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Research on the Construction of Index System to Promote the Sustainable Development of Core Literacy of Physical Education Teachers in Chinese Universities from the Perspective of Higher Education Modernization

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Abstract: This study aims to comprehensively explore the core competencies required of physical education teachers in universities, within the context of modernizing higher education. The goal is to build an index system that conforms to the development of the core literacy of college PE teachers. With the vigorous development of higher education, increasingly higher requirements are placed for college teachers. Starting from the perspective of higher education modernization, this study comprehensively explores the corresponding core qualities of physical education teachers in colleges and universities, which has certain research value. The research utilizes qualitative analysis, the Delphi method, and the analytic hierarchy process to construct a comprehensive indicator system that includes four primary indicators: moral character, educational ability, teaching competence, and research expertise. These primary indicators are further divided into 15 secondary indicators, such as political morality, information literacy integration, research concept literacy, and educational and teaching philosophy, and 53 tertiary indicators, such as the integration of ideological and political education into the curriculum, information ethics and morality, research values, and pre-class teaching decision-making data. The analytic hierarchy process is employed to determine the weight coefficients of each level of indicators, as well as the comprehensive weight coefficients of the secondary and tertiary indicators. The primary indicators of the system are representative and used to determine the appropriate weight of the indicator system for different types of physical education teachers. The study found: 1. That moral character and educational ability occupy the first and second proportions, respectively, in the weight coefficients of the core competencies of different types of physical education teachers. 2. Teaching and research-oriented teachers have a considerable proportion of teaching and research expertise, respectively. 3. Research-oriented physical education teachers have a much higher proportion of research expertise than teaching expertise. 4. Teaching-oriented physical education teachers have a higher proportion of teaching expertise than research expertise. Discuss: The constructed indicator system is scientifically sound and structurally reasonable, providing theoretical reference and guidance for the evaluation and cultivation of core competencies of physical education teachers in universities, and effectively helps the sustainable development of college physical education teachers.

Keywords: modernization of higher education; physical education teachers in universities; core competencies; morality; educational ability; scientific research; teaching ability

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1. Introduction

"Education promotes national prosperity, and a strong education system leads to a strong nation" [1] highlights the crucial role that education plays in shaping the development of a country. The development of core competencies for students at all levels is based on a core competency system that defines specific educational goals and tasks for

each level and subject [2]. In addition, the deep integration of the three core qualities of "sports morality, health behavior and sports ability" and physical education teaching in colleges and universities is an important task of the current physical education and health curriculum reform. The cultivation of teachers' core accomplishments is related to the development of students' core accomplishments and the construction of physical education and health curriculum, which is the key element to supporting the implementation of the strategic task of higher education modernization. In recent years, the field of education for sustainability in higher education has seen rapid development [3]. As a result, education modernization has been achieved, and countries have gradually become education powerhouses, vigorously promoting comprehensive reforms in the education sector. The modernization of higher education, as an important component of education modernization, has been incorporated into the requirements of national modernization development, in line with the direction of comprehensive deepening of reforms and the fundamental goal of building an education power in the new era. Education at all levels and types around the world has entered a new stage of high-quality development, and the education sector is making rapid and significant progress.

Physical education is analyzed in this context as an important subject in the higher education sequence and physical education teachers are considered to play a central role in determining the success or failure of the subject. Therefore, it is crucial to carry out top-level design for the modernization of higher education, explore the modernization path of physical education in universities, and construct a reasonable indicator system of core competencies for physical education teachers in universities based on the requirements for teacher development in the context of education modernization. This will provide clear and effective guidance for the cultivation and evaluation of physical education teachers in universities. The research status of physical education, educational modernization, and teachers' core literacy is analyzed from the perspective of internationalization.

First of all, it is research related to the modernization of higher education. We use CiteSpace.5.8.R3c software to carry out visual analysis. The research data comes from the core collection database of Web of Science, and the search information is as follows: With "Modernization of higher education" as the main inscription, a total of 5254 records were retrieved (Figure 1).

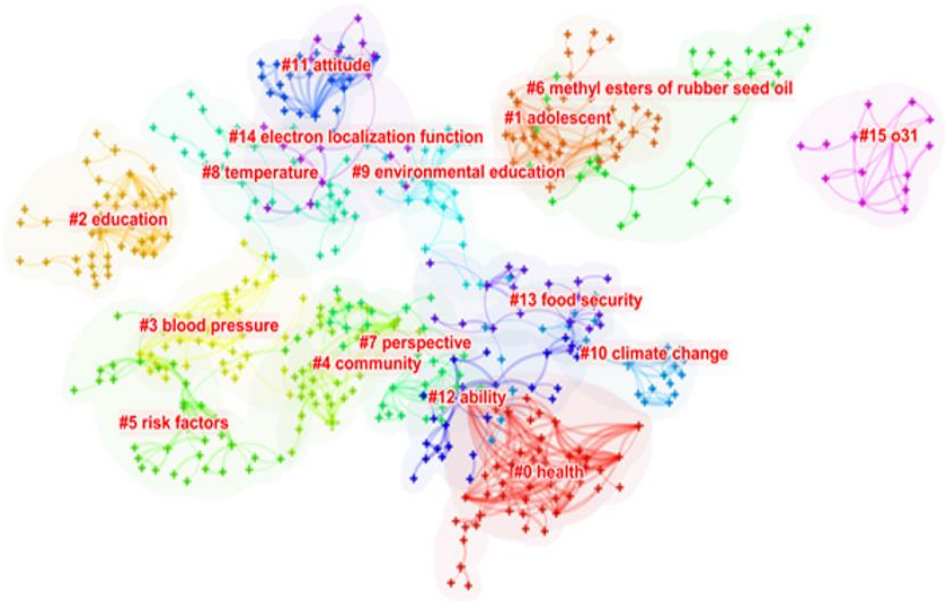

Figure 1. Keywords of foreign higher education modernization research cluster analysis graph.

As can be seen from the figure, the research on the modernization of foreign higher education mainly consists of numerous cluster knowledge groups. Including "electron localization function", "food security", "ability", "attitude" and "climate change", these

knowledge groups represent the hot issues and frontier fields of higher education modernization research abroad. From the historical level of comparison and analysis, it can be asserted that Western education has proved this point, to be competitive in the modernization of education, to be selective, but to have a fundamentally different model, and finally to draw a specific conclusion, to develop the modernization of education according to its own reality [4]. Higher education modernization is a core driver in developing a nation's education [5]. Influenced by the globalization process, the higher education of Central Asian countries has undergone key changes, the general trend of educational modernization has expanded, and the educational pattern has a remarkable diversity [6]. Portugal has integrated the school system into social and political developments, while the modernity of education has brought school cartography closer to demographic, administrative, and cultural cartography, which has historical and pedagogical importance in the modernization of school education [7]. Russia, on the other hand, focuses on the logic and design of practice-oriented educational programs to promote the modernization of education [8].

Second, look at the related research in the field of physical education. The Norwegian state attaches great importance to physical education activities. The students expressed as important the fact that the pupils in PE obtain a lot of physical activity through a variety of activities. Furthermore, the students believe that physical learning and motivation are connected and are mutually important to each other and that the joy of movement is central to the subject, teachers play an important role in this process [9]. Physical education teachers need to further improve their ability of inclusive education. Teachers' inclusive education competency is an important factor influencing the realization of high-quality inclusive education [10]. In physical education teaching, from immediate, short-term events to distant, long-term events, both teachers and students have relevant factors that lead to an active lifestyle for adolescents [11]. In addition, studies have shown that physical education can also improve attention problems in children and adolescents [12]. With the acceleration of the educational information process, the management and integration of college sports resources through cloud computing can promote the mutual exchange of college resources and have practical significance for the development of college education [13]. Physical education runs through people's lives, so as to promote people's all-round development through high-quality physical education [14].

Third, look at the research of teacher core literacy-related fields. The influence of teachers' core literacy on teaching quality and students' achievement is an important criterion to measure the external validity of education [15], In order to strengthen the integrated training of European teachers, the European Union has published a series of education policy reports. Scotland, the Netherlands, Serbia, and other countries have taken this as a model and formulated a specific core "competence list" of teachers according to their own teachers' competence characteristics [16].The European Union also believes that teachers should "fully grasp the functions of current education, the possibilities and limitations of development, fully understand the core qualities and the connotation of teacher professionalism, and strive to acquire knowledge related to the improvement of the quality of school education" [17].The National Institute of Education of Singapore takes the cultivation of teachers' values as the core and guidance, runs through the learning and application of knowledge and skills, and aims to cultivate teachers' professional qualities for the future teaching profession through the guidance of teachers' values [18]. The contents of teachers' core literacy should be future-oriented and reflect the characteristics of the times. Meanwhile, they should pay more attention to the particularity of politics, economy, and culture and reflect the obvious local characteristics [19].

