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*Research Article*

# Construction of the Evaluation Index System of Physical Education Teaching in Colleges and Universities Based on Scientific Knowledge Graph

**Chang Wang** [1] **and Shuangshuang Xu** [2]

[1]School of Physical Education, Northeast Normal University, Changchun 130024, Jilin, China
[2]School of Sports Health and Technology, Jilin Institute of Physical Education, Changchun 130022, Jilin, China

Correspondence should be addressed to Shuangshuang Xu; 0766@jlsu.edu.cn

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The purpose of physical education (PE) teaching in general institutions of higher education is to enhance students' fitness and mental quality, which in turn improves students' physiological ability and sports skills and finally enables students to develop healthy lifestyle. The conventional assessment of students' PE instruction only focuses on the evaluation of their body condition and sports skills, ignoring the cultivation of their mental and physical development and healthy living habits and evaluating students with a relatively single evaluation standard, lacking the cultivation of "teaching to suit the individual." At present, the evaluation method of instructional quality of PE teachers in China's institutions of higher education is relatively single and dominated by qualitative methods, which cannot be applied to instructional innovation. The evaluation of physical education teaching quality plays an important role in building a complete and effective teaching process, which plays an important role in judging whether the formulation of physical education teaching objectives and principles is reasonable, and the evaluation of students' learning behavior and learning effect. This article takes the relevant theory of scientific knowledge graph as the guiding idea, based on the current situation of PE teaching assessment in institutions of higher education, and employs experimental research methods to conduct empirical studies on 10 universities in Jilin Province. The empirical findings suggest that students' satisfaction with the new evaluation method is 83.68 points on average, and the accuracy rate is 84.54 points on average; teachers' satisfaction with the new evaluation method is 86.12 points on average, and the accuracy rate is 88.4 points on average.

## 1. Introduction

Assessment of physical education is an important part of PE training. The way of evaluating the teaching of PE, who should calculate, how to calculate, and what to calculate play an important role in improving the quality of PE education in high school and in cultivating the quality of students. The current PE teaching evaluation of the university is divided into two types: one is the teacher evaluation of the students' academic status, and the other is the students' evaluation of the teacher's teaching position. The first ones consist mainly of physical education grades of the teachers based on the students of the final grades and the attendance. The latter is the importance of online assessment of teaching students at the end of the year, and their assessment is based on the classes of physical education teachers and special education assessment programs established at the school, which eventually lead to training sessions at that time. This model has significant differences, which is one of the key factors in the development of innovation in PE in Chinese universities. The 14th National Education Evaluation System of the country clearly states that a set of scientific evaluation machines should learn to recognize the guiding effect of curriculum evaluation on the cultivation of talents. The Center for Education has also published Guidelines for Physical Education in Public Schools and Colleges, Supply Levels for Physical Education Evaluation in Colleges and Universities, Guidelines for the Selection and Evaluation of

Physical Education, and other related documents in recent years. As a result, the introduction of a grading system and allowing teachers and students to be more involved in educational reform has become an increasingly important issue for higher education institutions.

