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Assessment of Core Literacy Cultivation Level of Physical Education and Health Curriculum under the Concept of OBE

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Abstract This paper interprets the idea of constructing the evaluation index system of core literacy under the concept of OBE, and takes the results of core literacy cultivation as the starting point, proposes the design of teaching evaluation direction, and highlights the concept of constructing the evaluation system of core literacy cultivation process. Adopting the Delphi method to correct the initial proposed indicators, combining the fuzzy comprehensive indicator system establishment process to determine the evaluation index system of core literacy cultivation level, and calculating the weights of each indicator to get the impact ranking of each indicator of core literacy cultivation level. Utilize sample data to empirically test the core literacy evaluation index system. The core literacy teaching improvement strategy of physical education and health curriculum is proposed for the results of multilevel fuzzy comprehensive judgment. The total ranking results of the indicators show that the three secondary indicators of emotion regulation and management, sports cognition, and sports ethics have an important influence on the cultivation of physical education core literacy, with weight values of 0.1053, 0.1051, and 0.1048, respectively. The first ranked level of physical education core literacy is N3, with fuzzy composite grade-assigned scores of 0.9635, 0.0015, 0.035, and 0, and the total score is 88.524, indicating that the student's core literacy level is good, and the existing physical education and health curriculum core literacy development program meets the requirements of the physical education and health curriculum and follows the principle of students' core literacy development. This paper shows the high level of professionalism in the theory and method of the paper, and provides valuable research achievements and practical guidance for sports education.

Index Terms fuzzy comprehensive judgment, evaluation index system, OBE concept, core literacy

1. Introduction

Amid the comprehensive reform of China's education system in the new era, human-centered quality education has emerged as the primary objective of contemporary Chinese education [1]. Classroom teaching activities under the new curriculum reform prioritize students as the central focus, with them occupying the pivotal role in educational endeavors [2]. Driven by the momentum of the new curriculum reform, institutions have intensified their efforts to innovate and enhance their teaching systems in accordance with the new curriculum [3]. Notably, the classroom teaching evaluation system has garnered significant attention from educators alike [4]. Within the context of the new curriculum reform, classroom teaching evaluation constitutes a comprehensive analysis of the entire teaching system, encompassing aspects such as the teacher's instructional process, students' in-class performance, the delivery of educational content, the adoption of teaching methodologies, and others [5].

The evaluation of public physical education and health courses ought to encompass the entire course content or specific segments within it, adopting a diverse range of forms for a comprehensive set of value judgments. However, the

current prevalent use of evaluation results deviates significantly from the nurturing orientation of quality education [6]. The traditional mode of evaluating physical education courses is marred by at least three issues: outdated evaluation concepts, a singular evaluation method, and an inadequate comprehensiveness in the evaluation index system [7].

In the realm of physical and health education, process evaluation pertains specifically to the analysis and dynamic feedback of the myriad of information generated during the physical education teaching process and the students' learning endeavors. This practice aims to uncover, select, evaluate, and ultimately realize the value of instructional activities. Process, being an inherent characteristic of education [8], is particularly significant in physical and health education. Consequently, in assessing the teaching of these subjects, while acknowledging the importance of teaching outcomes, it is crucial to prioritize the evaluation of the teaching process. During the instruction of physical and health education courses, learners formulate learning objectives and select individualized knowledge construction programs based on the course content, their personal interests, and other relevant factors. Process evaluation, in this context, serves as a vital tool

for promptly identifying and addressing any issues that arise during teaching, thereby enhancing the overall effectiveness and efficiency of the educational process [9].

The traditional evaluation mode of physical education courses is plagued by issues such as an outdated evaluation concept, a sole reliance on a single evaluation method, and a lack of comprehensiveness in the evaluation index system. Given the significant process inherent in physical and health education, it is imperative to emphasize the teaching process in its evaluation, while simultaneously focusing on teaching outcomes. Literature [10] conducted an experiment to assess the applicability of the PPLI tool in perceiving the physical education literacy of teachers in Turkey. The experimental results confirmed both the applicability and validity of the tool, rendering it a reliable instrument for evaluating physical education teachers' literacy. A study conducted in Literature [11] employed a questionnaire to investigate factors associated with students' sedentary behavior. Based on the questionnaire responses, gender differences in sedentary behavior were observed, whereas no significant correlations were detected between sedentary behavior and levels of physical activity or psychological factors. Literature [12] reported a positive impact of school-based physical activity interventions on reducing the risk of cardiometabolic disease among students, as evidenced by a six-and-a-half-year follow-up study of cardiometabolic risk indicators. Furthermore, Literature [13] examined the teaching effectiveness of physical education teachers and the achievement of learning goals, highlighting the necessity to prioritize the cultivation and development of sustainability perspectives within teacher development programs in physical education. Lastly, Literature [14] argued that limited or no internship teaching experiences have a constrained influence on the transformation of teaching values among physical education teachers. Consequently, the training of physical education teachers should continuously emphasize the exportation of teaching concepts that align with societal needs and requirements.

The teaching evaluation of physical education and health courses ought to encompass a blend of outcome and process evaluations, as well as personalized and institutionalized evaluations. Leveraging big data, the Internet, and other information technologies, this approach aims to comprehensively enhance the scientific, professional, and objective nature of the evaluation process. Literature [15] has proposed a TOPSIS strategy, with intuitive distance serving as its underpinning logic, specifically tailored to cater to the requirements of physical education teaching evaluation. Feasibility analysis and validation have confirmed that this strategy comprehensively satisfies the needs of such evaluations. Meanwhile, Literature [16] has devised an assessment tool for core teaching behaviors in physical education (PE), aimed at augmenting the teaching competence and literacy of pre-service PE teachers. This tool integrates insights from PE teaching experts to facilitate the development of PE teachers' teaching competence. Furthermore, Literature [17] has conceptualized and implemented an optimized, new adaptive genetic planning

robust scheduling algorithm within the context of physical education teaching management assessment. This algorithm not only enhances the information infrastructure of physical education teaching management but also optimizes the scientific allocation of teaching resources, ultimately fostering improved physical education learning outcomes for students.