Our results showed that previous studies mainly focus on the modernization of physical education and the core competence of physical education educators. However, a notable research gap exists regarding the specific cultivation of core competencies for physical education teachers in higher education settings. As an integral component of the higher education curriculum, physical education plays a critical role in the physical

and psychological development of students, exerting influence even on their academic performance across other subjects. Consequently, it assumes an indispensable position within the higher education continuum. The role of physical education teachers in higher education institutions assumes paramount importance in determining the triumph or failure of this discipline. Only through fostering their sustainable development can we effectively nurture the growth of both students and the discipline as a whole. The evaluation of physical education teachers' core competencies can be effectively achieved by assessing students' performance, thereby facilitating the advancement of physical education and health curricula.

This study distinguishes itself from previous research endeavors by anchoring itself in the context of higher education modernization. Methodologically, it employs qualitative analysis, the Delphi method, and the analytic hierarchy process to establish a comprehensive framework for the modernization of higher education. Focusing specifically on physical education instructors in higher education institutions, this study explores the trajectory toward realizing modernization in the field of physical education at the university level. By taking into account the requisites for faculty development within the purview of educational modernization, a robust system of core competencies for physical education teachers in higher education institutions is methodically constructed. This system effectively serves as an evaluative instrument, aiming to furnish lucid and efficacious guidance for the cultivation and assessment of physical education teachers within higher education institutions. Consequently, the significance of this research lies notably in its potential to contribute to the advancement of higher education institutions as a whole.

2. Materials and Methods

The methodology of this article will be introduced in this section. Research concept: Pay attention to the innovation of the core quality of teachers, and promote the sustainable development of college physical education teachers; Research methods: Qualitative analysis, Delphi method, analytic hierarchy process, and mathematical statistics were used. Research strategy: The index system was initially constructed by Delphi method, and then the importance of different indicators was compared by analytic hierarchy process (AHP). Finally, the first-level index weights of the four dimensions of the index system were used to determine the appropriate weights of the index system under different types of college physical education teachers; Time frame: 20th century to present; Data collection and analysis: calculate average, full score frequency, coefficient of variation, coordination coefficient and weight coefficient; Scale development: The core literacy index system of college physical education teachers constructed from the perspective of internationalization will be suitable for more countries to adopt; Software used: Nvivo 12, CiteSpace.5.8.R3c, MATLAB 9.1, Excel 2016, IBM SPSS Statistics 22; Ethical aspects: The study meets ethical requirements.

2.1. Qualitative Textual Analysis Method

In the initial stage, the relevant literature materials were subjected to keyword clustering visualization analysis using the CiteSpace.5.8.R3c visualization knowledge map analysis software. Subsequently, representative knowledge clusters were identified, and the NVivo 12 qualitative data analysis software was utilized to effectively code the nodes. Through this method, the core competencies indicator structure for physical education teachers in Chinese universities was preliminarily selected.

2.2. Delphi Method and Analytic Hierarchy Process

The Delphi method was employed to select indicators and solicit input from multiple experts, drawing on their expertise and knowledge. Anonymity was maintained throughout the process to allow each expert to independently provide their assessments. After two rounds of inquiry, the expert opinions gradually converged, leading to the establishment of a set of widely representative indicators. Using the established indicator system as a model, a judgment matrix was constructed to compare the importance of each indicator at

each hierarchical level. The derived weight coefficients were then calculated to accurately distinguish the importance of each indicator. For pairwise comparisons of indicators at the same hierarchical level in the core competencies indicator system for physical education teachers in Chinese universities, the Saaty 1–9 scale was used as the standard to assign relative importance values. Finally, the data were transformed into pairwise comparison judgment matrices, and consistency tests were conducted on each judgment matrix to calculate the weight coefficients.

The number of experts selected would vary depending on the scope of the research, but generally, it is recommended to select 8–20 experts [20].The selection criteria for experts mainly focus on: (1) education experts with relevant research experience in higher education; (2) experts with experience in teacher education research; (3) humanities and social science experts with a research focus on core competencies for physical education teachers; and (4) physical education teachers from different types of universities. The selection criteria aim to ensure that experts meet professional requirements, have sufficient energy, can speak freely, and provide open feedback [21].

According to the above criteria, 18 professors and 7 associate professors from Beijing Normal University, Beijing Sport University, and East China Normal University were selected to determine the indicators and weights. The expert correspondence form is in Appendix A.

2.3. Mathematical Statistics Method

To collect, process, and analyze data, Excel 2007 was employed to calculate the mean, percentage, and coefficient of variation. The consistency of the data was tested using SPSS 22.0 software, whereas the weight coefficients of the indicators were calculated using MATLAB 9.1 software.

3. Results

3.1. The Initial Development of the Core Competencies Indicator System for Physical Education Teachers

3.1.1. Methodology for Initial Development

Qualitative text analysis was employed in this stage, and the CiteSpace V software was utilized to visualize and cluster keywords in the relevant literature. Representative knowledge clusters were selected, and the NVivo 12 qualitative data analysis software was used for coding the nodes. In NVivo 12, modern teacher moral literacy, modern teacher knowledge literacy, modern teacher teaching literacy, and modern teacher research literacy were established as parent nodes, and related contents in the text were extracted and coded to generate several child nodes. The coding process continued until no new categories were identified, achieving saturation. As a result of the initial development, a core competencies indicator system for physical education teachers in Chinese universities was created, consisting of four primary indicators, thirteen secondary indicators, and fifty-three tertiary indicators.

3.1.2. Principles for Initial Development

To ensure the scientific and practical value of the constructed indicators, the principles of objectivity, scientificity, integrity, significance, feasibility, and representativeness were adhered to in selecting the indicators, constructing the framework, and arranging the hierarchy. These principles were employed to ensure the overall coherence and logical soundness of the indicator system.

3.2. Optimization of the Core Competencies Indicator System for Physical Education Teachers in Universities

3.2.1. Positive Response Rate of Experts

The positive response rate of experts is a crucial factor in evaluating the quality and reliability of research results. In the first round of expert inquiry, a total of 19 inquiry ques-

tionnaires were distributed, and all 19 were returned, resulting in a response rate of 100%. This high response rate in the initial round indicates a strong willingness and commitment of the experts to participate in the research and provide valuable feedback. In the second round of expert inquiry, 19 inquiry questionnaires were distributed, and 18 were returned, resulting in a response rate of 94.7%. Although the response rate slightly decreased in the second round, the remaining 18 questionnaires still represent a considerable number of expert opinions, which further confirms the high level of participation and engagement of the experts in the research process. In summary, the positive response rate of experts in both rounds of inquiry demonstrates the importance and relevance of the research topic and the effectiveness of the research design in eliciting valuable feedback from the experts. Their active participation and engagement have contributed to the quality and reliability of the research findings.

3.2.2. Expert Authority

Expert authority plays a critical role in assessing the reliability and validity of research outcomes. In the first round of inquiry, experts demonstrated a judgment coefficient (Ca) of 0.94 and a familiarity coefficient (Cs) of 0.89, resulting in an expert authority level of $(Ca + Cs)/2 = 0.92 > 0.7$. During the second round of inquiry, experts had a judgment coefficient (Ca) of 0.97, a familiarity coefficient (Cs) of 0.84, and an expert authority level of $(Ca + Cs)/2 = 0.91 > 0.7$. It is widely accepted that an expert authority level greater than or equal to 0.7 indicates a high level of expertise and authority. In summary, the expert authority levels achieved during both rounds of inquiry indicate that the participating experts possess a high level of expertise and authority in the research area. Their valuable insights and feedback have significantly contributed to the reliability and validity of the research outcomes.

3.2.3. Concentration of Expert Opinions

The concentration of expert opinions is a crucial determinant of research outcomes' validity and reliability. During the first round of expert inquiry, the average scores for the first-, second-, and third-level indicators ranged between 4.53–4.95, 4.32–4.95, and 3.84–4.95, respectively. The maximum frequency of scores for most indicators was between 0.63–0.95, 0.47–0.95, and 0.42–0.95 for the first-, second-, and third-level indicators, respectively. However, the second-level indicator "rich general knowledge" scored 0.37, the third-level indicator "public sports management" scored 0.16, and "relevant knowledge of sports event organization" scored 0.32, which were relatively low and required further discussion in the later stages. The remaining indicators met the inclusion criteria. During the second round of expert inquiry, the average scores for the first-, second-, and third-level indicators were between 4.5–5, 4.61–5, and 4.11–4.94, respectively. The maximum frequency of scores for most indicators was between 0.56–1, 0.56–0.95, and 0.44–0.94 for the first-, second-, and third-level indicators, respectively. However, the third-level indicators "public sports management" scored 0.33, "rich facial expressions" scored 0.33, and "management knowledge of high-level sports teams" scored 0.28, which were relatively low and required further discussion in the later stages. The remaining indicators met the inclusion criteria. In summary, the concentration of expert opinions in both rounds of inquiry suggests that most indicators met the inclusion criteria. However, a few indicators scored relatively low and necessitated further discussion in the later stages.