The scientific knowledge graph is a visual chart showing the development trajectories and knowledge networks of various disciplines from the perspective of the basic knowledge units carried by scientific journals. In terms of theoretical research, domestic and foreign experts and scholars have discussed the application and development prospects of scientific knowledge graph in various fields. Xiao G built a model based on scientific knowledge, dividing all knowledge into two parts, science and scientific method, and there is a gap between these two kinds of knowledge. In this paper, he proposes a new theory that the brain is a knowledge graph that will fill in the gaps. His knowledge organization model holds that, on the one hand, science is the first type of knowledge, including natural sciences, social sciences, and cognitive sciences. On the other hand, the scientific method includes language, mathematics, philosophy, statistics, information, education, and communication [1]. Tan et al. studied knowledge graphs representations based on similarity embeddings, and he proposed a novel low-complexity embedding model, SimE-ER, for computing the similarity of entities in independent space and related space. It was shown that this model outperforms other embedding models with shorter embedding time and lower memory space complexity, and thus, it has strong practicality [2]. Fan et al. proposed a method to build a knowledge graph of electric grid scheduling. This method utilizes the dispatching data in the power field and then recognizes patterns of scheduling conduct in relation to construct a knowledge graph of electric power scheduling data and provide an embedded intellectual module for automated electric power scheduling and associated activities [3]. Fuji et al. have developed an artificial intelligence technique that incorporates Deep Tensor, Fujitsu's original machine learning technique grounded in augmented deep learning, and another knowledge graph-based machine learning technique developed by Fujitsu, a knowledge base represented by graph data. This article demonstrates the practicality and effectiveness of the method by analyzing the network intrusion detection and application examples of genetic medicine [4]. Fan et al. explore knowledge graph features about sepsis research based on scientometrics. By visualizing sepsis hotspots and trends, she found that current research directions tend to favor animal experiments, epidemiology, and other basic sciences. The current research is mainly on inflammatory response, immune response, and organ dysfunction [5]. Chernova uses the knowledge graph to devise a perceptual module of KM, which is used to form a complete education plan in the training system. She analyzed the specific situation of expert training in higher education institutions and constructed a knowledge management system for the university education process. In addition, she takes into account the probability of the major regulation of knowledge management aeries in the pedagogic procedure since the improvement of the training qualification is the target of any pedagogic institution. The paper develops a perception framework for KM regimes, revealing helpful models reflecting the impact of different elements of physical nature on training outcomes on the basis of cognitive analysis [6]. Ekanayake et al. study the methodological field of scientific knowledge graph, that is, the application of bibliometric methods, aiming to provide a launching platform for further value management and knowledge development. They used the CiteSpace bibliometric analysis software system to analyze the literature related to value management comprehensively and accurately and drew a graph of the field of value management knowledge, which provided a reference for the development of value management knowledge [7]. Ming uses the scientific metrology software CiteSpace to visually analyze the English test in China from 1995 to 2020 by graphs the cooccurrence of keywords, time zones, author cooperation network, and collaboration systems of academic organizations. The focus of the analysis mainly includes university preparatory English evaluation, university English instruction, summarized evaluation, and linguistic assessment [8]. Liu et al. studied the impact of the accessibility of scientific knowledge graph on land usage and scenic grids. They used CiteSpace and the VOS viewer to analyze the accessibility relevant information and analyze the impact of access to land usage and scenic grids. It was found that accessibility performed a vital part in the analysis of the interaction among traffic, land usage, and scenic grids [9]. In order to better explore the construction network based on building information modeling, Guo and Feng conducted a structured methodological overview of relevant research released in the last decade. An "integrated pentagon" composed of contexts, processes, organizations, tasks, and actors is used to recognize and create a scientific knowledge graph depicting the connections in building construction networks [10]. Based on the scientific knowledge graph, Stein M proposes an automatic annotation method for efficient what-if analysis in football. The designed system covers the automatic detection of erroneous motor behaviors, as well as suggestions for possible improvement, and the method allows experts to adjust the suggestions for improved motion and their analysis of regional control through an interactive network, which effectively supports football coaches in analyzing matches [11]. Using the scientific knowledge graph, Koide et al. investigate discrepancies in posterity stableness and mobile commercialization in adolescents related to physical activity. Thirty-nine healthy adolescents were classified into a sports group and a non-sports group based on their questionnaires on their involvement in sports activities in the last twelve months on a regular basis. Both groups measured posterity stableness while standing quietly and rotating their heads in stance, and dynamic visualization analysis was performed during head-rotation. The results showed that healthy adolescents who were physically active had better postural stability during head rotation [12]. Guo et al. explored the establishment of a computational model of vision perception in the field of exercise and sports mentality based on knowledge graph. They used methods such as litho-metrics, copresent analysis, and term spectrum profiling, and they used CiteSpace III software to conduct a visual analysis of special journals in sports psychology, including released articles, study topics, study subject periods, central writers, writer colines, and study organizations, aiming to comprehensively grasp the research trends of the advancement of exercise and sports mentality in China [13]. Klemish et al. used a knowledge graph to assess the existence of variation in sensorimotor ability between batters and throwers among baseball players of different experience levels. The test subjects were 566 baseball players (112 high schools, 85 colleges, 369 professionals) from different sports centers. They used a Bayesian hierarchical regression model to compare the differences between bowlers and batsmen. They used basic regression splines to model interpretive covariates such as height, accustomed hand, advantageous eye, stroke history, and player location, as well as age profiles. Regression analysis showed that expert-level hitters had greater visual ability and distance awareness compared to pitchers, confirming the concept that athlete with more experience possess different sensory abilities [14]. These studies are only some theoretical studies on knowledge graph and have not been practiced.