In this paper, we propose the construction of an evaluation index system for the core literacy training level, grounded in the OBE (Outcome-Based Education) concept, which is fundamentally output-oriented and underscores the assessment of educational outcomes. This OBE-inspired evaluation index system serves as the conceptual foundation for establishing an evaluation framework tailored to the cultivation of core literacy, integrating both output-driven teaching and evaluation. We commence by selecting indicators from three key domains: physical education and health curriculum, sports ability, health behavior, and sports morality. By incorporating the essence of core literacy cultivation, we initially devise the evaluation index system, which is subsequently refined through the Delphi method. To determine the weights of the evaluation indexes, we employ the multi-layer fuzzy comprehensive judgment method, resulting in a ranked order of index weights. To validate the evaluation index system, we select experimental lecture samples and apply both qualitative and quantitative methods. Drawing upon the outcomes of the fuzzy comprehensive judgment, we propose a strategy for enhancing the teaching of core literacy in physical education and health curricula.

II. Construction of an Assessment Index System based on the OBE Concept

A. Evaluation index system construction under the OBE philosophy

OBE represents a novel concept underpinning the support system for physical education teaching evaluation. This OBE concept underscores the emphasis on the process evaluation of teaching outcomes, fostering a continuous improvement mechanism, and implementing a comprehensive assessment of students' physical education abilities aimed at achieving sustained progress.

1) Characterization of OBE conceptual indicator construction

This study leverages expert feedback to devise an evaluation index system for assessing the core literacy level in physical education and health courses, grounded in the OBE (Outcome-Based Education) concept. This system emphasizes learning outcomes, fosters an operational mechanism within the teaching of these courses, and ultimately enhances the quality of instruction. By clarifying the teaching evaluation index system in accordance with the OBE concept, students are able to attain distinct learning objectives, thereby facilitating teachers' endeavors to improve the teaching of physical education and health courses. Additionally, this approach benefits teachers by enabling them to better comprehend students' needs and

innovate their teaching designs. This study compiles the scientific methodologies of teaching evaluation and the indicator system development processes from prior literature, integrating conceptual foundations, construction principles and factors, preliminary design and planning, indicator system finalization, and weight calculation to achieve the construction's completion.

The teaching evaluation index system for core literacy development in physical education and health courses is theoretically compatible with the diverse internal and external needs of students. It continually enhances teaching activities to ensure alignment with the requirements for students' successful completion of the course. Furthermore, this system effectively analyzes students' learning outcomes and performance within the course, thereby achieving the four objectives of selection, screening, development, and incentives. Consequently, it facilitates a visual assessment of the teaching outcomes in physical education and health courses, ultimately contributing to the enhancement of core literacy quality.

2) Interpretation of the concept of the construction of the assessment indicator system

The construction of the evaluation index system pertaining to the level of core literacy cultivation is undertaken within the overarching framework of the OBE (Outcome-Based Education) concept. Initially, it is imperative to prioritize grasping the accurate orientation of the teaching evaluation design for physical education and health courses within the OBE paradigm. Furthermore, during the establishment of this evaluation index system for cultivation level, it is crucial to adhere to the central theme of output-driven teaching and maintain the fundamental threshold of output evaluation.

The course teaching design under the OBE (Outcome-Based Education) concept, which focuses on "teaching output," is illustrated in Figure 1. The evaluation of output-oriented course teaching objectives serves to assess the extent of accomplishment of these objectives, thereby enabling an evaluation of the achievement of the anticipated core literacy skills and the rationality of the evaluation criteria.

The evaluation of graduation requirements that are oriented towards outputs assesses the fulfillment of these requirements, thereby facilitating an assessment of the rationality in the decomposition of graduation requirement index points and the corresponding supportive course design.

The assessment of output-oriented core literacy cultivation objectives examines the attainment of these objectives, thereby enabling an evaluation of the measurability of the cultivation objectives and the rationality of the supporting relationship between graduation requirements and cultivation objectives.

In conclusion, the construction of the study's index system is initiated from the ultimate goal of student learning (outcome), with the teaching evaluation structured in a reverse-engineered manner. This designed teaching evaluation index system comprehensively encompasses both the cultivation objectives and graduation (completion) requirements, thereby

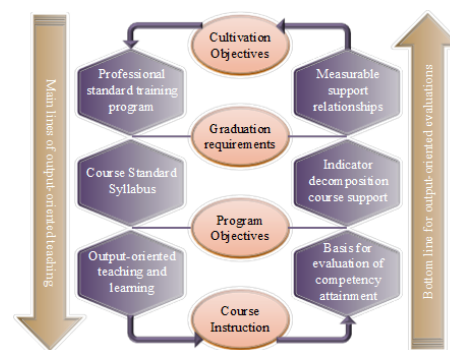


Figure 1: The teaching design of "teaching output" under the idea of OBE

facilitating the attainment of students' learning outcomes and the continual enhancement of the program. Notably, the teaching evaluation places a heightened emphasis on learning evaluation, addressing pivotal questions pertaining to 'what to learn, how to learn, and why to learn', while also devoting greater attention to fostering students' self-exploration, self-study capabilities, and other vital competencies.

B. Construction of core literacy evaluation indicators

1) Screening of core literacy-related Indicators

The screening and determination of indicators pertinent to the core literacy of the physical education and health curriculum are crucial, as they pertain to reflecting the status of core literacy among physical education majors, fulfilling the needs of both their personal development and societal advancements, and ensuring their operationalization for effective cultivation.