3.2.4. Coordination of Expert Opinions

The coordination of expert opinions is typically quantified using the coefficient of variation and coordination coefficient. During the first round of expert inquiry, the coefficient of variation (Vj) for the first-, second-, and third-level indicators ranged between 0.05–0.17, 0.05–0.21, and 0.05–0.22, respectively, all of which were less than 0.25 and therefore satisfied the inclusion criteria. Similarly, in the second round of expert inquiry, the coefficient of variation (Vj) for the first-, second-, and third-level indicators ranged between 0.00–0.11,

0.00–0.13, and 0.05–0.18, respectively, with all indicators meeting inclusion criteria. Both the overall Kendall coordination coefficient W and chi-square were computed for both rounds of expert inquiry. The coefficient of W was 0.249 and 0.205 for the first and second rounds, respectively, and the chi-square was 326.010 and 261.916, respectively, with a *p*-value of 0.000 for both rounds. The coefficient of W ranges between 0 and 1, indicating a high degree of evaluation consistency. Moreover, the *p*-value of 0.000 < 0.05 indicates a significant level of consistency among the evaluations of each indicator. In summary, the coordination of expert opinions, as determined by the coefficient of variation and coordination coefficient, satisfied the inclusion criteria in both rounds of expert inquiry. The Kendall coordination coefficient and chi-square results imply a high level of consistency among the evaluations of each indicator.

3.2.5. Summary of Expert Opinions on the Results of Two Rounds of Correspondence

- **Summary of expert opinions on the results of the first round of inquiry**.

Modified indicators: The first-level indicators underwent revision to incorporate "moral literacy", "educational competence literacy", "teaching competence literacy", and "research competence literacy", based on expert recommendations. Of particular note was the emphasis placed on educational competence as a core competency for university physical education teachers. Accordingly, the previously proposed "modern teacher knowledge literacy" was subsumed under educational competence. The indicators were then revised to enhance their concision and precision, with redundant modifiers removed.

The second-level indicator "solid knowledge of sports disciplines" underwent revision to emphasize "the ability to solidify knowledge of sports disciplines". Similarly, "other comprehensive knowledge related to sports disciplines" was revised to "the ability to integrate other comprehensive knowledge related to sports disciplines", while "rich general knowledge" was modified to "the ability to acquire general knowledge".

The third-level indicators underwent revision to more accurately convey their intended meaning. For example, "incorporating ideological and political thinking into curriculum design" was refined to "incorporating ideological and political thinking into curriculum design thinking". Similarly, "implementing the party's line, principles, and policies" was modified to "implementing the party's educational line, principles, and policies". "Spirit of innovation" was changed to "spirit of hard work", while "sports and medicine" was revised to "medical knowledge for sports injuries". "Sports and nutrition" was modified to "nutrition knowledge to promote exercise health", and "sports and psychology" was changed to "psychology knowledge to overcome competition stress and anxiety". "Sports and physiology" was revised to "physiology knowledge to regulate energy metabolism and cardiopulmonary function", and "sports and management" was modified to "management knowledge to ensure sports events and school sports organizations". Additionally, "modern information education technology knowledge" was changed to "knowledge for the professional development of physical education teachers", while "the ability to acquire cutting-edge knowledge in the field" was revised to "the ability to create cutting-edge knowledge in the field".

Added indicators: The revised indicator system includes two second-level indicators, namely "the ability to integrate information literacy" and "the ability to express body language", as well as seven third-level indicators. These third-level indicators include "information ethics and morality", "information awareness needs", "information knowledge and skills", "rich expression language", "three-dimensional spatial language", "dignified demeanor language", and "standardized voice language".

Deleted indicators: Including seven third-level indicators, namely "technical and theoretical skills for writing sports research papers", "knowledge of sports human science", "dedication to work", "lifelong education", "teaching and educating people", "sports and biology", and "sports and sociology". These indicators capture the diverse range of competencies required of university physical education teachers, including their ability to

conduct research and effectively communicate their findings, as well as their knowledge of various disciplinary domains that intersect with sports and physical education.

- **Summary of Expert Opinions on the Results of the Second Round of Inquiry**.

The results of the data analysis indicated that the full score frequencies of the third-level indicators "public sports management", "rich expression language", and "management knowledge of high-level sports teams" were relatively low, at 0.33, 0.33, and 0.28, respectively. Further consultation with experts revealed that "public sports management" pertains to diverse public sports organizations and their respective public sports affairs [22], and that university physical education teachers have a social responsibility to fulfill in this regard. The appropriate use of "rich expression language" in physical education classes can effectively convey ideas and emotions to students, thereby enhancing their learning efficiency. Given that university physical education teachers commonly serve as leaders, coaches, and directors of high-level sports teams, "management knowledge of high-level sports teams" was deemed necessary to support these roles. Consequently, these three indicators were retained. Modifiers of the indicators were removed in order to improve concision, and "the ability to integrate other comprehensive knowledge related to sports disciplines" was revised to "the ability to integrate other knowledge related to relevant disciplines".

Following two rounds of inquiry, the "Core literacy index system of college physical education teachers" was finalized. This system comprises 4 first-level indicators, 15 second-level indicators, and 53 third-level indicators.

3.3. Determining the Weighting of Core Competencies for Physical Education Teachers in Higher Education

The hierarchical structure model is organized on the basis of establishing the index system. Once the hierarchical structure model is finalized, a judgment matrix is constructed to facilitate pairwise comparisons among elements at the same level, thereby ascertaining the relative weights assigned to each element within each level. In this research, a relative importance scale utilizing a nine-point scale is introduced to assign values representing the significance of pairwise comparisons between indicators [23]. This approach enables the execution of both a single ranking and consistency test at each level, as well as an overall ranking and consistency test encompassing all levels.

3.3.1. Single Ranking and Consistency Test

The "root method" is used to find the maximum feature root and feature vector for single hierarchical ranking and consistency test. First, each row of the judgment matrix is normalized (M_i), calculate the "N"TH root of "M_i" ($\overline{W}$). The vector "$\overline{W}$" is normalized. The resulting "W_i" is the eigenvector of the judgment matrix. Then the maximum eigenroot "λ_{max}" of the judgment matrix is calculated. Finally, a consistency check is performed. First calculation $CI = \frac{\lambda_{max}-n}{n-1}$, RI value is taken, CR < 0.1 is calculated at last, and the judgment matrix passes the consistency test. Taking the first-level index as an example, the weight coefficients of the second-level index and third-level index of each judgment matrix are calculated, respectively, and the consistency test is carried out (Table 1).

Table 1. Quantification table of the relative importance degree of first-level indicators.

	Moral Accomplishment	Educational Ability and Accomplishment	Teaching Literacy	Scientific Research Literacy
Moral accomplishment	1.000	2.358	2.525	1.546
Educational ability and accomplishment	0.424	1.000	2.067	1.430
Teaching literacy	0.396	0.484	1.000	1.521
Scientific research literacy	0.647	0.699	0.657	1.000
Maximum characteristic root: λ_{max} = 4.158, CI = 0.0526, CR = 0.058				

3.3.2. Total Hierarchical Sorting and Consistency Test

Calculating comprehensive weight: $W = W^{(k)}\ W^{(k-1)} \ldots W^{(2)}$, "$K$" is the level, hierarchical total sort consistency test calculation: $CI = \frac{\sum_{j=1}^{n}(W_j \times CI_j)}{\sum_{j=1}^{n}(W_j \times RI_j)}$, the total ranking consistency test results (CR) of the secondary index and tertiary index were 0.035 and 0.046, respectively, with satisfactory consistency (Table 2).

Table 2. Core literacy index system of college physical education teachers (weight coefficient).