Cao and Gadekallu have designed a sports safety information mining platform based on multimedia data sharing technology [15]. Shi Z's location-based service for mobile users provides a convenient way to filter information based on current geographical location [16].

With the development of advanced graphic design technology, a new growth trend is in the field of sports training. Technical illustrations can provide rich data support for physical education evaluation, making physical education evaluation much more rational. Meanwhile, the evaluation of physical education under the auspices of big data can provide a more immediate response to the evaluation results of education. This article analyzes and researches data related to the education evaluation program based on the analysis of the education evaluation program at Jilin Universities and constructs two physical learning systems from the point of view of teachers and students, respectively. Teaching evaluation of physical education courses in colleges and universities is an important part of education and teaching, which can evaluate both the teaching effect and the learning effect and is an important aspect to improve the quality of schooling and reflect the characteristics of schooling. Clarify the teaching evaluation in the physical education body. Through interdisciplinary research, knowledge graphs knowledge is applied to the evaluation of physical education in universities and colleges, which increases the content of physical education evaluation and provides a reference for physical education evaluation research, providing tips and reference methods for reforming the physical education evaluation system in colleges and universities in the big data age. The main contribution of this paper is to use the scientific knowledge graphs to construct a physical education evaluation index system in colleges and universities, which provides a reference scheme for the application of knowledge graph and the construction of the physical education evaluation index system.

## 2. Scientific Knowledge Graph and Physical Education Teaching Evaluation

*2.1. Scientific Knowledge Graph.* With the rapid development and application of contemporary computer science and technology, and the continuous maturity and popularization of Internet technology, global knowledge has shown explosive growth. The difficulty of obtaining information and finding the knowledge it needs in the massive information has also increased. In this context, the scientific knowledge graphs came into being. The scientific knowledge graph, referred to as the knowledge graph, is an interdisciplinary field that integrates multiple disciplines. By integrating methods and technologies from multiple fields, it aims to present knowledge and information in the form of graphics, including graphics, visualization technology, computer science, information science, and applied mathematics. The structure, development history, popular research directions, and frontier fields of the discipline are displayed in the form of graphics.

The so-called scientific knowledge graph refers to the description of a set of entities and the relationship between these entities. It is often used to represent various concepts existing in the real world and various relationships between them and is generally identified by triples. More figuratively, a knowledge graph can be viewed as a large network structure graph, which consists of nodes and edges. Nodes represent concepts or real objects in the real world, while edges represent a relationship between them. In the real world, everything such as a bird, a plane, and a leaf can be abstracted into the existence of a point in the knowledge graph, and there may be some hidden relationship between them. This relationship is abstracted as a connection between nodes in the graph. In a knowledge graph, each node represents an "entity" that exists in the real world, and each edge is a "relationship" between entities. Knowledge graph is the most efficient representation of relationships. In this way, by abstracting all the things and relationships in the big world, a huge network is formed. This network is structured and an abstract representation of the real world.

In general, the center of the arm can be divided into four categories: center ring, center of proximity, center axis, and center of eigenvector. Different center angles weigh important parts of different sizes. The degree of centrality refers to the number of correlations between one node and the other segment, indicating whether the node is in the center of the graph. Proximity shows how close a meeting with the other parties is. The center of gravity is an important indication of a meeting in terms of the number of shortest distances passed through a meeting. The Centrality Eigenvector also depends on the importance of the neighbors by counting the number of neighbors (i.e., the meeting room). The principles and statistical methods of the common centers are presented below.