This study is grounded in the three dimensions of core literacy in physical education: athletic ability, healthy behavior, and physical integrity, as refined by the Physical Education and Health Curriculum Standard Development Group. Utilizing these 10 dimensions as a foundation, and incorporating the needs of physical education majors, the cultivation characteristics of physical education and health courses, as well as the guiding principles of the index system, we conducted an extensive literature review and interviewed several experts, resulting in the preliminary identification of the three-level indexes.

- a) Screening of athletic ability indicators.
- b) Screening of health behavior indicators.
- c) Screening of physical integrity indicators.

2) Preliminary development of an indicator system

Drawing upon the theoretical foundation of core literacy and the specific connotations and structure of core literacy within physical education disciplines, and adhering to the principles governing the construction of indicator systems as well as the research objectives of this paper, we formulated the preliminary framework of the core literacy indicator system for students enrolled in physical education and health courses. This

framework comprises three first-level indicators, ten second-level indicators, and thirty-eight third-level indicators.

The preliminary formulation of the core literacy indicator system for students enrolled in physical education and health courses is presented in Table 1. This system comprises first-level assessment indicators, namely athletic ability, health behavior, and physical integrity, along with second-level indicators, specifically, athletic cognition, skill application, physical development, athletic and exercise awareness and habits, health knowledge mastery and application, emotional regulation and management, adaptability, sports morality, sportsmanship, and sports character.

3) Amendments to the indicator system by the Delphi method To ensure the scientificity, systematicity, timeliness, and operability of the indicator system's construction, a rigorous assessment of the initially formulated system's scientificity is imperative. Utilizing the Delphi method, the study conducted three rounds of investigation and feedback with experts, culminating in the final conclusion regarding the construction of the indicator system. Additionally, to cater to the specific requirements of the system's construction, ten experts participated in these three rounds of questionnaire surveys.

The questionnaire design is assigned 1, 3, 5, 7 and 9 points according to "unimportant", "less important", "average", "more important" and "important" respectively, combined with the modification opinions of experts, by calculating the mean value of $\bar{x}$ (reflecting the overall score of a certain index, the score is set to 5 points in this study, $\geq$ the selected index system of the score, and the lower score is deleted), standard deviation S (expressed by discreteness, reflecting the degree of dispersion of the index score), and coefficient of variation V (expressed by relatively discrete Chengdu, reflecting the degree of disagreement of experts on the selection of indicators, the coefficient of variation is set to 0.3 in this study, and indicators below this value are selected into the index system) and other characteristic values to filter and modify the indicators.

Table 2 shows the results of the three-level index survey of students' core literacy in physical education and health courses.

The survey results showed that the scores of all indicators were greater than 5 points, and the coefficient of variation of V was less than 0.3, indicating that the construction of indicators could reflect the core literacy of students in physical education and health courses, and the differences among experts were small. Through the results of the above three rounds of expert surveys, the core literacy index system of students in physical education and health courses was finally determined. It includes three first-level indicators, 10 second-level indicators and 30 third-level indicators.

III. Analysis of Weighting Coefficients of Core Literacy Evaluation Indicators

A. Fuzzy synthesis judgment

1) Fuzzy mathematical algorithms

- a) Fuzzy sets and degrees of affiliation: In the realm of classical mathematics, the membership of an element within a set is unequivocally defined. Conversely, fuzzy sets postulate that an element may possess a degree of belonging to a set, with this degree quantified by a numerical value ranging from 0 to 1, termed the degree of affiliation. Let the fuzzy set $\tilde{A}$ in the domain U be the set characterized by the affiliation function μ_A , i.e:

$$\mu_{\tilde{A}}^{-} : U \rightarrow [0, 1]. \quad (1)$$

For any $u \in U$, there is $u \rightarrow \mu_{\tilde{A}}(u), \mu_{\tilde{A}}(u) \in [0, 1], \mu_{\tilde{A}}(u)$ for the degree of affiliation of element u with respect to $\tilde{A}$, indicating the degree to which element u belongs to $\tilde{A}$.

- b) Affiliation function establishment method: The establishment of the affiliation function, a pivotal step in constructing the fuzzy mathematical model, poses a challenge due to its varied forms and corresponding conditions. Consequently, there exists no universally accepted methodology for its determination, with the majority of approaches tailored to specific practical scenarios. The formulation of the affiliation function inherently involves a certain level of subjective influence in its establishment. Nevertheless, as an objective phenomenon that maps to the fuzzy model, the affiliation function possesses a definitive relationship with reality. Consequently, it is subject to the constraints and limitations imposed by objective conditions, yet its essence remains congruent with objective facts. The primary methodologies for establishing the affiliation function encompass the mode three approach, the fuzzy distribution method, statistical methods, as well as the utilization of fuzzy numbers to determine the degree of affiliation, among others. Notably, the semi-trapezoidal method currently stands as one of the prevalently employed techniques. The semi-trapezoidal distribution of the affiliation function is outlined as follows:

$$U_I(x) = \begin{cases} 1, & x \leq S_1, \\ \frac{s_2-x}{S_2-S_1}, & S_1 < x \leq S_2, \\ 0, & x > S_2. \end{cases} \quad (2)$$

$$U_{II}(x) = \begin{cases} 0, & x \leq S_1, x > S_3, \\ \frac{x-S_1}{S_2-S_1}, & S_1 < x \leq S_2, \\ \frac{S_3-x}{S_3-S_2}, & S_2 < x \leq S_3. \end{cases} \quad (3)$$

$$U_{III}(x) = \begin{cases} 0, & x \leq S_2, x > S_4, \\ \frac{x-S_2}{S_3-S_2}, & S_2 < x \leq S_3, \\ \frac{S_4-x}{S_4-S_3}, & S_3 < x \leq S_4. \end{cases} \quad (4)$$

$$U_{IV}(x) = \begin{cases} 0, & x \leq S_3, \\ \frac{x-S_3}{S_4-S_3}, & S_3 < x \leq S_4, \\ 1, & x > S_4. \end{cases} \quad (5)$$

Here S_1, S_2, S_3, S_4 is the evaluation boundary conditions and x is the measured value of the relevant evaluation indexes, respectively.

