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## Performance-Oriented Teaching Quality Evaluation in University Sports Training Using Neutrosophic Distance Measures

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### Abstract

Considering higher education changes and the increased desire for holistic student development, evaluating the quality of instruction in university sports training has taken on more significance. This study presents a methodology for evaluating the quality of instruction in sports training programs that is performance-oriented and student-centered. The six main components of quality evaluation were determined to include instructional design and planning, pedagogical innovation, student involvement, performance results, assessment and feedback methods, and resource utilization. We looked at eight different teaching options, from blended learning and flipped classrooms to peer-assisted learning and performance analytics tools. The framework places a strong emphasis on developing lifetime learning qualities, motivation, and teamwork in addition to technical and physical skill acquisition. This study uses the neutrosophic set to overcome vague data. The neutrosophic distance measure is used to obtain the final score of each option. The study offers a methodical foundation for enhancing the efficacy of instruction in sports training by matching assessment techniques with learning procedures and performance outcomes. According to the research, combining cutting-edge teaching strategies with performance evaluation can improve student learning and athletic results.

**Keywords:** Neutrosophic Distance Measure; Ranking Methodology; University Sports Training; Teaching Quality Evaluation.

## 1 | Introduction

The concept of a fuzzy set (FS), in which an element is represented by a membership degree with a value between 0 and 1, was first proposed by Zadeh. The FC views the non-membership degree as a supplement to the membership degree, which is the sole degree it contains. However, in practical issues, this isn't always the case. Additionally, several FS generalizations have been proposed and used for diverse objectives. By representing the degrees of membership and non-membership, Atanassov developed the idea of Intuitionistic Fuzzy Set (IFS), which is a refinement of FS. More focus has been placed on this set to address the ambiguity and uncertainty brought on by imperfect information.

Truth Membership (TM), Indeterminacy Membership (IM), and Falsity Membership (FM) functions are independent according to Smarandache's [1] Neutrosophic Set (NS) theory. In addition to being helpful for handling incomplete information, this set may also be used to handle inconsistent and uncertain information[2]. The concept of "Single-Valued Neutrosophic Set (SVNS)" was presented as a noteworthy



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development of FS theory, which is better suited to addressing scientific and technical issues, as a specific subset of NS theory. An object is represented in SVNS by degrees of TM, IM, and FM, each of which is independent and whose aggregate falls between 0 and 3 [3].

The key contributions of this study are organized as follows:

- The difference between SVNSs is described by a new SVNDM, which is also utilized to calculate the relative proximity coefficients of indicators.
- To demonstrate the superiority of the suggested SVNDM over the current ones, a few examples are examined.
- Based on the criterion weight-determination model, the SVNWA and SVNWG operators are presented.

A case study of Teaching Quality Evaluation of University Sports Training: A Student-Centered and Performance-Oriented Approach uses the suggested hybrid ranking system, demonstrating its usefulness and efficacy.

## 2 | Literature Review

University sports instruction is based on staff expertise, training methods, and student performance and competition results. A significant amount of information on training and teaching patterns is needed for the evaluation of teaching quality. Han et al. [4] suggested a Teaching Convolved Quality Assessment Model (TCQAM) as a reliable way to measure teaching quality. The suggested model considers several variables related to the teaching sessions, including training schedules, sessions, and time. A fuzzy decision system is used to assess the related parameters based on the requirements for sports training. Each of the elements is complicated by the potential factors for the highest teaching quality in this choice method. To conduct an improvement assessment, the fuzzy membership derivatives determine the least performance factor.

The need for social sports specialists is continuously growing against the backdrop of the national fitness obsession. Nonetheless, the author's research indicates that there aren't many excellent social sports professionals in Chinese colleges and universities overall. Building a strong teaching quality evaluation system for social sports majors is essential since, among other things, it is one of the primary factors influencing the development of exceptionally talented individuals. Simultaneously, the ideal social physical education teaching quality assessment method serves as a crucial foundation for assessing instructors' work performance and enhancing their management. Additionally, a multi-attribute group decision-making (MAGDM) problem is commonly thought of as this one [5].