Primary Index (Weight)	Secondary Index (Weight, Comprehensive Weight)	Three-Level Index (Weight, Comprehensive Weight)
A1 Moral accomplishment (0.408)	**B1** Political morality (0.465,0.190)	**C1** Incorporating ideological and political thinking into the curriculum (0.555,0.105) **C2** Adhere to the direction of education (0.300,0.057) **C3** Implement educational lines, guidelines, and policies (0.145,0.027)
	B2 Professional ethics (0.298,0.122)	**C4** Noble dedication spirit (0.523,0.064) **C5** Spirit of hard work and struggle (0.328,0.040) **C6** Rigorous academic spirit (0.149,0.018)
	B3 Social public morality (0.237,0.097)	**C7** Public welfare sports activities (0.527,0.051) **C8** Public sports management (0.241,0.023) **C9** Public welfare sports services (0.232,0.022)
A2 Educational ability and accomplishment (0.248)	**B4** Integration of Information Literacy (0.366,0.091)	**C10** Information Ethics and Morality (0.522,0.047) **C11** Information Awareness and Needs (0.331,0.030) **C12** Information Knowledge and Skills (0.147,0.013)
	B5 Expressive Ability of Body Language (0.250,0.062)	**C13** Rich Facial Expressions (0.412,0.025) **C14** Three-dimensional Spatial Language (0.274,0.017) **C15** Dignified instrumentation language (0.199,0.012) **C16** Standard Vocal Language (0.115,0.007)
	B6 Solid Foundation in Physical Education Knowledge (0.154,0.038)	**C17** Relevant Knowledge of Sports Refereeing (0.320,0.012) **C18** Relevant Knowledge of Sports Event Organization (0.290,0.011) **C19** Management Knowledge of High-level Sports Teams (0.135,0.0051) **C20** Knowledge of Specialized Skills in Sports (0.130,0.0050) **C21** Training Knowledge of Sports Professional Teams (0.125,0.0048)
	B7 Integration of Other Comprehensive Knowledge Related to Physical Education (0.126,0.031)	**C22** Medical knowledge of coping with sports injuries (0.329,0.010) **C23** Nutrition knowledge to promote sports health (0.224,0.007) **C24** The psychological knowledge of overcoming competition nervousness and anxiety (0.177,0.006) **C25** Ensure the management knowledge of sports events and school sports organization (0.149,0.005) **C26** Physiological knowledge of regulating energy metabolism and cardiopulmonary function (0.121,0.004)
	B8 Acquisition of General Knowledge (0.104,0.026)	**C27** PE teacher career development knowledge (0.491,0.013) **C28** basic knowledge of physical education in Chinese colleges and universities (0.308,0.008) **C29** education target knowledge of physical education in Chinese colleges and universities (0.201,0.005)
A3 Scientific research literacy (0.173)	**B9** Research concept literacy (0.422,0.073)	**C30** Research values (0.498,0.036) **C31** Research function awareness (0.360,0.026) **C32** Research problem awareness (0.142,0.010)
	B10 Scientific research ability literacy (0.233,0.040)	**C33** Reflective ability in academic conferences (0.428,0.017) **C34** Ability to undertake research projects(0.209,0.008) **C35** ability to use research software (0.194,0.008) **C36** Ability to create interdisciplinary knowledge (0.097,0.004) **C37** Ability to apply interdisciplinary knowledge (0.072,0.003)
	B11 Scientific research theoretical literacy (0.192,0.033)	**C38** Basic principles and theories of sports science research (0.730,0.024) **C39** The basic method theory of sports science research (0.270,0.009)
	B12 Scientific research spirit (0.154,0.027)	**C40** Team spirit (0.454,0.012) **C41** Persistence spirit (0.217,0.006) **C42** Innovation spirit (0.216,0.006) **C43** Pragmatic spirit (0.113,0.003)
A4 Teaching literacy (0.172)	**B13** Educational teaching concept (0.479,0.082)	**C44** "Integration of sports and medicine" health teaching philosophy (0.337,0.028) **C45** "Moral education and cultivating students 'character" teaching philosophy (0.311,0.026) **C46** "Integration of sports and education' development" teaching philosophy (0.198,0.016) **C47** "Integration of the four dimensions" deep teaching philosophy (0.153,0.013)
	B14 Educational and teaching methods (0.316,0.054)	**C48** Teaching demonstration using information technology (0.478,0.026) **C49** Teaching practice using wearable AI devices (0.392,0.021) **C50** High-quality teaching guidance using a blended 'online + offline' approach (0.130,0.007)
	B15 Educational Assessment Methods (0.205,0.035)	**C51** Data-driven decision-making for pre-class teaching (0.536,0.019) **C52** Three-dimensional communication and interaction in-class (0.306,0.011) **C53** Timeliness of post-class evaluation and feedback (0.158,0.006)

4. Discussion: Discussion on the Weight of Each Index of the Core Literacy Index System of College Physical Education Teachers

4.1. Discussion on "Moral Accomplishment" Index and Its Subordinate Index

This dimension comprises one primary indicator, three secondary indicators, and nine tertiary indicators. Among all the primary indicators, "Moral accomplishment (0.408)" holds the highest weighting coefficient. Teacher ethics play a crucial role in the teaching process, and university physical education teachers have the professional mission of imparting knowledge, teaching skills, and resolving doubts. They also bear the responsibility of conducting research for the development of the discipline. There is no teacher morality running through all these activities, which will make teachers have the heart, but the strength is insufficient, and even go astray (Figure 2).

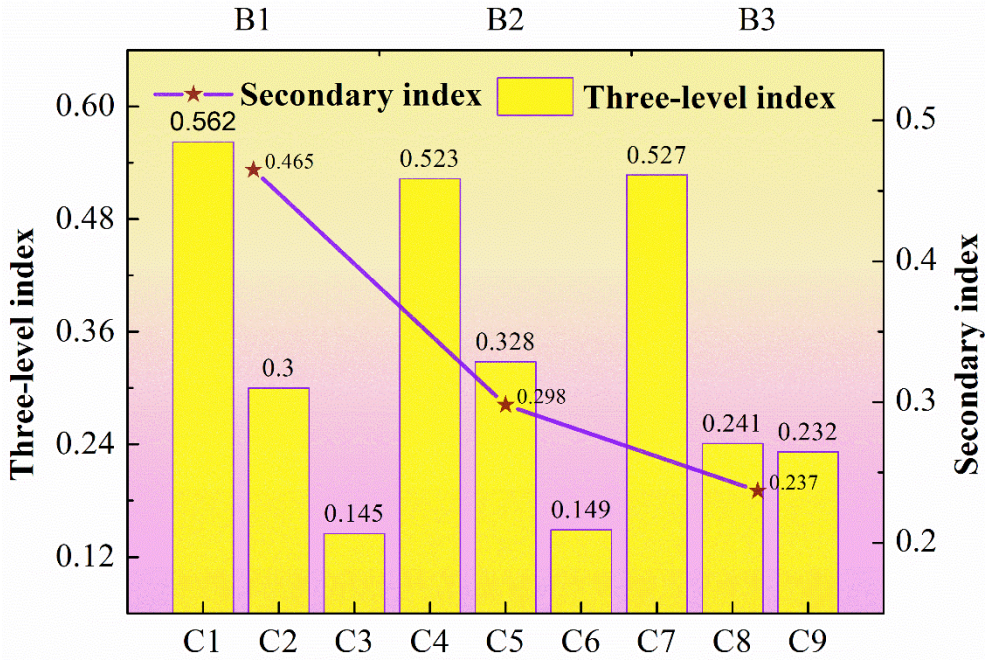

Figure 2. Weight coefficient of membership index under the dimension of "moral literacy".

The secondary indicators, ranked in descending order by a weighting coefficient, are "Political morality (0.465)", "Professional ethics (0.298)", and "Social ethics (0.237)". The overall ranking remains consistent. Within this hierarchy, "Political morality" stands out as the indicator with the highest weighting coefficient. In our country, university physical education teachers play a critical role in cultivating physical fitness and sports skills among the next generation of high-level talents and must maintain a clear political stance. "Professional ethics" refers to the relatively stable moral concepts formed by teachers during their engagement in educational teaching. Regardless of the time period, the foundation of education always lies in the teacher's own moral qualities and moral teaching, with knowledge being of secondary importance [24]. As university physical education teachers find themselves amidst rapid economic development and social transformation, intangible temptations arise, making it imperative to enhance the professional ethics of physical education teachers". Social public morality" pertains to an individual's commitment to serving the collective and upholding national moral principles. Previous studies often consider social ethics as the ability to make decisions regarding rightness or wrongness in situations involving a person's well-being, justice, rights, caring, and virtues. It also refers to the ability to regulate behaviors that impact others [25]. In this context, social ethics primarily encompasses proactive and positive public ethics, such as being helpful and courageous. With the improvement in living standards, various public sports competitions and comprehensive fitness activities are emerging. As professionals, university physical

education teachers should actively participate in public welfare initiatives and assume social responsibilities.

Below the level of "Political morality", the weighting coefficients rank as follows: "Incorporating ideological and political thinking into the curriculum (0.555)", "Adhere to the direction of education (0.300)", and "Implement educational lines, guidelines and policies (0.145)". The overall ranking remains unchanged. Within this hierarchy, "Incorporating ideological and political thinking into the curriculum" holds the highest weighting coefficient. By integrating ideological and political thinking into physical education teaching, the moral education function and value guidance of physical education can be fully realized. Ideological and political thinking should permeate all aspects and processes of physical education, including curriculum development, implementation, and resource utilization [26]. At every stage of the education process, university physical education teachers should adhere to the country's path, learning guidelines, and policy implementation.