Primary indicator	Secondary indicator	Tertiary index
A1 Motor ability	B1 Motor cognition	C1.1 Physical terms cognition
		C1.2 Action cognition
		C1.3 Field equipment cognition
	B2 Skill use	C2.1 Exercise the physical practice method for fitness guidance
		C2.2 Use sporting events to organize competitions
		C2.3 Demonstrate the teaching of sports teaching
	B3 Physical development	C3.1 Development power quality
		C3.2 Speed quality
		C3.3 Develop endurance quality
		C3.4 Develop the quality of flexibility
		C3.5 Develop sensitive and harmonious quality
		C3.6 Improve the pulse and lung capacity
A2 Health behavior	B4 Exercise awareness and habit	C4.1 Sports safety awareness
		C4.2 Motivational consciousness
		C4.3 Exercise method
	B5 Health knowledge mastery and application	C5.1 Familiar with the concept of health and the factors that affect health
		C5.2 Knowledge of injury and first aid
		C5.3 Knowledge of water, environment and food safety
		C5.4 Healthy lifestyle
	B6 Emotional control and management	C6.1 Reasonable emotional expression
		C6.2 Positive energy interaction
		C6.3 Effective emotional control
	B7 Adaptive ability	C7.1 Interpersonal communication
		C7.2 Competitive consciousness
A3 Physical character	B8 Sports ethics	C8.1 Love sports
		C8.2 Follow the rules
		C8.3 Self-discipline
		C8.4 Fair and fair
	B9 Sportsmanship	C9.1 Exercise persistence
		C9.2 Tenacity
		C9.3 Beyond oneself
		C9.4 Assistive
		C9.5 Delve
	B10 Physical character	C10.1 Teamwork
		C10.2 Mutual respect
		C10.3 Civility
		C10.4 Social responsibility
		C10.5 Right game

Table 1: The core quality index system of sports and health courses is preliminary

- c) Fuzzy pattern recognition method: Pattern recognition is a discipline focused on identifying the class to which a specific object belongs. Within the realm of fuzzy pattern recognition, two primary methods exist: the direct method and the indirect method. Maximum affiliation principle, set $\tilde{A}_i \in F(U) (i = 1, 2, \dots, n)$, $u_0 \in U$, if there is $j \in (1, 2, \dots, n)$, make:

$$\tilde{A}_j(u_0) = 1 \leq \max_i \tilde{A}_i(u_0). \quad (6)$$

Then u_0 belongs to $\tilde{A}_j$, i.e., the element pair u_0 , and if u_0 corresponds to $\tilde{A}_j$ with a greater degree of affiliation than all the other element counterparts, then u_0 is assigned to the category $\tilde{A}_j$.

- d) Fuzzy relations: Fuzzy relations are the development and broadening of ordinary relations, which are richer in meaning than ordinary relations and more in line with the objective facts of a variety of situations. Given the domain U, V , the fuzzy subset $\tilde{R}$ of the product set $U \times V$ is called a fuzzy binary relation from U to V , and the affiliation function of $\tilde{R}$ is:

$$\mu_{\tilde{R}} : U \times V \rightarrow [0, 1]. \quad (7)$$

Given the ordinal couple (u, v) , $\mu_{\tilde{R}}(u, v)$ is said to be the degree of correlation between u and v with respect to $\tilde{R}$.

- e) Fuzzy mapping: Let U, V be an argument domain and $\tilde{B} \in F(V)$, let:

$$\tilde{f} : U \rightarrow F(V) \quad u \mapsto \tilde{f}(u) = \tilde{B} \in F(V). \quad (8)$$

Call $\tilde{f}$ a fuzzy mapping from U to V . If a fuzzy relation $\tilde{R}$, i.e. $\tilde{R} : U \times V \rightarrow [0, 1]$, is established between U and V such that $\tilde{R}(u, v) = \tilde{f}(u)(v)$, then when $\tilde{f}$ is determined, $\tilde{R}$ is also uniquely determined.

- f) Fuzzy transformation: Let U, V be the domain of the argument such that the mapping $\tilde{T} : F(U) \rightarrow F(V)$, for $\forall \tilde{A} \in F(U)$, has:

$$\tilde{A} \mapsto P(\tilde{A}) = \tilde{B} \in F(V). \quad (9)$$

Then $\tilde{T}$ is said to be a fuzzy transformation from U to V , also known as a generalized fuzzy mapping. The fuzzy relation $\tilde{R}$ corresponds to the fuzzy transformation $\tilde{T}$ i.e. a fuzzy relation $\tilde{R}$ from U to V corresponds to the only fuzzy transformation $\tilde{T}$ from U to V . Viz:

$$\tilde{T}_R(\tilde{A}) = \tilde{A} \circ \tilde{R}. \quad (10)$$

Tertiary index	Mean $\bar{x}$	Standard deviation S	Variation coefficient V
C1.1 Physical terms cognition	6.8	1.253	0.153
C1.2 Action cognition	7.1	1.241	0.168
C1.3 Field equipment cognition	7.6	1.225	0.133
C2.1 Exercise the physical practice method for fitness guidance	8.6	1.305	0.145
C2.2 Use sporting events to organize competitions	8.3	1.404	0.147
C2.3 Demonstrate the teaching of sports teaching	8.0	1.237	0.036
C3.1 Development power quality	7.8	1.392	0.083
C3.2 Speed quality	6.8	1.305	0.182
C3.3 Develop endurance quality	6.9	1.201	0.171
C3.4 Develop the quality of flexibility	7.3	1.025	0.131
C3.5 Develop sensitive and harmonious quality	7.5	1.039	0.145
C3.6 Improve the pulse and lung capacity	6.8	1.045	0.163
C4.1 Sports safety awareness	7.5	1.075	0.112
C4.2 Motivational consciousness	7.6	1.053	0.135
C5.1 Familiar with the concept of health and the factors that affect health	7.7	1.086	0.112
C5.2 Knowledge of injury and first aid	8.1	1.042	0.025
C5.4 Healthy lifestyle	7.9	0.936	0.175
C6.1 Reasonable emotional expression	8.2	0.983	0.133
C6.2 Positive energy interaction	8.6	0.917	0.114
C6.3 Effective emotional control	8.8	0.925	0.131
C7.1 Interpersonal communication	8.4	1.063	0.120
C7.2 Competitive consciousness	8.5	0.836	0.110
C8.2 Follow the rules	7.6	0.293	0.183
C8.3 Self-discipline	7.7	1.023	0.105
C8.4 Fair and fair	6.5	0.968	0.108
C9.2 Tenacity	7.3	0.936	0.153
C9.3 Beyond oneself	7.4	0.932	0.103
C10.1 Teamwork	7.7	0.908	0.137
C10.2 Mutual respect	8.3	0.942	0.111
C10.5 Right game	8.5	1.003	0.114

Table 2: Students' core quality level three index survey results

In numerous problems, the evaluation of entities frequently exhibits a fuzzy character, and the employment of fuzzy mathematics for comprehensive evaluation typically leads to superior outcomes. The mathematical framework for fuzzy comprehensive evaluation can be broadly categorized into one-level and multi-level models, with this particular study adopting a three-level evaluation model.

2) Multi-level fuzzy composite judgments

The multilevel comprehensive evaluation model typically comprises several integral components, including the evaluation factor set, evaluation set, factor weight set, affiliation function, single-factor evaluation matrix, and fuzzy operation operator, among others. When dealing with complex systems, numerous factors must be taken into account, often exhibiting a hierarchical relationship among them. Consequently, it is advisable to categorize the factor set U into distinct classes based on specific attributes. Subsequently, a comprehensive evaluation is conducted for each class, followed by a higher-level comprehensive evaluation among the "classes" of the evaluation outcomes.

The specific steps for multilevel comprehensive judging are as follows:

- Divide factor set U : Create factor set U and divide U into S disjoint subsets according to the different attributes of each factor:

$$U = \{U_{i1}, U_{i2}, \dots, U_{in}\} \quad (i = 1, 2, \dots, s). \quad (11)$$

- Single-stage judgment: In each subset of factors within the range of $U_k (k = 1, 2, \dots, s)$ according to the nature of the selection of a suitable model for comprehensive judgment. Specifically, it is to determine the fuzzy vector of factors $A_k = (a_{k1}, a_{k2}, \dots, a_{kn})$ according to the role played by each factor in $U_k = \{u_{k1}, u_{k2}, \dots, u_{kn}\}$, and assess the affiliation degree of U_{ki} to V_j of each factor U_{ki} according to the rank of judgment set $V = \{v_1, v_2, \dots, v_m\}$, $r_{kij} (i = 1, 2, \dots, n; j = 1, 2, \dots, m)$, which forms a single-factor judgment matrix R_k , which is obtained accordingly:

$$A_k \circ R_k = B_k = (b_{k1}, b_{k2}, \dots, b_{km}), \quad (12)$$

for $k = 1, 2, \dots, s$.

- Multi-level judging: The single factor judgment matrix R_k gets U the total evaluation matrix $\tilde{R}$ for:

$$\tilde{R} = \begin{bmatrix} \tilde{B}_1 \\ \tilde{B}_2 \\ \dots \\ \tilde{B}_s \end{bmatrix} = \begin{bmatrix} b_{11} & \circ & b_{1n} \\ b_{21} & \circ & b_{2n} \\ \dots & \circ & \dots \\ b_{s1} & \circ & b_{sn} \end{bmatrix}. \quad (13)$$

The overall composite judgment is then derived:

$$\tilde{B} = \tilde{A} \circ \tilde{R} = \tilde{A} \circ \begin{bmatrix} \tilde{B}_1 \\ \tilde{B}_2 \\ \dots \\ \tilde{B}_s \end{bmatrix} = \begin{bmatrix} \tilde{A}_1 & \circ & \tilde{R}_1 \\ \tilde{A}_2 & \circ & \tilde{R}_2 \\ \dots & \circ & \dots \\ \tilde{A}_s & \circ & \tilde{R}_s \end{bmatrix}. \quad (14)$$

This is the mathematical model of the second level of comprehensive judgment, if U can be divided into more levels, similarly you can get three or more levels of comprehensive judgment model.

3) Methods of analyzing evaluation results

The evaluation outcomes derived from the fuzzy comprehensive judgment method necessitate further quantitative and qualitative analyses for comprehensive understanding. Quantitative analysis, rooted in the comparability of selected indicators, underscores the diverse expressions of these indicators and results, alongside the application of statistical testing methodologies. Conversely, qualitative analysis emphasizes the profound comprehension of the indicators' substantive connotations, the comprehension of pertinent policies, and the holistic assessment of the historical status quo. While quantitative judgments yield a degree of scientific rigor and persuasive force, they may still possess an element of subjectivity. Therefore, the implementation of evaluation results necessitates a nuanced analysis tailored to specific issues at hand.

There are various methods for analyzing the results of fuzzy comprehensive judgments, including the maximum affiliation method.

The maximum affiliation method is based on finding the set of judging results $\tilde{B}$, if any:

$$b_0 = \max(b_1, b_2, \dots, b_m). \quad (15)$$

The elements in the set of judgments $V = \{v_1, v_2, \dots, v_n\}$ corresponding to b_0 are then the results of the judgments.