Yildiz [6] assess the caliber of instruction provided by Turkey's Schools of Physical Education and Sports (SPESs). After identifying the service qualities in the SPESs, an exploration analysis was conducted. A four-factor structure was identified by the examination: academic support, access, behavioral factors, and academic aspects. Service qualities were assessed using importance-performance analysis (IPA). The findings demonstrated that there was a quality deficiency in every facet of the services provided to students in the SPESs and that IPA was a suitable tool for assessing service quality in education. Thus, the current study presents a conceptual framework for policy-making administrators who assess service delivery as well as unique information on the service quality needs of the SPESs in Turkey.

## 3 | Neutrosophic Distance Measure

This section first shows fundamental ideas and further develops a novel single valued neutrosophic distance measure (SVNDM) to describe the degree of discrimination between single valued neutrosophic sets (SVNSs). Moreover, a comparison with existing SVNDMs is performed to exemplify the efficacy of introduced SVNDM [7].

### 3.1 | Preliminaries

**Definition 1:** SVNS is defined as:

$$S = \{T_S(K_i), I_S(K_i), F_S(K_i)\}$$

$$0 \leq T_S(K_i) + I_S(K_i) + F_S(K_i) \leq 3$$

**Definition 2:** The single valued neutrosophic weighted average (SVNWA) and single valued neutrosophic weighted geometric (SVNWG)

$$SVNWA = \left( \begin{array}{c} 1 - \prod_{i=1}^n (1 - T_i)^{w_i}, \\ \prod_{i=1}^n (I_i)^{w_i}, \\ \prod_{i=1}^n (F_i)^{w_i} \end{array} \right)$$

$$SVNWG = \left( \begin{array}{c} \prod_{i=1}^n (T_i)^{w_i}, \\ 1 - \prod_{i=1}^n (1 - I_i)^{w_i}, \\ 1 - \prod_{i=1}^n (1 - F_i)^{w_i} \end{array} \right)$$

### 3.2 | SVN Distance Measure (SVNDM)

The SVNDM is defined as:

$$D(A, B) = \frac{1}{n} \prod_{i=1}^n \left( \begin{array}{c} \frac{|T_A(K_i) - T_B(K_i)| + |I_A(K_i) - I_B(K_i)| + |F_A(K_i) - F_B(K_i)|}{6} + \\ \frac{(|\max\{T_A(K_i) - F_B(K_i)\} - \max\{T_B(K_i) - F_A(K_i)\}|)}{4} + \\ \frac{(|\max\{T_A(K_i) - I_B(K_i)\} - \max\{T_B(K_i) - I_A(K_i)\}|)}{4} + \\ \frac{(|\max\{I_A(K_i) - F_B(K_i)\} - \max\{I_B(K_i) - F_A(K_i)\}|)}{4} \end{array} \right)$$

