556737468746,0.871572277850539,0.761192850580323,0.867084226860413,0.878557185816379) |
| $\zeta_5$ | (0.238807149419677,0.146150420328585,0.761192850580323,0.863956606439743,0.784376800276696,0.878557185816379) |
| $\zeta_6$ | (0.357832284322267,0.180029075330077,0.906347794958908,0.618722297220453,0.846429586091461,0.878557185816379) |
| $\zeta_7$ | (0.0774010079133364,0.146150420328585,0.590410329733905,0.986544256896044,0.747639618612704,0.853849579671415) |
| $\zeta_8$ | (0.394704792797074,0.320459823765333,0.922598992086664,0.694908457345052,0.964107452481993,0.878557185816379) |
| $\zeta_9$ | (0.202425380134502,0.357832284322267,0.88374397353437,0.715018856006836,0.871572277850539,0.878557185816379) |
| $\zeta_{10}$ | (0.161624023997793,0.52655486249525,0.923309669787378,0.671129165937257,0.901570517848714,0.918913119798161) |

Table 5. Combined values from Criterion 2.

| | $\xi_1$ |
|---|---|
| $\zeta_1$ | (0.146150420328585,0.638581138847919,0.964107452481993,0.747639618612704,0.922598992086664,0.922598992086664) |
| $\zeta_2$ | (0.0774010079133364,0.146150420328585,0.590410329733905,0.986544256896044,0.747639618612704,0.853849579671415) |
| $\zeta_3$ | (0.357832284322267,0.305091542654948,0.971412688867707,0.47344513750475,0.938115078549459,0.853849579671415) |
| $\zeta_4$ | (0.291342630828894,0.215623199723304,0.899564405036874,0.573715426041991,0.871572277850539,0.853849579671415) |
| $\zeta_5$ | (0.426284573958009,0.320459823765333,0.871572277850539,0.708657369171106,0.934779278279899,0.938115078549459) |
| $\zeta_6$ | (0.215623199723304,0.146150420328585,0.812113921242193,0.824896583615123,0.732390984779235,0.878557185816379) |
| $\zeta_7$ | (0.409589670266095,0.252360381387296,0.986544256896044,0.361418861152081,0.922598992086664,0.853849579671415) |
| $\zeta_8$ | (0.638581138847919,0.146150420328585,0.922598992086664,0.590410329733905,0.964107452481993,0.922598992086664) |
| $\zeta_9$ | (0.0358925475180069,0.146150420328585,0.747639618612704,0.922598992086664,0.590410329733905,0.853849579671415) |
| $\zeta_{10}$ | (0.0134557431039558,0.638581138847919,0.747639618612704,0.922598992086664,0.853849579671415,0.964107452481993) |

Table 6. Combined values from Criterion 3.

| | $\xi_1$ |
|---|---|
| $\zeta_1$ | (0.409589670266095,0.252360381387296,0.986544256896044,0.361418861152081,0.922598992086664,0.853849579671415) |
| $\zeta_2$ | (0.0134557431039558,0.638581138847919,0.747639618612704,0.922598992086664,0.853849579671415,0.964107452481993) |
| $\zeta_3$ | (0.638581138847919,0.146150420328585,0.922598992086664,0.590410329733905,0.964107452481993,0.922598992086664) |
| $\zeta_4$ | (0.180029075330077,0.570430723647717,0.951988473041907,0.747639618612704,0.938115078549459,0.901570517848714) |
| $\zeta_5$ | (0.291342630828894,0.215623199723304,0.899564405036874,0.573715426041991,0.871572277850539,0.853849579671415) |

| | |
|---|---|
| $\zeta_6$ | (0.426284573958009,0.320459823765333,0.871572277850539,0.708657369171106,0.934779278279899,0.938115078549459) |
| $\zeta_7$ | (0.305091542654948,0.230556737468746,0.871572277850539,0.761192850580323,0.867084226860413,0.878557185816379) |
| $\zeta_8$ | (0.238807149419677,0.146150420328585,0.761192850580323,0.863956606439743,0.784376800276696,0.878557185816379) |
| $\zeta_9$ | (0.394704792797074,0.320459823765333,0.922598992086664,0.694908457345052,0.964107452481993,0.878557185816379) |
| $\zeta_{10}$ | (0.247671541173019,0.394704792797074,0.936474414993166,0.532632775892625,0.901570517848714,0.897500359614321) |

- **Stage 3 (Score function)**

The unified aggregated NCNs are subjected to a scoring function to convert each alternative into distinct numerical scores.