The maximum affiliation method solely considers the contribution of the most prominent judging indicator, neglecting the information conveyed by the remaining indicators. In scenarios where multiple maximal criteria coexist, it becomes challenging to designate a specific criterion utilizing the maximum affiliation method, hence, the weighted average method is often employed as an alternative.

The weighted average method normalizes the set of judgments to $\tilde{B} = (b_1, b_2, \dots, b_m)$:

$$\tilde{B}' = (b'_1, b'_2, \dots, b'_m), \quad (16)$$

where, $b'_i = b_i / \sum_{j=1}^m b_j, (i = 1, 2, \dots, m)$.

The judgment set is expressed quantitatively, i.e. $V = (k_1, k_2, \dots, k_m)^T$, and the judgment result is $S = (b'_1, b'_2, \dots, b'_m) (k_1, k_2, \dots, k_m)^T$.

The fuzzy distribution method is to take the judgment result of the fuzzy comprehensive judgment method directly as the final result, or to take the judgment result set as the final result after normalization. The results obtained from the analysis of fuzzy distribution method are quantitative results. When there is more than one maximum judgment indicator, it is difficult to decide the specific judgment result by using the maximum affiliation method, and then it is necessary to use the weighted average method.

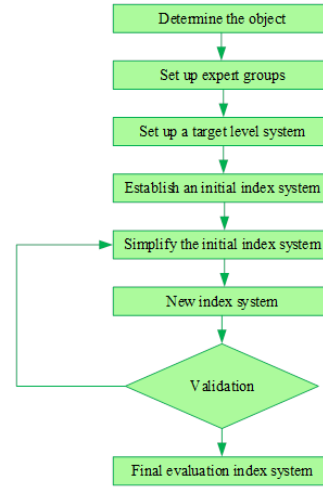


Figure 2: The fuzzy comprehensive evaluation index system is established

B. Establishment of fuzzy comprehensive judgment index system

To comprehensively assess the optimization of objectives from diverse perspectives, it is imperative to employ a multitude of indicators and assign varying weights to each, thereby reflecting the distinct significance of each indicator. The evaluation grade standard serves as the basis upon which the expert panel conducts their assessments.

The indicator system is of paramount importance in evaluating the evaluation object. Only with a comprehensive and accurate indicator system can a comprehensive and objective evaluation of the object be formed. The establishment of such a system is not arbitrary but necessitates the involvement of scholars, experts, and system analysts who possess profound knowledge in evaluating the specific object. This process entails adherence to specific procedures, adherence to certain principles, and thorough screening. Ultimately, the effectiveness of the established indicator system must be validated through experiments, thereby formalizing it as the effective evaluation factor indicator system for the object under consideration.

The establishment of the fuzzy comprehensive judgment indicator system, as illustrated in Figure 2, involves several pivotal steps: identifying the evaluation object, assembling an expert panel, constructing a target hierarchy system, and refining the initial indicator system through simplification to yield a refined indicator system. Subsequently, fuzzy synthesis is employed to authenticate the indices' validity, culminating in the establishment of a definitive index system aimed at assessing the level of core literacy cultivation in physical education and health courses within the OBE framework.

C. Weight calculation based on multilevel fuzzy comprehensive evaluation

Table 3 presents the outcomes of both the individual and overall rankings of indicators, revealing that three secondary

indicators—emotion regulation and management, sports cognition, and sports ethics—exert a significant influence on the development of core literacy in sports. These indicators possess respective weight values of 0.1053, 0.1051, and 0.1048, indicating their comparative importance. Subsequently, the mastery and utilization of health knowledge emerges as another influential factor, assigned a weight value of 0.1023.

IV. Validation of the Core Literacy Evaluation Index System for Physical Education and Health Courses

In order to ensure that the constructed evaluation index system is scientific and operable, the study selected 20 junior students of a college's physical education and health program as a sample for empirical testing to validate the index system.

A. Sample for empirical tests

For the purpose of evaluation, the study selected a cohort of 20 students enrolled in the physical education and health course at a university, where the students had a strong mutual acquaintance. Utilizing the evaluation form previously developed in an earlier paper, specifically tailored to assess the development of core literacy in physical education and health courses under the OBE framework, the form was administered to the participants for completion. Following submission, the questionnaires were retrieved and assigned unique identifiers (N1-N20) to facilitate subsequent data analysis and computation.

B. Fuzzy synthesized judgment method

The Core Literacy Development Evaluation Form was disseminated to all participating students (N1-N20), who subsequently completed the form. Specifically, student N1 initiated the process by self-evaluating and then proceeded to evaluate his/her teammates (N2, N3, ..., and so forth) in a sequential manner. Following this, each student from N2 to N20 repeated the same process, resulting in a comprehensive set of evaluations. Once all evaluations were completed, the questionnaires were collected and the data was organized to generate a statistical table. To illustrate, let us consider student N1 as a case study. The data statistics pertaining to student N1 are presented in Table 4. According to student N1's evaluation, the most advanced development of core literacy among the 20 students was observed in the domain of sports ethics, with 17 students demonstrating a commendable level of fairness and justice, earning an A grade, indicative of excellence. Following closely behind in terms of development were indicators related to the endurance quality of physical development, the reasonable emotional expression facet of emotional regulation and management, as well as the integrity and self-discipline aspects of sports ethics.

The data pertaining to the core literacy development levels of 20 students were incorporated to derive a ranking of their respective core literacy level scores, which is presented in Table 5. The ranking system employed grades of A (Excellent), B (Good), C (Medium), and D (Poor), assigned scores of 90, 75, 60, and 45, respectively.

Student N3 achieved the highest rank in physical education core literacy level, with a score of 88.9275. The combined weights assigned to the four grades of A (Excellent), B (Good), C (Moderate), and D (Poor) were 0.9635, 0.0015, 0.0350, and 0, respectively.