Below the level of "Professional ethics", the weighting coefficients rank as follows: "Noble dedication spirit (0.523)", "Spirit of hard work and struggle (0.328)", and "Rigorous academic spirit (0.149)". The overall ranking remains the same. Within this hierarchy, "Noble dedication spirit" holds the highest weighting coefficient. It has been observed that dedication, communication, and teamwork spirit among university physical education teachers contribute significantly to student development [27]. Additionally, they should possess a spirit of hard work and perseverance. As a relatively unique discipline, physical education requires university teachers to confront the challenges of outdoor teaching environments and overcome any teaching difficulties. Moreover, a rigorous academic spirit is essential for university physical education teachers, whether in academic research or the dissemination of profound knowledge.

Below the level of "Social ethics", the weighting coefficients rank as follows: "Public welfare sports activities (0.527)", "Public welfare sports services (0.232)", and "Public sports management (0.241)". The overall ranking remains the same. Within this hierarchy, "Public welfare sports activities" holds the highest weighting coefficient. Presently, an increasing number of charity activities are organized in the form of sports, such as basketball charity events and marathon charity runs. University physical education teachers should be skilled in organizing and actively participating in these activities. Additionally, they should actively engage in public welfare sports services. With the vigorous development of nationwide fitness initiatives and various sports events, more professional talents are needed to volunteer and serve. By adopting a volunteer service perspective, understanding the proper positioning, and ensuring the active implementation of services and the stable development of the team [28], university physical education teachers can fulfill their social responsibilities. The subject of public sports management encompasses diverse public sports organizations, and the content of public sports management involves public sports affairs. University physical education teachers need to shoulder the social responsibility of public sports management [22].

4.2. Discussion on the Index of "Educational Ability and Accomplishment" and Its Subordinate Index

The dimension comprises a primary indicator, five secondary indicators, and twenty tertiary indicators. Among all primary indicators, "Educational ability and accomplishment (0.248)" holds the second-highest weight. The educational competence of teachers is refined and developed through educational activities, directly influencing the effectiveness and quality of teaching [29]. Educational competence is a crucial requirement for teachers to excel in educational and instructional work (Figure 3).

The secondary indicators, listed in descending order of weight, are "Integration of Information Literacy (0.366)", "Expressive Ability of Body Language (0.250)", "Solid Foundation in Physical Education Knowledge (0.154)", "Integration of Other Comprehensive Knowledge Related to Physical Education (0.126)", and "Acquisition of General Knowledge (0.104)". The overall weight order remains the same. Among these indicators, "Integration

of Information Literacy" carries the highest weight. In the context of educational modernization, teachers are encouraged to incorporate technology in their teaching to help students become digitally literate citizens capable of navigating the complexities of today's societies [30]. Therefore, it is vital for physical education (PE) teachers to acquire relevant ICT proficiencies to effectively plan, deliver, and intervene in the learning process [31]. Additionally, the expressive ability of body language is equally important for PE teachers as they need to provide necessary demonstrations and guidance during specialized skill teaching. Hence, the expression of physical movements becomes particularly crucial. Furthermore, having a solid knowledge of physical education serves as the foundation for university PE teachers. Only by consolidating various professional knowledge can they effectively address knowledge challenges in teaching. In addition, other comprehensive knowledge related to physical education is indispensable for university PE teachers. The teaching process in physical education faces complex and unforeseen situations, and many challenges in sports research require support from other related knowledge to be effectively resolved. Lastly, university PE teachers need to have the ability to acquire general knowledge to assist them in fulfilling their role as teachers and promote a comprehensive understanding of the subject.

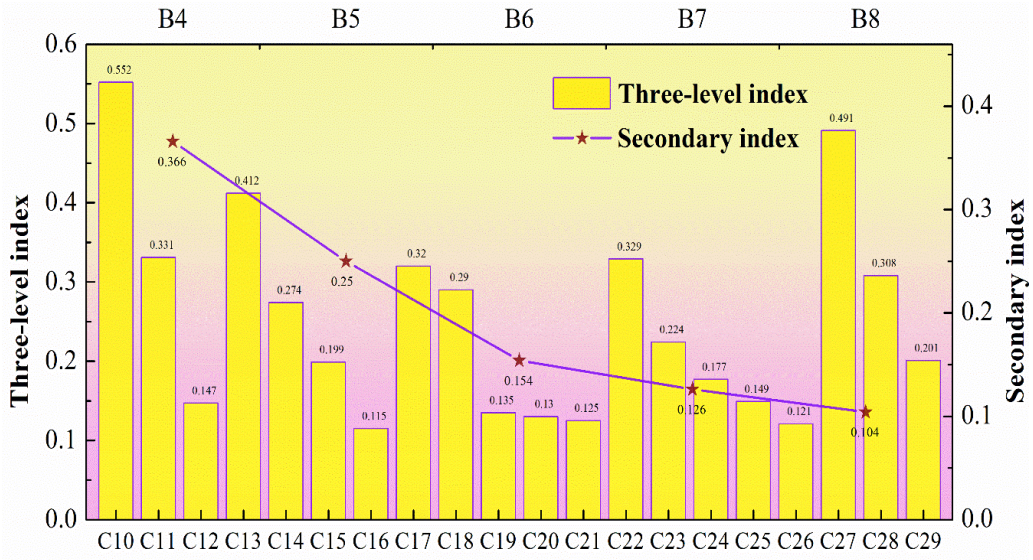

Figure 3. Weight coefficient of membership index under the dimension of "educational ability and literacy".

Below the level of "Integration of Information Literacy", the weighting coefficients rank as follows: "Information Ethics and Morality (0.522)", "Information Awareness and Needs (0.331)", and "Information Knowledge and Skills (0.147)". The overall weight order remains unchanged. In this category, "Information Ethics and Morality" carries the highest weight. While fully utilizing information technology, university PE teachers should always adhere to information ethics and morality. Information ethics provide valuable insights and adequate discernment, encompassing a wide range of conceptual and moral phenomena forming the ethical discourse [31]. Furthermore, information awareness and needs refer to the autonomous awareness of information by university PE teachers, enabling them to naturally generate information consciousness and proactively employ information means when necessary. Finally, acquiring information knowledge and skills is a prerequisite for utilizing information technology. Only by mastering information knowledge and skills can it be freely applied in the process of teaching.

Below the level of "Expressive Ability of Body Language", the weighting coefficients rank as follows: "Rich Facial Expressions (0.412)", "Three-dimensional Spatial Language (0.274)", "Dignified instrumentation language (0.199)", and "Standard Vocal Language (0.115)". The overall weight order remains the same. In this category, "Rich Facial Expressions" holds the highest weight. A wide variety of facial expressions can stimulate students'

interest in learning and contribute to the mastery of knowledge. Three-dimensional spatial language refers to the use of body language, including the distance and contact between teachers and students, to express thoughts and emotions, and convey instructional information. It deepens students' understanding and mastery of movements in the process of physical education teaching. Dignified demeanor refers to the psychological and physiological impact that a teacher's appearance and bearing have on students from an educational psychology perspective. The appearance and demeanor of university PE teachers should meet the requirements. Standard vocal language refers to the clear and sonorous voice of a physical education teacher, the rhythmic command, and the pleasant whistle. It is not only an outward expression of one's physical and mental health but also attracts and influences students, creating a positive teaching atmosphere [32].

Below the level of "Solid Foundation in Physical Education Knowledge", the weighting coefficients rank as follows: "Relevant Knowledge of Sports Refereeing (0.320)", "Relevant Knowledge of Sports Event Organization (0.290)", "Management Knowledge of High-level Sports Teams (0.135)", "Knowledge of Specialized Skills in Sports (0.130)", and "Training Knowledge of Sports Professional Teams (0.125)". The overall weight order remains the same. Whether it is competitions held by schools or non-governmental organizations, professional referees and event organizers are required, and university PE teachers possess these abilities. Additionally, many university PE teachers also assume the roles of leaders and head coaches of high-level sports teams in their schools. Therefore, it is essential for them to possess professional training and management knowledge. Lastly, as the primary instructors of university general education, university PE teachers should have a solid foundation in physical education knowledge, which includes knowledge of specialized skills in various sports and training knowledge of sports professional teams. This knowledge enables them to provide comprehensive and effective physical education instruction to students.