**Stage 4 (Compute the criteria weights)**

The criteria weights are computed using the average method to show the importance of each criterion.

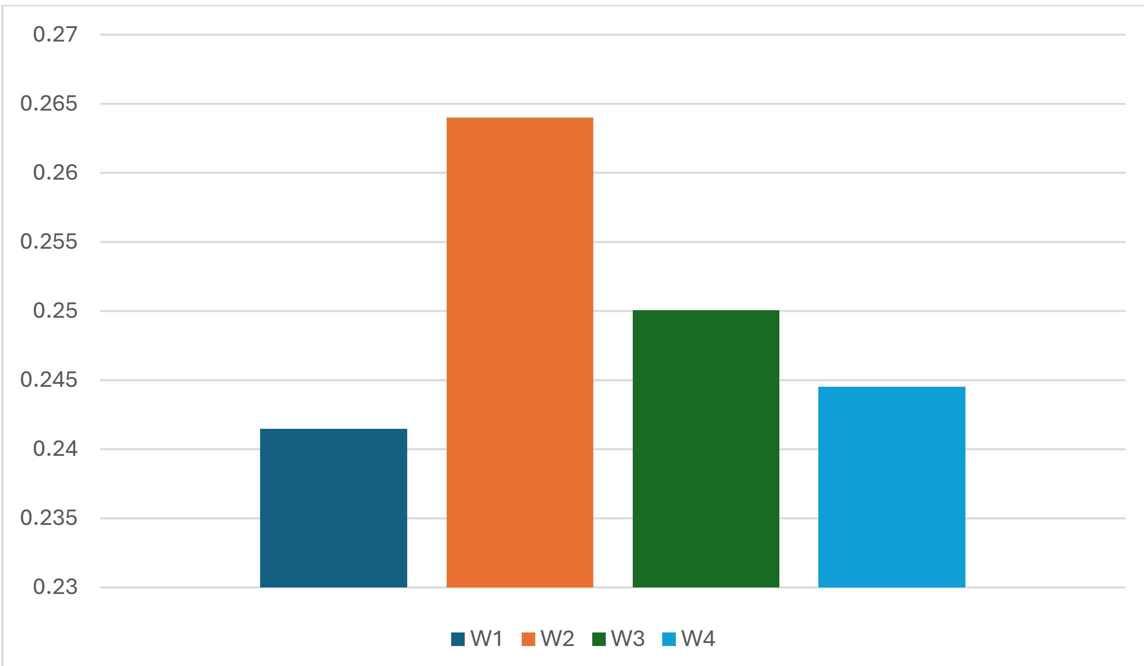


Figure 2. Weights of criteria.

- **Stage 5 (Rank the alternatives)**

A clear ranking of options is provided by the inclusion of a score function, which ensures that the multidimensional data included in NCNs is methodically condensed into a single number that is simple to comprehend and rate. Figure 3 shows the ranks.