*2.1.1. Degree Centrality.* The degree centrality $C_D(V_i)$ of node $V_i$ is calculated as follows:

$$C_D(v_i) = \frac{k_i}{(N-1)}. \quad (1)$$

*2.1.2. Closeness Centrality.* The proximity centrality $C_c(V_i)$ of node $V_i$ is calculated as follows:

$$C_C(v_i) = \sum_{j}^{N} d_{ij}^{-1}, \tag{2}$$

where $d_{ij}$ is the shortest distance between node $v_i$ and node $v_j$.

*2.1.3. Between Centrality.* The degree centrality $C_B(V_i)$ of node $V_i$ is calculated as follows:

$$C_B(v_i) = \frac{2B_i}{[(N-2)(N-1)]}. \tag{3}$$

Among them, $N$ represents the number of nodes, and $B_i$ is the node intermediary, which can be expressed by the following formula:

$$C_i = \sum_{j\neq l\neq i} \left[\frac{N_{jl}(i)}{N_{jl}}\right]. \tag{4}$$

*2.1.4. Eigenvector Centrality.* The eigenvector centrality $EC(V_i)$ of node $V_i$ is calculated as follows:

$$EC(v_i) = \alpha_{\max}(v_i). \tag{5}$$

In the Google search engine, eigenvector centrality and its variant applications are very common, such as the PageRank algorithm. The PR value of each node is the sum of its PR. Therefore, at time $t$, the PR value of node $v_i$ is

$$PR_i(t) = \sum_{j}^{n} a_{ij} \frac{PR_i(t-1)}{k_j^{\text{out}}}. \tag{6}$$

Then, iterate again until the PR value of each node reaches a stable state.

The key technology of scientific knowledge graph is the calculation of node centrality. The sweetness centrality calculation method in social network analysis is adopted.

First, according to the definition of sweetness centrality, its calculation formula is as follows:

$$C_B(v) = \sum_{s\neq v\neq t\in V} \frac{\sigma_{st}(v)}{\sigma_{st}}. \tag{7}$$

Among them, $\sigma_{st}$ represents the number of shortest paths from node $s$ to node $t$. In a weightless network, the path length refers directly to the number of edges passing, while in a weight network, the path length refers to the number of edge weights passing, which is a statistical formula.

To simplify the formula, define the node pair dependency as

$$\delta_{st}(v) = \frac{\sigma_{st}(v)}{\sigma_{st}}. \tag{8}$$

To get

$$C_B(v) = \sum_{s\neq v\neq t\in V} \delta_{st}(v). \tag{9}$$

If the shortest path from node $s$ to node $t$ passes through node $v$, then there is

$$d(s,v) + d(v,t) = d(s,t). \tag{10}$$

Then, the $v$ node is the precursor node of the $t$ node and belongs to the precursor node set of $t$. From this, it can be concluded that

$$\sigma_{st} = \sum_{u\in P_S(v)} \sigma_{su}. \tag{11}$$

Formula (11) shows that if node $u$ is the predecessor node of node $v$, then the shortest path from node $s$ to node $v$ must pass through node $u$ first.

After obtaining $\sigma_{st}$, the next step is to calculate $\sigma_{st}(v)$, based on the following formula:

$$\sigma_{st}(v) = \left\{\begin{matrix} \sigma_{sv} * \sigma_{vt}, d(s,v) + d(v,t) = d(s,t) \\ 0, \text{Other} \end{matrix}\right\}. \tag{12}$$

Formula (12) represents the following: if $d(s,v) + d(v,t) = d(s,t)$ is satisfied, that is, the shortest path from node $s$ to node $t$ passes through node $v$.

The sweetness centrality value of node $v$ from node $s$ is the sum of the proportional values of all paths starting from $s$ to all other nodes $t_0, t_1, t_2$, etc. passing through node $v$, and its expression is as follows:

$$\delta_{S*}(v) = \sum_{t\in V} \delta_{st}(v). \tag{13}$$

To calculate this value, there are two cases:

(1) When $t$ is $w$, that is, when $t$ node is the successor node of $v$ node, as shown in Figure 1.