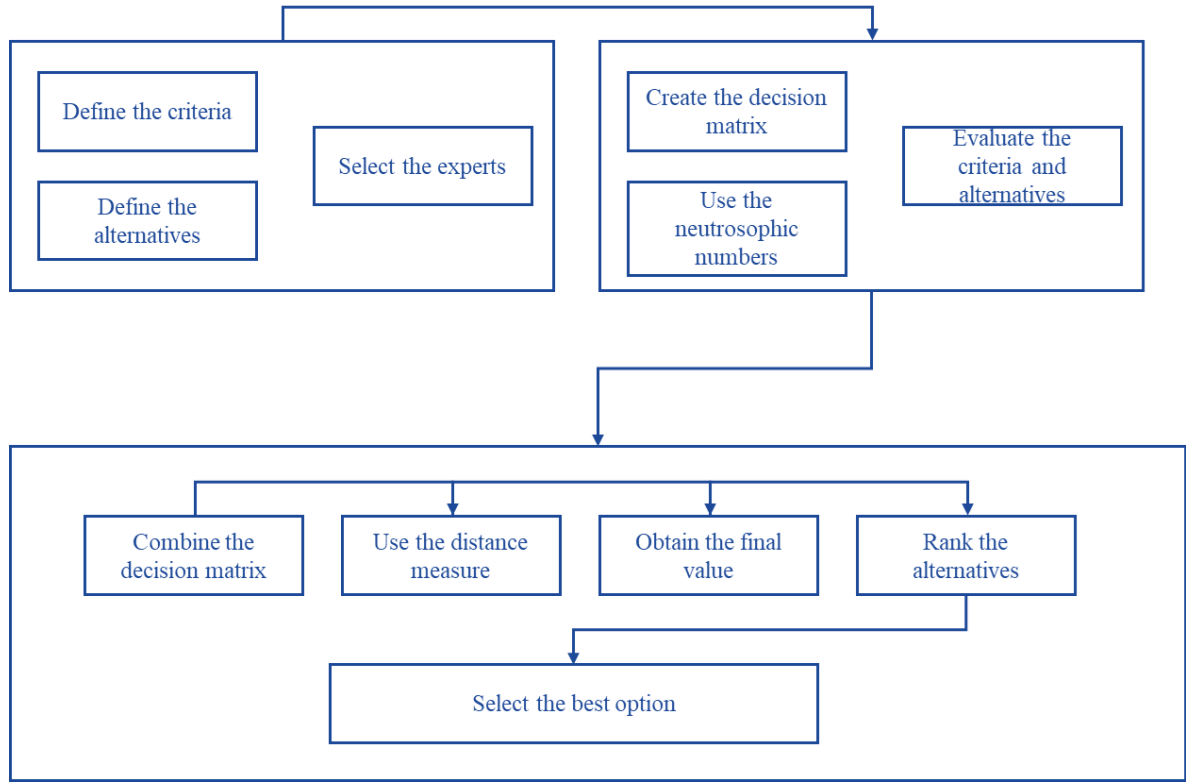


**Figure 1.** Flow of the proposed ranking methodology.

## 4 | Ranking Methodology

This section presents SVN hybrid ranking system that combines the ranking method with SVN<sub>NS</sub>s, the SVN<sub>WA</sub> and SVN<sub>WG</sub> operators, the suggested SVN<sub>DM</sub>, and the DEs' weight-determination formula. An illustration of the suggested hybrid framework is shown in Figure 1. The process steps of the proposed ranking system are presented below.

- Create the decision matrix
- Experts are evacuated the criteria and alternatives using the SVN<sub>NS</sub>s.
- Construct the combined decision matrix.

The SVN<sub>WA</sub> is used to combine the decision matrix.

$$SVNWA = \begin{pmatrix} 1 - \prod_{i=1}^n (1 - T_i)^{w_i}, \\ \prod_{i=1}^n (I_i)^{w_i}, \\ \prod_{i=1}^n (F_i)^{w_i} \end{pmatrix}$$

- Use the SVN<sub>DM</sub> to obtain final value.

$$D(A, B) = \frac{1}{n} \prod_{i=1}^n \left( \frac{|T_A(K_i) - T_B(K_i)| + |I_A(K_i) - I_B(K_i)| + |F_A(K_i) - F_B(K_i)|}{6} + \frac{(|\max\{T_A(K_i) - F_B(K_i)\} - \max\{T_B(K_i) - F_A(K_i)\}|)}{4} + \frac{(|\max\{T_A(K_i) - I_B(K_i)\} - \max\{T_B(K_i) - I_A(K_i)\}|)}{4} + \frac{(|\max\{I_A(K_i) - F_B(K_i)\} - \max\{I_B(K_i) - F_A(K_i)\}|)}{4} \right)$$

- Rank the alternatives.

## 5 | Case Study

The issue description of the case study under consideration is presented first in this part, after which the established SVN approach is further implemented to assess and alternatives.

### 5.1 | Problem Description

This study collects six criteria and eight alternatives as shown in Figure 2.