Collectively, all 20 students surpassed the average performance across all indicators of core literacy development, with none receiving a D grade. Notably, all students demonstrated proficiency in every indicator, underscoring their competencies. The lowest total rating score, achieved by student N10, was 77.856, which serves as evidence that the 20 randomly selected students possess a satisfactory level of core literacy. Furthermore, this finding suggests that the current physical education and health curriculum's core literacy development program aligns with the curriculum's requirements and adheres to the principle of fostering students' core literacy development.

Upon comparing the final score rankings of the 20 students with the qualitative and quantitative evaluation results provided by the coaches, it is observed that N3, N1, and N12 share the top position, while N7, N6, N14, and N10 are ranked jointly in second place.

The ranking of the final weighted average results aligns well with the qualitative analysis provided by the coach, suggesting that the ranking of the indicator system exhibits greater scientific rigor. A comprehensive comparison between qualitative and quantitative assessments validates the efficacy of the proposed Outcome-Based Education (OBE) evaluation index system for core literacy in physical education and health courses. This system is shown to cater effectively to the developmental needs of students and accurately reflects their core literacy levels in these courses.

V. Strategies for Improving the Teaching of Physical Education and Health Courses

A. Improvement of training and implementation policies

1) Strengthening the focus of schools

The level of attention bestowed upon physical education by schools and their respective leaders indirectly influences the core literacy of college students in this domain. This degree of support and attention serves as both a prerequisite and a guarantee for the successful implementation of cultivation efforts undertaken by departments and educators. Consequently, it is imperative for schools and leaders to articulate their unequivocal support for such endeavors. Historically, within the traditional exam-oriented education paradigm, physical education has often been misconstrued as a hindrance to students' intellectual development. However, amidst the ongoing reform aimed at fostering core literacy education, school leaders must embark on a paradigm shift, recognizing the intrinsic value of physical education. This necessitates treating physical education with parity, prioritizing the cultivation of college students' core literacy in this field, accurately interpreting

Target layer	Criterion layer	Criterion layer weight	Tertiary index	Total sorting
The core literacy culture level evaluation index system of the OBE concept	B1 Motor cognition	0.1051	C1.1 Physical terms cognition	0.0225
			C1.2 Action cognition	0.0236
			C1.3 Field equipment cognition	0.0252
	B2 Skill use	0.0936	C2.1 Exercise the physical practice method for fitness guidance	0.0361
			C2.2 Use sporting events to organize competitions	0.0358
			C2.3 Demonstrate the teaching of sports teaching	0.0335
	B3 Physical development	0.0988	C3.1 Development power quality	0.0425
			C3.2 Speed quality	0.0505
			C3.3 Develop endurance quality	0.0451
	B4 Exercise awareness and habit	0.0966	C3.4 Develop the quality of flexibility	0.0353
			C3.5 Develop sensitive and harmonious quality	0.0462
			C3.6 Improve the pulse and lung capacity	0.0351
	B5 Health knowledge mastery and application	0.1023	C4.1 Sports safety awareness	0.0368
			C4.2 Motivational consciousness	0.0454
			C5.1 Familiar with the concept of health and the factors that affect health	0.0325
	B6 Emotional control and management	0.1053	C5.2 Knowledge of injury and first aid	0.0312
			C5.4 Healthy lifestyle	0.0256
			C6.1 Reasonable emotional expression	0.0459
	B7 Adaptive ability	0.1004	C6.2 Positive energy interaction	0.0365
			C6.3 Effective emotional control	0.019
			C7.1 Interpersonal communication	0.0382
	B8 Sports ethics	0.1048	C7.2 Competitive consciousness	0.0236
			C8.2 Follow the rules	0.0272
			C8.3 Self-discipline	0.0283
	B9 Sportsmanship	0.0968	C8.4 Fair and fair	0.0255
			C9.2 Tenacity	0.0336
			C9.3 Beyond oneself	0.0228
	B10 Physical character	0.0963	C10.1 Teamwork	0.0209
			C10.2 Mutual respect	0.0382
			C10.5 Right game	0.0373

Table 3: Index single sequence and index total sort result

Tertiary index	A superior	B good	C medium	D poor
C1.1 Physical terms cognition	14	5	1	0
C1.2 Action cognition	15	2	3	0
C1.3 Field equipment cognition	12	6	2	0
C2.1 Exercise the physical practice method for fitness guidance	15	5	0	0
C2.2 Use sporting events to organize competitions	13	2	5	0
C2.3 Demonstrate the teaching of sports teaching	12	8	0	0
C3.1 Development power quality	14	5	1	0
C3.2 Speed quality	13	6	1	0
C3.3 Develop endurance quality	16	4	0	0
C3.4 Develop the quality of flexibility	15	4	1	0
C3.5 Develop sensitive and harmonious quality	13	7	0	0
C3.6 Improve the pulse and lung capacity	14	3	3	0
C4.1 Sports safety awareness	15	2	3	0
C4.2 Motivational consciousness	14	5	1	0
C5.1 Familiar with the concept of health and the factors that affect health	12	6	2	0
C5.2 Knowledge of injury and first aid	12	7	1	0
C5.4 Healthy lifestyle	15	5	0	0
C6.1 Reasonable emotional expression	16	1	3	0
C6.2 Positive energy interaction	14	6	0	0
C6.3 Effective emotional control	15	4	1	0
C7.1 Interpersonal communication	15	2	3	0
C7.2 Competitive consciousness	14	6	0	0
C8.2 Follow the rules	15	3	2	0
C8.3 Self-discipline	16	3	1	0
C8.4 Fair and fair	17	2	1	0
C9.2 Tenacity	14	2	4	0
C9.3 Beyond oneself	13	5	2	0
C10.1 Teamwork	15	2	3	0
C10.2 Mutual respect	14	3	3	0
C10.5 Right game	14	2	4	0