Combining the formula to get

$$\delta_{S*}(v) = \sum_{t\in V} \delta_{st}(v) = \sum_{t\in V} \delta_{sw}(v) = \sum_{t\in V} \frac{\sigma_{sw}(v)}{\sigma_{sw}}. \tag{14}$$

That is,

$$\delta_{S*}(v) = \sum_{t\in V} \frac{\sigma_{sv}}{\sigma_{sw}}. \tag{15}$$

(2) When $t$ is not $w$, that is, when $t$ node is not the successor node of $v$ node, as shown in Figure 2.

Combining the formula to get

$$\delta_{S*}(v) = \sum_{t\in V} \delta_{st}(v) = \sum_{t\in V} \frac{\sigma_{st}(v)}{\sigma_{st}}. \tag{16}$$

At this time, the path from $v$ to $t$ must pass through the successor node $w$ of $v$, and then formula (13) can be changed to

$$\delta_{S*}(v) = \sum_{t\in V} \frac{\sigma_{sv} * \sigma_{wt}}{\sigma_{st}} = \sum_{t\in V} \frac{\sigma_{sv}}{\sigma_{st}} * \frac{\sigma_{st}(w)}{\sigma_{st}}. \tag{17}$$

Combined with formula (9), we get

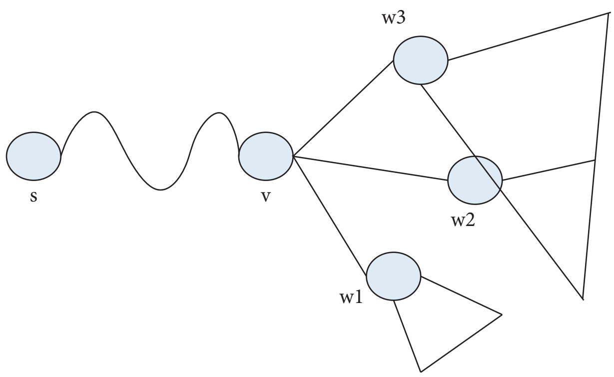


Figure 1: Network example diagram.

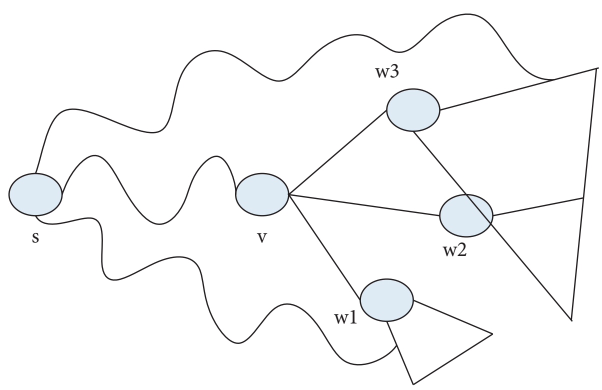


Figure 2: Network example diagram.

$$\delta_{S*}(v) = \sum_{t\in V} \frac{\sigma_{sv}}{\sigma_{sw}} * \frac{\sigma_{st}(w)}{\sigma_{st}} = \sum_{t\in V} \frac{\sigma_{sv}}{\sigma_{sw}} * \delta_{S*}(w). \quad (18)$$

That is,

$$\delta_{S*}(v) = \frac{\sigma_{sv}}{\sigma_{sw}} \sum_{t\in V} \delta_{S*}(w). \quad (19)$$

Finally, adding the above two cases together, we get

$$\delta_{S*}(v) = \sum_{w,v\in P_s(w)} \frac{\sigma_{sv}}{\sigma_{sw}} \left[1 + \delta_{S*}(w)\right]. \quad (20)$$

In this way, the sum of the sweetness centrality values of node $v$ from node $s$ can be obtained. Taking all nodes as the starting node $s$ and calculating the sum, the sweetness centrality value of node $v$ can be obtained.

The scientific knowledge graph theory condenses a collection of many theoretical foundations and methods, thus reflecting the different characteristics and laws of the literature activities. Table 1 lists the main theories and their knowledge bases in the scientific knowledge graph theory.