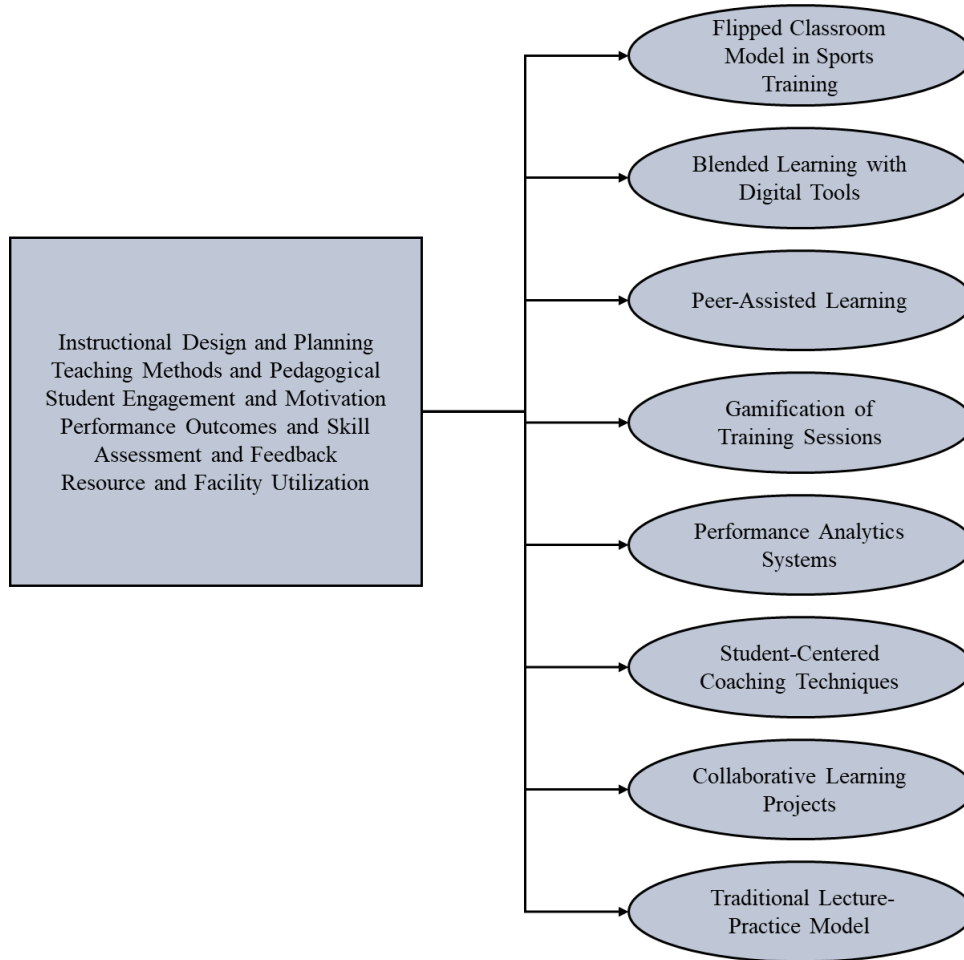


Figure 2. Hierarchical structure.

### 5.2 | Data Collection

This study gathers data based on opinions of experts and decision makers. This study invites three experts and decision makers to evaluate the criteria and alternatives as shown in Table 1.

**Table 1.** Experts' information.

| Expert | Expertise    | Education level |
|--------|--------------|-----------------|
| 1      | PhD          | 28              |
| 2      | Masters      | 20              |
| 3      | Postdoctoral | 16              |

### 5.3 | Implementation

This part shows results of the proposed approach. Three experts evaluate the criteria and alternatives as shown in Table 2.