Below the level of "Integration of Other Comprehensive Knowledge Related to Physical Education", the weighting coefficients rank as follows: "Medical knowledge of coping with sports injuries (0.330)", "Nutrition knowledge to promote sports health (0.224)", "The psychological knowledge of overcoming competition nervousness and anxiety (0.177)", "Ensure the management knowledge of sports events and school sports organization (0.149)", and "Physiological knowledge of regulating energy metabolism and cardiopulmonary function (0.121)". The overall weight order remains the same. The weight coefficient of the index "medical knowledge to deal with sports injuries" is the highest under this element level. Sports injuries may occur in the process of sports activities. PE teachers should master sports medicine knowledge to effectively deal with unexpected situations in the PE classroom. During sports competitions, athletes will inevitably have anxiety and tension, so they should make full use of psychological knowledge to effectively guide them. The process of physical exercise is a process in which various systems of the body cooperate with each other. Therefore, it is necessary to master the corresponding physiological knowledge to effectively grasp the body during exercise. At the same time, the consumption and loss of nutrients will be accompanied by the exercise process. Finally, physical education teachers in colleges and universities will also participate in the construction of various school sports organizations and take charge of various sports competitions. Different from the organizational ability of sports competitions mentioned above, combining the knowledge of sports competition organization with the knowledge of management can make the operation of sports competitions smoother and achieve better results. Therefore, college physical education teachers should fully integrate management knowledge into administrative affairs management.

Below the level of "ability to acquire general knowledge", the weighting coefficients rank as follows: "PE teacher career development knowledge (0.491)", "basic knowledge of physical education in Chinese colleges and universities (0.308)" and "education target knowledge of physical education in Chinese colleges and universities (0.201)". Under this element level, the index weight coefficient of "PE teacher career development knowledge"

is the highest. Only by clearly understanding the path of teacher career development and the space for promotion can we have the direction of efforts, release our own motivation, and facilitate career development. Physical education teachers in colleges and universities should make clear the basic situation of physical education, take its essence, discard its dross, find out the problems, and then make improvement plans for the existing problems. Finally, physical education teachers in colleges and universities should grasp the educational objectives of physical education subjects. Goal-setting is not always a simple motivational technique when used in an applied sports setting, especially in relation to the meaning of achievement in competitive sports [33]. Then, guide the students towards the correct educational goal.

4.3. Discussion on the Index of "Scientific Research Literacy" and Its Subordinate Indexes

This dimension comprises one primary indicator, four secondary indicators, and fourteen tertiary indicators. Among all the primary indicators, "Research literacy (0.173)" holds the third highest weight coefficient, surpassing "Teaching literacy ". This indicates the significant role of research for university teachers. As the primary institution for research output, university sports teachers must devote their time and effort to academic research in order to advance the discipline of sports (Figure 4).

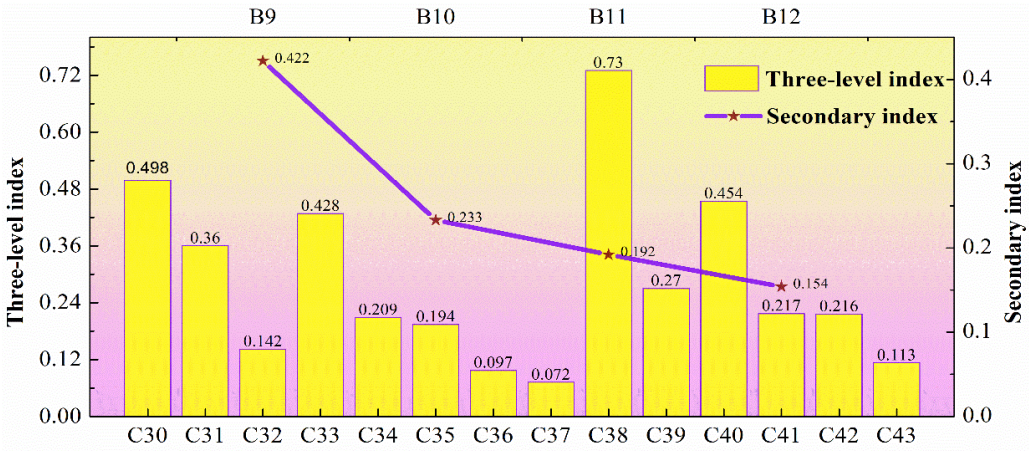

Figure 4. Weight coefficient of membership index under the dimension of "scientific research literacy".

The secondary indicators, ranked by weight coefficients, are "Research concept literacy (0.422)", "Scientific research ability literacy (0.233)", "Scientific research theoretical literacy (0.192)" and "Scientific research spirit (0.154)". The overall ranking of weight coefficients remains the same. Among these, the indicator "Correct research concept literacy" holds the highest weight coefficient. Engaging in research activities requires establishing the correct research concept, understanding the essence of research, and clarifying the purpose of research. Additionally, research ability is fundamental to achieving research results and serves as the key to overcoming research challenges. Furthermore, theoretical knowledge guides practice and mastering research theory acts as a stepping stone for engaging in academic research. Research is not an easy path; it is filled with hardships and setbacks. It requires firm beliefs and spiritual guidance to navigate through obstacles and stay true to the pursuit of knowledge.

Below the level of "Research concept literacy", the weighting coefficients rank as follows: "Research values (0.498)", "Research function awareness (0.360)", and "Research problem awareness (0.142)". The overall ranking of weight coefficients remains the same. Among these, the indicator "Research values" holds the highest weight coefficient. Many teachers write and publish research papers solely to enhance their professional titles and qualifications, exhibiting a severe utilitarian tendency. This leads to unsatisfactory research outcomes and ineffective problem-solving [34]. Therefore, establishing the correct research values is a fundamental requirement for scientific research. Additionally, university sports

teachers should have a clear understanding of their research function from a professional perspective [35]. Moreover, they should possess a strong awareness of research problems, actively seek solutions, and transform problems into research topics.

Below the level of "Scientific research ability literacy", the weighting coefficients rank as follows: "Reflective ability in academic conferences (0.428)", "Ability to undertake research projects (0.209)", "Ability to use research software (0.194)", "Ability to create interdisciplinary knowledge (0.097)", and "Ability to apply interdisciplinary knowledge (0.072)". The overall ranking of weight coefficients remains the same. Among these, the indicator "Reflective ability in academic conferences" holds the highest weight coefficient. Academic conferences typically revolve around the most significant and cutting-edge issues in the field. Researchers should explore problems, engage in continuous reflection, and generate new research content. For university sports teachers, especially young teachers, the number and level of research projects undertaken are important indicators of their research abilities. Additionally, to improve research efficiency and innovate the research process, it is crucial to master the most intelligent and convenient research software. Teachers should also stay informed about current events, media opinions, and new research and discoveries in fields outside their own discipline. By drawing connections and researching cutting-edge knowledge related to their own discipline, they can enhance their research capabilities. Lastly, in the process of conducting sports science research, it is essential to incorporate knowledge from other disciplines to solve problems within the field. Engaging with knowledge from other disciplines is of utmost importance in improving research abilities.

Below the level of "Scientific research theoretical literacy", the weighting coefficients rank as follows: "Basic principles and theories of sports science research (0.730)" and "The basic method theory of sports science research (0.270)". The overall ranking of weight coefficients remains the same. Among these, the indicator "Basic principles and theories of sports science research" holds the highest weight coefficient. Regardless of the nature of sports science research, starting from the basic principles is necessary to achieve profound research outcomes. During the process of sports science research, research methods serve as important tools to ensure smooth progress and accurate results.

Below the level of "Scientific research spirit", the weighting coefficients rank as follows: "Team spirit (0.454)", "Innovation spirit (0.216)", "Persistence spirit (0.217)" and "Pragmatic spirit (0.113)". The overall ranking of weight coefficients remains the same. Among these, the indicator "Team spirit" holds the highest weight coefficient. Scientific research has always been a collaborative endeavor. Researchers need to work together, challenge and affirm each other, and constantly move forward. Team spirit is the essence of research teams [36]. With the development of the times, new forms of industry continue to emerge, and scientific research should not be limited to the present. University sports teachers should update their research ideas, explore new research questions, and innovate research outcomes [37]. In the journey of research, difficulties and setbacks are inevitable, such as failed experiments.

4.4. Discussion on "Teaching Literacy" Index and Its Subordinate Index

This dimension comprises one primary indicator, three secondary indicators, and ten tertiary indicators. Among all primary indicators, "Teaching literacy (0.172)" holds the fourth position in terms of weight. Teaching constitutes the primary duty of educators, thus making teaching competence an indispensable component of this indicator system. Teaching competence encompasses the specialized knowledge and relevant understanding that teachers must possess to effectively engage in purposeful instructional practices. It serves as the foundational aptitude for teachers to execute teaching with precision and scientific rigor [38] (Figure 5).