In the whole process of building a knowledge graph, the main links are knowledge acquisition, fusion, verification, and finally construction. Knowledge can be obtained from various sources, including Web resources, dictionaries, glossaries, encyclopedias, books, and existing knowledge bases. Some large-scale knowledge bases include foreign Yago, DBpedia, Freebase, Google Knowledge Graph, and Nell. Some typical Chinese knowledge bases include CNKI, as well as enterprise knowledge bases such as Baidu Zhixin. Drawing a knowledge graph generally includes eight main links, and the specific content is shown in Figure 3. The construction process of domain knowledge graph mainly includes 6 links: knowledge modeling, knowledge storage, knowledge extraction, knowledge fusion, knowledge calculation, and knowledge application.

Tools for drawing knowledge graph include some general tools and tools specifically for drawing knowledge graph. Common software such as SPSS, UCINET, and Pajek can also be used to draw knowledge graph. The specialized knowledge graph drawing tools include CiteSpace, BibExcel, ColPalred, and IN-SPIRE. Among them, CiteSpace is currently the most recognized and widely used specialized knowledge graph drawing tool, and the CiteSpace tool will be used in this research. In Table 2, some commonly used knowledge graph drawing tools are listed, and the preprocessing links and network construction methods of these tools are compared.

The main analysis principle of the visualization tool CiteSpace is based on coword analysis technology, cocitation analysis technology, and TF-IDF statistical method. Cocitation analysis means that two documents appear together in the bibliography of the third citing document, and the two documents form a cocitation relationship. The main principle of coword analysis technology is to establish a coword matrix, as shown in Figure 4. In detail, there are a total of M articles, and the number of cooccurrences of Word 1 and Word 2 in these articles is 54, and 54 is filled in the corresponding position in the matrix in Figure 4. Next, cluster analysis and other methods are used for classification, and very similar words are clustered under a category, which represents a research direction. The objects of cocitation analysis include journals, articles, and authors, all of which work on the same principle. TF-IDF technology is a statistical method often used in information retrieval and exploration, which can be used to evaluate the importance of a word or a word in an article or a text database.

### 2.2. Evaluation of Physical Education Teaching

*2.2.1. Problems Existing in the Evaluation of Physical Education Teaching in Ordinary Colleges and Universities.* The traditional understanding of physical education emphasizes that a single reference to "sports skills" has become a measure of quality education. The result is that the excitement of participating in sports, the development of physical and mental health, and the improvement of physical condition are apparent processes. Under such a strategy, it is not only true to promote talents with comprehensive character development, understanding, body, beauty, and performance. As a study of the real state of physical education at Jilin universities and colleges, it was found that problems in the current physical education evaluation system were first identified in the following areas.

In the content of evaluation, it pays too much attention to sports performance. For this reason, it pays attention to the instillation of sports science knowledge, ignores the practical link, pays attention to the general trend of evaluation, and ignores individual development and independence. At the

Table 1: Theoretical basis of scientific knowledge graph.

| Theory | Principle |
|---|---|
| Word frequency analysis | Use topic vocabulary to describe hotspots in the field |
| Cocitation analysis | Provide information retrieval interface to discover related disciplines |
| Citation analysis | Use statistical methods to analyze citation |
| Social network analysis | Study the relationship between knowledge processing entities |
| Collinear analysis | Analyse kinship between disciplines |

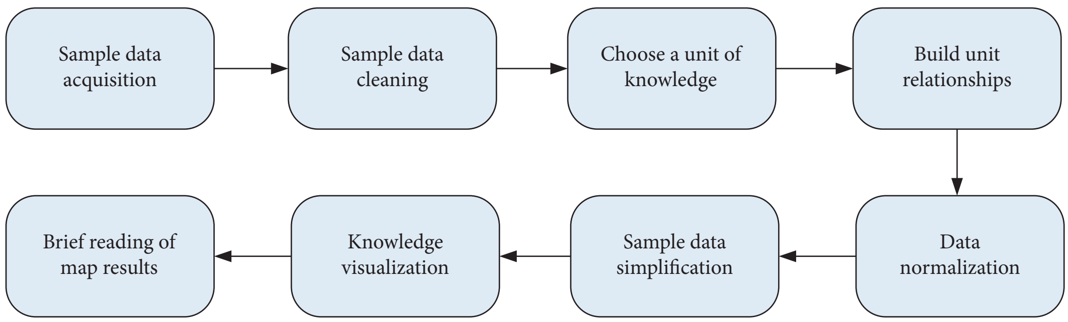


Figure 3: General flow chart of knowledge graph drawing.