**Table 2.** SVN values.

|                   | SDMC <sub>1</sub> | SDMC <sub>2</sub> | SDMC <sub>3</sub> | SDMC <sub>4</sub> | SDMC <sub>5</sub> | SDMC <sub>6</sub> |
|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| SDMA <sub>1</sub> | (0.9, 0.1, 0.1)   | (0.8, 0.15, 0.2)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  |
| SDMA <sub>2</sub> | (0.9, 0.1, 0.1)   | (0.3, 0.75, 0.7)  | (0.4, 0.65, 0.6)  | (0.5, 0.5, 0.5)   | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  |
| SDMA <sub>3</sub> | (0.8, 0.15, 0.2)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  | (0.8, 0.15, 0.2)  |
| SDMA <sub>4</sub> | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  | (0.8, 0.15, 0.2)  | (0.9, 0.1, 0.1)   | (0.3, 0.75, 0.7)  | (0.9, 0.1, 0.1)   |
| SDMA <sub>5</sub> | (0.5, 0.5, 0.5)   | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  | (0.8, 0.15, 0.2)  | (0.9, 0.1, 0.1)   | (0.3, 0.75, 0.7)  |
| SDMA <sub>6</sub> | (0.5, 0.5, 0.5)   | (0.5, 0.5, 0.5)   | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.3, 0.75, 0.7)  | (0.4, 0.65, 0.6)  |
| SDMA <sub>7</sub> | (0.3, 0.75, 0.7)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.3, 0.75, 0.7)  | (0.9, 0.1, 0.1)   | (0.8, 0.15, 0.2)  |
| SDMA <sub>8</sub> | (0.9, 0.1, 0.1)   | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  | (0.3, 0.75, 0.7)  | (0.7, 0.25, 0.3)  |
|                   | SDMC <sub>1</sub> | SDMC <sub>2</sub> | SDMC <sub>3</sub> | SDMC <sub>4</sub> | SDMC <sub>5</sub> | SDMC <sub>6</sub> |
| SDMA <sub>1</sub> | (0.6, 0.35, 0.4)  | (0.8, 0.15, 0.2)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  |
| SDMA <sub>2</sub> | (0.7, 0.25, 0.3)  | (0.3, 0.75, 0.7)  | (0.4, 0.65, 0.6)  | (0.6, 0.35, 0.4)  | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  |
| SDMA <sub>3</sub> | (0.8, 0.15, 0.2)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.8, 0.15, 0.2)  |
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| SDMA <sub>5</sub> | (0.3, 0.75, 0.7)  | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  | (0.9, 0.1, 0.1)   | (0.8, 0.15, 0.2)  | (0.3, 0.75, 0.7)  |
| SDMA <sub>6</sub> | (0.6, 0.35, 0.4)  | (0.6, 0.35, 0.4)  | (0.6, 0.35, 0.4)  | (0.3, 0.75, 0.7)  | (0.9, 0.1, 0.1)   | (0.4, 0.65, 0.6)  |
| SDMA <sub>7</sub> | (0.3, 0.75, 0.7)  | (0.7, 0.25, 0.3)  | (0.9, 0.1, 0.1)   | (0.5, 0.5, 0.5)   | (0.3, 0.75, 0.7)  | (0.5, 0.5, 0.5)   |
| SDMA <sub>8</sub> | (0.6, 0.35, 0.4)  | (0.6, 0.35, 0.4)  | (0.3, 0.75, 0.7)  | (0.4, 0.65, 0.6)  | (0.9, 0.1, 0.1)   | (0.6, 0.35, 0.4)  |
|                   | SDMC <sub>1</sub> | SDMC <sub>2</sub> | SDMC <sub>3</sub> | SDMC <sub>4</sub> | SDMC <sub>5</sub> | SDMC <sub>6</sub> |
| SDMA <sub>1</sub> | (0.9, 0.1, 0.1)   | (0.8, 0.15, 0.2)  | (0.7, 0.25, 0.3)  | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  |
| SDMA <sub>2</sub> | (0.3, 0.75, 0.7)  | (0.3, 0.75, 0.7)  | (0.4, 0.65, 0.6)  | (0.5, 0.5, 0.5)   | (0.6, 0.35, 0.4)  | (0.7, 0.25, 0.3)  |
| SDMA <sub>3</sub> | (0.4, 0.65, 0.6)  | (0.9, 0.1, 0.1)   | (0.6, 0.35, 0.4)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  | (0.8, 0.15, 0.2)  |
| SDMA <sub>4</sub> | (0.5, 0.5, 0.5)   | (0.3, 0.75, 0.7)  | (0.9, 0.1, 0.1)   | (0.9, 0.1, 0.1)   | (0.9, 0.1, 0.1)   | (0.9, 0.1, 0.1)   |
| SDMA <sub>5</sub> | (0.6, 0.35, 0.4)  | (0.4, 0.65, 0.6)  | (0.3, 0.75, 0.7)  | (0.9, 0.1, 0.1)   | (0.3, 0.75, 0.7)  | (0.9, 0.1, 0.1)   |
| SDMA <sub>6</sub> | (0.7, 0.25, 0.3)  | (0.5, 0.5, 0.5)   | (0.4, 0.65, 0.6)  | (0.3, 0.75, 0.7)  | (0.4, 0.65, 0.6)  | (0.3, 0.75, 0.7)  |
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| SDMA <sub>8</sub> | (0.9, 0.1, 0.1)   | (0.6, 0.35, 0.4)  | (0.6, 0.35, 0.4)  | (0.4, 0.65, 0.6)  | (0.8, 0.15, 0.2)  | (0.5, 0.5, 0.5)   |