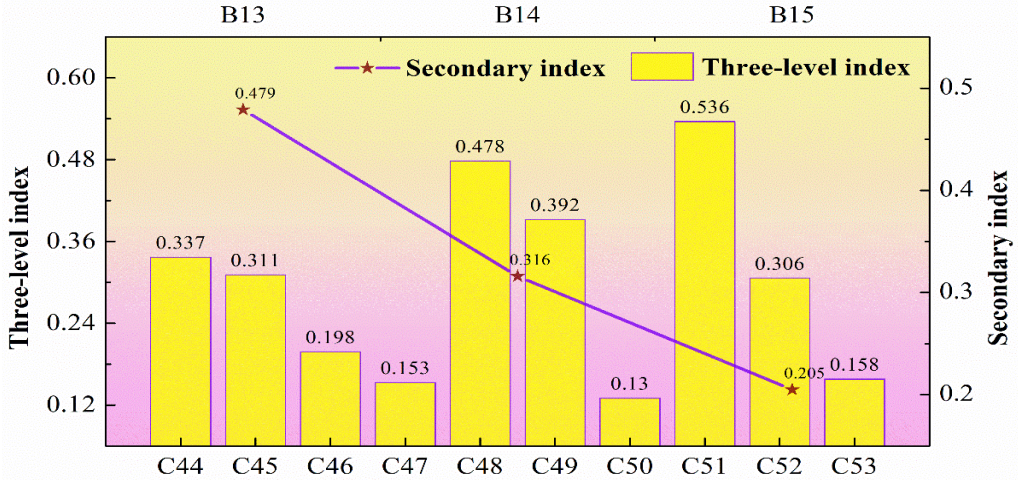

Figure 5. Weight coefficient of membership index under the dimension of "teaching literacy".

Within the secondary indicators, ordered by their weight coefficients, are "Educational teaching concept (0.479)", "Educational and teaching methods (0.316)" and "Educational Assessment Methods (0.205)". The overall weight ranking remains consistent. Among these indicators, the "Educational teaching concept " bears the highest weight coefficient within this hierarchical structure. Teaching philosophy assumes paramount significance as it guides all instructional endeavors. The absence of a sound teaching philosophy might result in a deviation from the intended trajectory of teaching or even lead to misguided practices. Moreover, within the context of contemporary education, the adoption of innovative teaching methods and the acquisition of a diverse skill set are imperative. Grounded in the objectives of instruction and taking into account the distinctive features of the curriculum, educators should adhere to the principle of diversified teaching, comprehensively employ an array of pedagogical approaches, and select the most suitable methods based on students' learning characteristics [39]. Lastly, throughout the process of education and teaching, both teachers and students ought to effectively utilize educational and teaching evaluation methods. Research has demonstrated a correlation between the quality of college teachers' classroom instruction and students' future achievements, particularly in terms of their professional development [40]. Evaluations of teaching performance commonly serve two primary purposes: informing administrative decision-making and facilitating instructional enhancement [41].

Below the level of "Educational and teaching concept", the weighting coefficients rank as follows: "'Moral education and cultivating students' character' teaching philosophy (0.311)", "'Integration of sports and medicine' health teaching philosophy (0.337)", "'Integration of sports and education' development teaching philosophy (0.198)", and "'Integration of the four dimensions' deep teaching philosophy (0.153)". The comprehensive weight ranking remains unchanged, with "'Moral education and cultivating students' character' teaching philosophy" holding the highest weight coefficient. The cultivation of moral character is paramount, as learning should be firmly grounded in moral development. Without moral integrity, life and learning become shallow and lack a solid foundation [42]. Moral education, as an integral component of instruction, accompanies learners throughout their lives. The integration of sports and medicine, commonly referred to as "sports + medical", has emerged as a key and challenging topic within the domains of sports and medicine. The comprehensive model that combines sports with medical services plays an active role in preventing chronic diseases, facilitating rehabilitation, and promoting health [43]. This proactive, cost-effective, and long-term beneficial "sports + medical" model enhances the well-being of the majority, thereby reducing the demand for medical resources [44]. The health philosophy of integrating sports and medicine should be incorporated into physical education classrooms. Additionally, the integration of sports and education has evolved from a simple combination to a fusion, providing a clear direction for the future devel-

opment of physical education in schools. This deep integration of sports and education represents a strategic adjustment proposed by the country in these two critical domains during a new historical period. Lastly [45], in-depth sports teaching should adhere to the strategies of contextualization, structuring, skill development, and physical fitness enhancement, collectively known as the "four dimensions" teaching approach [46]. The emerging deep teaching philosophy of "integration of the four dimensions" should also be applied in physical education classrooms.

Below the level of "Educational and teaching methods", the weighting coefficients rank as follows: "Teaching demonstration using information technology (0.478)", "Teaching practice using wearable AI devices (0.392)" and "High-quality teaching guidance using a blended 'online + offline' approach (0.130)". The comprehensive weight ranking remains unchanged, with "Teaching demonstration using information technology" holding the highest weight coefficient. Teaching demonstration, as the fundamental application of information technology, has long been the most commonly used method among teachers since the advent of information-based instruction. In physical education teaching, this includes indoor theoretical courses utilizing PowerPoint presentations and the utilization of micro-videos to illustrate complex technical and tactical processes. For instance, in the current global COVID-19 pandemic, leveraging live streaming platforms for instruction has become an optimal choice for teaching demonstration. Moreover, in the teaching of sports-specific subjects, wearable smart devices can assist students in practicing and consolidating technical movements. By utilizing infrared motion capture systems to record movement trajectories and details, which are then converted into data, one can evaluate the accuracy of joint angles in executing certain movements. For example, in Tai Chi practice, the size of joint angles indicates the correctness of a particular movement. In shooting exercises, the shooting angle can be measured to analyze the most accurate shooting angle for achieving a high shooting percentage. Furthermore, with the advancement of modern education, blended teaching models that combine online and offline elements have gained popularity. The flipped classroom teaching model has become a favored approach in the field of education. It has been demonstrated that compared to the traditional classroom teaching mode, the "MOOC+ flipped Classroom" teaching mode is innovative in terms of teaching philosophy, teaching resources, and teaching methods [47].In addition, "SPOC + flipped classroom" teaching enables students to obtain more demand satisfaction by giving them more demand support, while demand support and demand satisfaction can promote the internalization of learning motivation so that students can maintain high autonomy motivation [48].These patterns promote the advancement of educational informatization and further facilitates the realization of educational modernization.

Below the level of "Educational Assessment Methods", the weighting coefficients rank as follows: "Data-driven decision-making for pre-class teaching (0.536)", "Three-dimensional communication and interaction in-class (0.306)" and "Timeliness of post-class evaluation and feedback (0.158)". The overall weighted ranking remains consistent. Notably, the indicator that holds the highest weighted coefficient within this element layer is "Data-driven decision-making for pre-class teaching". In May 2020, the University of California embraced a data-driven approach to bolster empirical research in the realm of education policy. Similarly, several European nations employ student performance data as a means to evaluate the instructional practices of teachers [49]. Given the diverse and dynamic nature of various educational contexts, it becomes imperative to effectively analyze teaching behavior data so as to circumvent a pedagogical approach excessively influenced by the subjective experiences of teachers [50]. Within a contemporary educational framework, the evaluation modalities employed before, during, and after class manifest novel characteristics. Pre-class evaluations involve the delineation of well-defined instructional objectives and the judicious selection of pedagogical strategies. During class, the judicious use of technological tools enables real-time interaction and communication with students, thereby facilitating the expeditious resolution of pedagogical challenges. Subsequently, a timely feedback and evaluation mechanism is instituted post-class, affording students

the opportunity to assess the efficacy of instructional delivery while concurrently enabling educators to gauge the extent of students' comprehension.

4.5. Determination and Discussion of Appropriate Weights for Different Types of College Physical Education Teachers

4.5.1. Determination of Appropriate Weight of Physical Education Teachers in Different Types of Colleges and Universities

Scholars have recommended the need to differentiate among various categories of physical education teachers within the university setting. Through a meticulous analysis of the existing literature, expert insights, and the specific requirements set by universities when recruiting physical education teachers, it has been possible to identify three distinct types of educators: those who place equal emphasis on both teaching and research, those who primarily concentrate on teaching, and those who prioritize research endeavors. Given that the primary indicators within the four dimensions of this index system are deemed representative, it becomes feasible to determine the weights of these primary indicators by considering the weights assigned to the index system across different types of physical education teachers at various universities.

Based on the questionnaire data of relevant experts, it is found that the weights of "moral literacy", "educational ability literacy", "teaching literacy" and "scientific research literacy" below the types of "Teaching and research and heavy physical education teacher", "Teaching Teacher" and "Research teacher" are as follows: 0.337, 0.295, 0.203, 0.165, 0.371, 0.305, 0.096, 0.228 and 0.390, 0.283, 0.177, 0.151. The CR values of 0.057, 0.045, and 0.096, respectively, are all less than 0.1 and can pass the consistency test.