Table 4: N1 athlete data statistics

Athlete number	A superior	B good	C medium	D poor	Scoring
N3	0.9635	0.0015	0.035	0	88.9275
N1	0.8652	0.0869	0.0479	0	87.2595
N12	0.8241	0.0756	0.1003	0	85.857
N19	0.7574	0.0826	0.16	0	83.961
N5	0.7461	0.1638	0.0901	0	84.84
N18	0.6881	0.1725	0.1394	0	83.2305
N17	0.669	0.1725	0.1585	0	82.6575
N8	0.668	0.2539	0.0781	0	83.8485
N9	0.6557	0.335	0.0093	0	84.696
N20	0.6251	0.1851	0.1898	0	81.5295
N11	0.6201	0.2724	0.1075	0	82.689
N13	0.6193	0.2643	0.1164	0	82.5435
N2	0.6174	0.3683	0.0143	0	84.0465
N4	0.6128	0.1978	0.1894	0	81.351
N15	0.6055	0.2524	0.1421	0	81.951
N6	0.5934	0.1935	0.2131	0	80.7045
N7	0.5869	0.1827	0.2304	0	80.3475
N16	0.5721	0.3576	0.0703	0	82.527
N14	0.5628	0.2571	0.1801	0	80.7405
N10	0.5536	0.0832	0.3632	0	77.856

Table 5: The students' core literacy level is ranked

work, ensuring its effectiveness and efficiency.

Schools ought to integrate the cultivation of sports core literacy into the individualized educational framework of colleges and universities, thereby crafting an overarching plan. This necessitates the formulation of a coherent cultivation and implementation policy that avoids haphazard execution and emphasizes the pivotal guiding role of the system. Furthermore, it is advocated that the implementation of sports core literacy among college students be ensured through the establishment of pertinent implementation policies, foundational supervisory mechanisms, and rigorous evaluation systems.

3) Incentive mechanisms for sound implementation

To bolster the enthusiasm and initiative exhibited by schools and teachers in implementing the cultivation of college students' physical education core literacy, it is imperative for the

relevant policies, and orchestrating the seamless execution of implementation plans.

2) Establishment of institutional safeguard mechanisms

Schools ought to devise a comprehensive macro-level cultivation policy that encapsulates the overall situation and outlines specific implementation strategies. Furthermore, they should decentralize the cultivation of sports core literacy components into distinct tasks, facilitating a more targeted approach. This, in turn, enables detailed analysis and shaping of the cultivation

pertinent government agencies and educational departments to undertake robust measures aimed at refining the corresponding incentive mechanism.

As a senior editor for SCI, I would suggest the following revisions to the provided text segment to improve its suitability for an English academic paper, while adhering to the instruction not to alter potentially incorrect terminology.

Secondly, it is imperative to ensure the status of teachers, particularly acknowledging the pivotal responsibility and indispensable role of physical education teachers, along with recognizing their noteworthy achievements in the past.

B. Creating a favorable sports environment

1) Improvement of hardware resources for sports

The school's sports hardware resources constitute the fundamental prerequisites for sports activities and are intricately intertwined with the enhancement of college students' sports core literacy. The essence of sports enjoyment often stems from the manipulation of sports equipment and the achievement of success. These hardware resources encompass a diverse array, comprising sports venues, diverse sports apparatuses, teaching aids, and other pertinent aspects. The adequacy of hardware resources serves as the bedrock for fostering college students' sports core literacy. The scarcity of sports venues, facilities, and equipment is a pivotal factor impeding the implementation of engaging and varied sports activities. The monotony of repetitive movements and exercises can hinder students' interest, underscoring the need for school administrators at all levels to prioritize and endeavor to upgrade the school's sports facilities.

2) Creating a sporting culture

Campus sports culture encompasses all cultural phenomena associated with sports that are primarily concentrated within the spatial confines of the university campus. It is imperative for college students to possess a vast array of sports knowledge, which not only facilitates their ability to engage in sports more accurately, thereby promoting the development of healthy behaviors, but also enriches their understanding of sports' inherent value and deepens their appreciation for sports culture. To this end, institutions should establish sports publicity platforms, diversify sports activities, and increase the frequency of sports competitions. Furthermore, organizing a series of lectures focused on sports core literacy, leveraging the influence of sports media, can effectively foster a conducive sports culture atmosphere. This, in turn, will enrich the sports knowledge base of college students, enabling them to discover the joys inherent in sports, alter preconceived notions, and establish appropriate values regarding sports.

VI. Conclusion

The OBE concept, as a new conceptual support for the evaluation system of physical education teaching, highlights the process evaluation of teaching results, which can implement a comprehensive evaluation of students' core literacy and

realize continuous improvement. This paper takes the OBE concept as the overall concept of the evaluation system construction, and utilizes the multi-layer fuzzy comprehensive judgment method to construct the evaluation index system of core literacy cultivation level. In view of the verification results of the evaluation index system of core literacy cultivation in physical education and health courses, the teaching improvement strategy of physical education and health courses is proposed.

Multi-layer fuzzy comprehensive judgment was utilized to obtain the weights of each indicator, and the weights of the 10 second-level indicators were 0.1051, 0.0936, 0.0988, 0.0966, 0.1023, 0.1053, 0.1004, 0.1048, 0.0968, and 0.0963, respectively.

For the purpose of validating the evaluation index system designed to assess the level of core literacy development, a sample of student data was selected. The validation results revealed that 20 students exceeded the average performance across all indices of core literacy development, with no instances of D grades recorded. Furthermore, each index demonstrated significant development in ability. Notably, the final weighted average results ranking closely aligns with the qualitative analysis conducted by the coach, indicating a heightened level of scientific rigor in the index system's ranking methodology. Consequently, this underscores the capability of the evaluation index system proposed in this paper, which is grounded in the Outcome-Based Education (OBE) concept for physical education and health courses, to adequately meet the practical needs of students and accurately reflect their level of core literacy in these courses.

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