We used the SVNWA to combine the decision matrices into a one matrix. Then the distance measure is used to obtain final score as shown in Table 3. Ranks of alternatives are shown in Table 3.

**Table 3.** Ranks of alternatives.

|                   | Final score | Ranks |
|-------------------|-------------|-------|
| SDMA <sub>1</sub> | 0.962712    | 4     |
| SDMA <sub>2</sub> | 1.034709    | 6     |
| SDMA <sub>3</sub> | 0.907144    | 3     |
| SDMA <sub>4</sub> | 1.26757     | 8     |
| SDMA <sub>5</sub> | 0.83875     | 2     |
| SDMA <sub>6</sub> | 1.039459    | 7     |
| SDMA <sub>7</sub> | 0.832114    | 1     |
| SDMA <sub>8</sub> | 0.993197    | 5     |

## 6 | Discussions and Implications

The managerial implications of this study are organized as:

- Policy and Curriculum Design – Universities should establish comprehensive teaching quality standards that combine student-centered pedagogy with performance-based evaluation metrics.
- Faculty Development – Professional training programs for sports educators should focus on equipping teachers with innovative teaching strategies, digital competencies, and feedback skills.
- Technology Integration – Institutions should invest in wearable devices, performance analysis tools, and interactive platforms to support data-driven evaluation of student outcomes.
- Student-Centered Policies – Encouraging peer learning, gamified training, and collaborative projects can enhance motivation and ensure that students remain active participants in the learning process.
- Resource Allocation – Adequate investment in facilities, equipment, and digital infrastructure is essential for sustaining high-quality teaching in sports training programs.
- Continuous Improvement – Teaching evaluation systems should be iterative, using feedback loops from students and performance data to refine teaching practices over time.

## 7 | Conclusions

A balanced strategy that incorporates pedagogical innovation with quantifiable performance outcomes is needed to assess the quality of instruction in university sports training. This study shows that good sports training emphasizes skill development, student involvement, and personalized feedback rather than just standard lecture. This study used the neutrosophic set to overcome vague information. We used the neutrosophic weighted average operator to combine the decision matrix. The distance measure between the criteria and alternatives is used. When compared to traditional teacher-led techniques, student-centered models like blended learning, gamification, and peer-assisted learning have been shown to promote better levels of motivation and learning outcomes. At the same time, rigorous tracking and evaluation of improvements is guaranteed by performance analytics and structured assessment systems. In the end, the capacity to develop self-directed, motivated, and resilient learners should be used to evaluate the quality of instruction in sports training, in addition to short-term performance improvements.

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## Data Availability

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

## Conflicts of Interest

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

## Ethical Approval

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

## Author Contributions

All authors contributed equally to this work.

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