4.5.2. Discussion on Appropriate Weight of Different Types of College Physical Education Teachers

The category of "physical education teachers who emphasize both teaching and research" encompasses individuals who possess exceptional specialized sports skills that enable them to effectively instruct a specific sports discipline. Additionally, they possess the capability to engage in theoretical sports courses within relevant research fields. Furthermore, these individuals are university-level physical education teachers who consistently generate research output. "Teaching-oriented physical education teachers" are distinguished by their exceptional technical requirements within their specialized domains. They possess the competence to autonomously undertake the training responsibilities of high-level sports teams, as well as instructing university-level general physical education courses and specialized physical education courses. Conversely, "research-oriented physical education teachers" are primarily devoted to academic research and the scholarly exploration of sports disciplines. They are proficient in conducting both teaching and research activities for theoretical courses in the field of physical education within academic institutions. The subsequent line chart presents a comprehensive analysis, in the form of weighted data, of the indicator system applicable to different types of physical education teachers across diverse universities.

Discussion on Appropriate Weight of Teaching and Research and Heavy Physical Education Teachers

Within the classification of "physical education teachers who emphasize both teaching and research", the indicators are assigned the following weights: "moral qualities (0.337)", "educational competence (0.295)", "teaching proficiency (0.191)", and "research competence (0.188)". The graphical representation in Figure 6 clearly illustrates that moral qualities and educational competence possess the greatest proportions, underscoring their status as the two most vital core competencies. Notably, teaching proficiency and research competence hold comparable weights, underscoring the equal significance of both teaching and research for physical education teachers who prioritize both aspects.

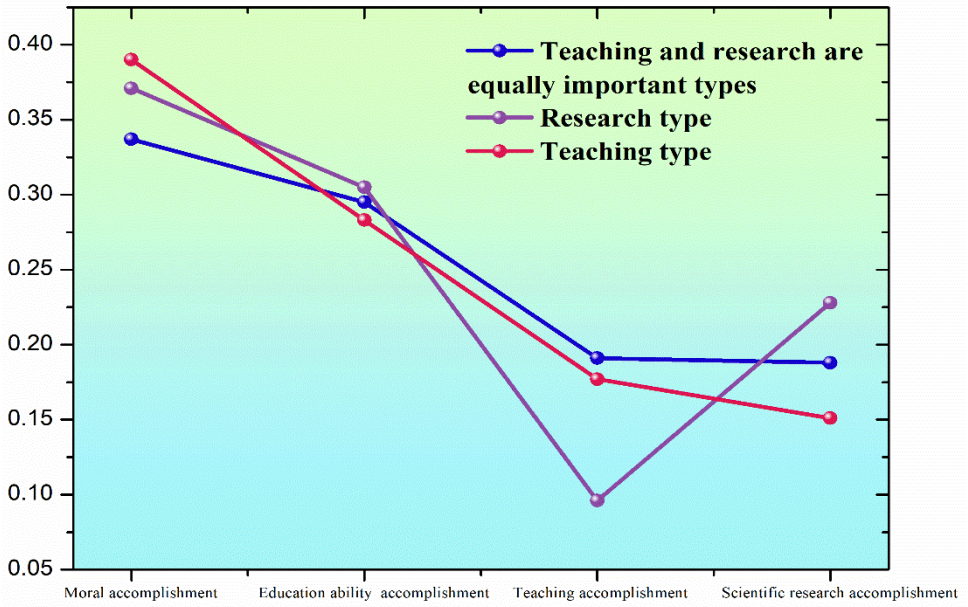

Figure 6. Comparison and analysis of indicator weights of PE teachers in different types of colleges and universities.

Discussion on Suitable Weight of Research-Oriented PE Teachers

Within the classification of "research-oriented" physical education teachers, the indicator system is weighted as follows: "moral qualities (0.371)", "educational competence (0.305)", "teaching proficiency (0.096)", and "research competence (0.228)". The graphical representation in Figure 6 clearly demonstrates that moral qualities and educational competence continue to hold their positions as the two most crucial core competencies. However, it is notable that the weight assigned to research competence significantly surpasses that of teaching proficiency. For research-oriented physical education teachers, the possession of exceptional research capabilities and the ability to generate substantial research output are paramount. These qualities contribute to the advancement of the discipline and represent focal points that demand emphasis.

Discussion on Suitable Weight of Teaching-Type PE Teachers

Within the classification of "teaching-oriented" physical education teachers, the indicator system is weighted as follows: "moral qualities (0.390)", "educational competence (0.283)", "teaching proficiency (0.177)", and "research competence (0.151)". The graphical representation in Figure 6 clearly demonstrates that moral qualities and educational competence remain the two highest weighted indicators. Notably, the weight assigned to teaching proficiency surpasses that of research competence. For teaching-oriented physical education teachers, it is essential to prioritize the enhancement of their teaching abilities, the acquisition of diverse teaching methods, and the imparting of comprehensive knowledge to their students.

5. Conclusions

An indicator system has been developed to assess the core competencies of university physical education teachers. This system comprises 4 primary indicators, 15 secondary indicators, and 53 tertiary indicators. Weight coefficients have been assigned to the primary, secondary, and tertiary indicators, as well as comprehensive weight coefficients for the secondary and tertiary indicators. This comprehensive indicator system encompasses diverse dimensions, demonstrating its rationality and comprehensiveness. Moreover, recognizing the distinct characteristics of university physical education teachers, they have been categorized into different types. Specific core competency indicator weight coefficients have been established for each type. This classification enables a targeted evaluation process,

providing valuable references for assessing the core competencies of university physical education teachers based on their unique roles and responsibilities. It mainly includes the following theoretical influences and practical influences. Theoretical influence: From the perspective of higher education modernization, this paper studies the physical education teachers in colleges and universities and provides thinking and help with the help of a new perspective. It can enrich the content system of the research on teachers' core literacy, and provide a theoretical basis for the sustainable development of college physical education teachers under the requirements of the new era of higher education modernization. Practical influence: The establishment of the core literacy index system of physical education teachers in colleges and universities can effectively promote the improvement of the core literacy level of physical education teachers in colleges and universities. Guided by the index system, it is helpful to improve their comprehensive ability, thus realizing the ultimate goal of the development of physical education in colleges and universities to the modernization of education and providing certain guidance and reference for the sustainable development of physical education teachers in colleges and universities.

In accordance with the prevailing trend of the times, it is imperative to reinforce the cultivation of diverse competencies. Sustainability science and sustainability education, which is an emerging field within the educational sciences, constitute the scientific basis for sustainability education in higher education [3]. The advancement of modernization in higher education plays a pivotal role in the construction of education systems embodying characteristics of the new era. The modernization of teacher education, characterized by its high quality, directly influences the level of modernization in higher education. As a significant cohort within the teaching profession, university physical education teachers should be nurtured to possess a comprehensive blend of moral qualities, educational competence, research acumen, and teaching proficiency. It conforms to the trend and law of the development of higher education modernization under the guidance of policies.

By establishing clear professional roles, university physical education teachers can sustain their contributions to the noble cause of education. Recognizing the diversity among different types of teachers, they should discern their own teacher type, delve deeper into the specific domains pertinent to their respective areas of physical education instruction, surmount professional barriers, leverage their strengths, impart knowledge and guidance to students, and contribute to the development of the discipline of physical education. By doing so, they can actively promote the sustainable development of education and sports.

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Data Availability Statement: The data that support the findings of this study are available on request from the first author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Expert correspondence form.

Name	Professional Title	Work Unit	Remark
Hong **	Professor	Faculty of Education, Beijing Normal University	Delphi expert
Gao *	Professor	College of Physical Education and Sports, Beijing Normal University	Delphi Expert/AHP expert
Yao *	Professor	School of Education, Beijing Sport University	AHP expert
Zhang *	Professor	School of Education, Beijing Sport University	AHP expert

Table A1. *Cont.*

Name	Professional Title	Work Unit	Remark
Dong **	Professor	School of Physical Education, East China Normal University	AHP expert
Li **	Professor	College of Physical Education and Sports, Beijing Normal University	AHP expert
Wang *	Professor	College of Physical Education and Sports, Beijing Normal University	Delphi Expert/AHP expert
Jiang **	Professor	College of Physical Education and Sports, Beijing Normal University	Delphi expert
Ren**	Professor	College of Physical Education and Sports, Beijing Normal University	Delphi expert
Wan **	Professor	College of Physical Education, Shaanxi Normal University	AHP expert
Jin *	Professor	School of Physical Education, Anhui Normal University	Delphi Expert/AHP expert
Zhang **	Professor	School of Grammar, Beijing University of Chemical Technology	Delphi expert
Dou **	Professor	Department of Physical Education, University of Science and Technology Beijing	Delphi Expert/AHP expert
Liu *	Professor	School of Physical Education, Sichuan University	Delphi Expert/AHP expert
Zhang *	Professor	College of Physical Education, Shaanxi Normal University	Delphi expert
Liu *	Professor	School of Physical Education, Shanxi University	Delphi expert
Li *	Professor	School of Physical Education, Changsha University of Science and Technology	Delphi Expert/AHP expert
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(Explain: In order to ensure the privacy of the expert, the full name of the expert is not displayed, only the surname is displayed, and the first name is replaced with "*" and "**").

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