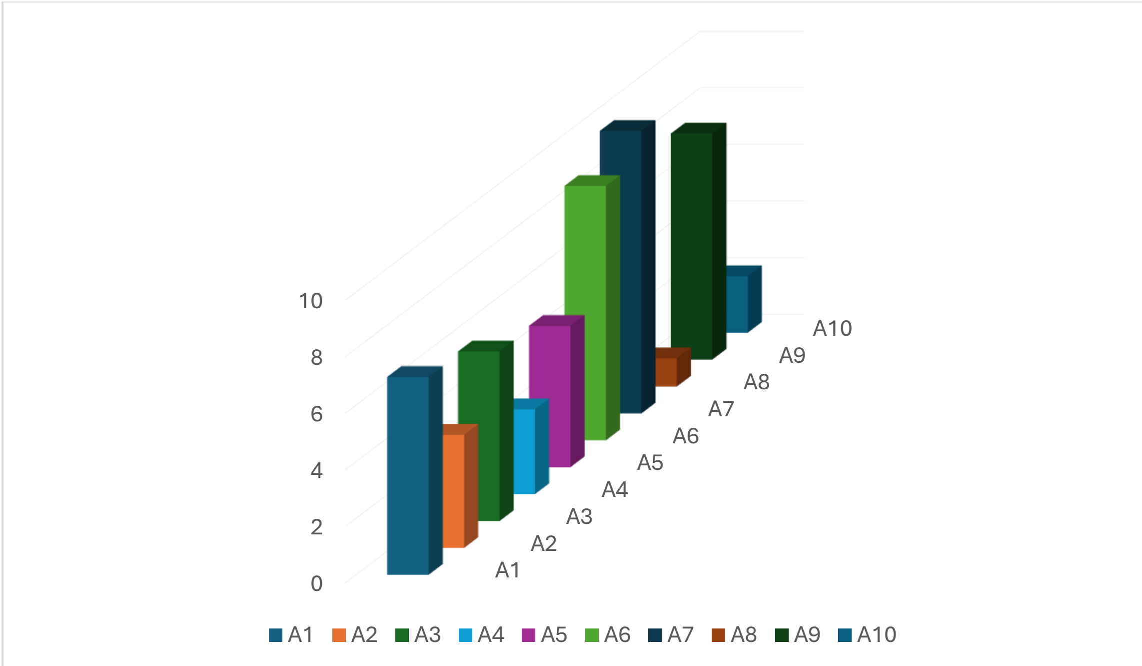


Figure 3. Ranks.

**6.3 Results Discussion**

Current approaches in the field of decision making find it difficult to deal with ambiguous and untrustworthy data in real-world scenarios when information differs from one source to another. The reliability of the observed data cannot be demonstrated by previous models that use fuzzy systems and neutrosophic sets. To fill in pertinent holes in current methods, we put up a unique idea for NCNs that combines conventional neutrosophic sets with credibility values. During the aggregation process, the created NCN operator factors the credibility levels of several sources while handling complicated uncertain input. To assist decision-makers in selecting alternatives based on trustworthy and dependable outcomes, we developed our structured decision-making approach on NCNs and NCN operators. We used our method evaluating teaching quality in college physical education to demonstrate its value.

To rate ten feasible options based on four features, our decision-making approach included four assessment criteria. While the NCN operator analyzed the data, we employed NCNs to collect both dependable and ambiguous expert input. The alternatives did well in every evaluation category, according to the evaluation method's unambiguous results, which put it at the top of the list. It is crucial to realize that while the NCNs-based MADM approach with the NCN operator offers a practical way to add credibility to the decision-making process, the computational complexity of the suggested approach increases as the size of the decision problem at hand increases.

Specifically, the number of choices, qualities, and decision-makers taken into consideration determines the computational effort. Several layered phases of neutrosophic numbers that are inherently endowed with credibility are involved in every action, from the production of NCNs to the multi-stage aggregation to the final scoring step. These calculations can easily become quite taxing in large-scale applications.

### 6.4 Managerial Implications

- Curriculum Development: To ensure a balance between hands-on instruction, theoretical knowledge, and student involvement, university officials should incorporate assessment data into curriculum development.
- Teacher Training: To assist educators in embracing cutting-edge, student-centered teaching strategies, regular professional development initiatives must be put in place.
- Inclusive Policies: Evaluation frameworks ought to have a strong emphasis on inclusion, supporting physical education programs that accommodate a range of student requirements, including those with different levels of fitness or physical restrictions.
- Feedback Systems: Organizations ought to set up open channels for feedback so instructors and students may take part in cycles of ongoing development.
- Resource Allocation: To improve the efficacy of teaching and learning, assessment results might direct the distribution of resources like athletic facilities, computer programs, and exercise gear.
- Monitoring Long-Term Outcomes: In addition to short-term performance results, universities should monitor the long-term effects of physical education programs on students' resilience, health, and collaboration.

## 7. Conclusions

For long-term educational growth, assessing the quality of college physical education instruction is crucial and multifaceted. The results indicate that effective physical education instruction should be evaluated based on students' motivation, engagement, and long-term development in addition to their learning of physical skills. Teaching tactics, inclusivity, student accomplishment, and open assessment procedures are all balanced in effective evaluation systems. An all-encompassing strategy like this helps create PE programs that are more impactful, egalitarian, and successful. In the end, improving the assessment of physical education instruction quality strengthens the program's contribution to student wellbeing, collaboration, and lifetime health awareness.

This study used the neutrosophic credibility number (NCN) to overcome uncertainty information. We used the NCN operator to combine different decision matrices. The score function is used to obtain crisp values. The criteria weights are computed using the average method and the alternatives are ranked.

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