Table 2: Comparison of commonly used knowledge graph drawing software.

| Software | Preprocessing | Network construction |
|---|---|---|
| BibExcel | Data and network simplification | DBCA, ACAA, CGAA |
| CiteSpace | Time-segmented data network simplification | CWA |
| ColPalred | Deduplication, data simplification by time period | CWA |
| Network bench tool | Deduplication, time-segmented data network simplification | — |

| | A | B | C |
|---|---|---|---|
| A | 0 | 54 | X |
| B | 54 | 0 | Y |
| C | X | Y | 0 |

Figure 4: Example diagram of coword matrix.

same time, the subject of evaluation is single, and like other disciplines, it makes subjective judgments from the top down and is in the position of being negatively evaluated, ignoring the three-dimensional cross-evaluation system of the same level and bottom-up. It is difficult to achieve teaching effect. And the evaluation results only pay attention to the final grades, while ignoring the procedural evaluation of different stages and different stages, which also leads to students to carry out sports activities for the test. Due to the lack of intermediate procedural assessments, problems cannot be found in time for timely supervision. In addition, the method of evaluation is too simplistic. Although focusing on the assessment of "quantitative indicators," this quantitative indicator itself lacks scientific basis. It is just some conventional indicators based on traditional performance assessment, which cannot produce actual results and lack "qualitative indicators." The qualitative indicators in the evaluation of physical education are physical strength, nurturing, application, harmony, and evaluation.

*2.2.2. Methods of Evaluating System Design.* The construction of the evaluation system is divided into two steps: (1) designing the proposed indicators; (2) modifying and improving the proposed indicators. In the design process of formulating indicators, it is necessary to investigate the status quo, collect experts, decompose and analyze the elements in the national documents, and clarify the goals of physical education. Then, according to the importance of the indicators, the indicators are layered in a pyramid style, the next layer is always the specific explanation of the previous layer, and the previous layer is always the general summary of the next layer. In the process of revising and improving the proposed indicators, the Delphi method should be used, the opinions of experts should be repeatedly solicited, and the most important thing is to apply it in practice. Using practice test, then use the analytic hierarchy process to stratify the indicators more reasonably, and quantify the original qualitative language with specific numerical values through importance [17].

*2.2.3. Design of Evaluation Index System Framework.* The physical education evaluation index in colleges and universities refers to the content of the physical education evaluation. Under the guise of a big data application, a systematic evaluation of physical education in colleges and universities should develop a relational fitness system. Physical education evaluations include field evaluation, criterion level, and mattress subcriteria. The evaluation index of this study is included in the physical education teacher evaluation system and the student physical education evaluation index system, as shown in Figures 5 and 6.

## 3. Experiment Design of Teaching Evaluation Indicators in Colleges and Universities

Experiments were carried out on 120 students and 40 physical education teachers in 10 colleges and universities in Jilin to evaluate the indicators of physical education learning. For the evaluation content in the constructed evaluation index system framework, ask them to express their views on its importance, and then select the percentage of people who choose "very important" according to the four content as shown in Figures 7 and 8. Figure 7 shows the evaluation of teachers and students on each index of the teaching process of the PE teacher's teaching evaluation index system. Figure 8 shows the evaluation of teachers and students on each index of the teaching effect of the PE teacher's teaching evaluation index system.

As can be seen from Figure 7, in the teacher's teaching evaluation system, the evaluation indicators included in the teaching process include preclass preparation, teaching attitude, teaching method, and teaching content. Students believe that teaching attitude is the most important, accounting for 36.28%, followed by teaching methods, accounting for 32.61%, and preclass preparation is less important, accounting for only 11.46%. Teachers believe that preclass preparation and teaching methods are very important, accounting for 31.52% and 34.49%, respectively, followed by teaching attitude, which is important at 23.37%, and teaching content is less important, accounting for only 10.62%. The evaluation indicators included in the teaching effect include the development of exercise awareness, sports theory, physical quality, and motor skills. Students think that sports skills are the most important, accounting for 40.48%, followed by physical fitness, accounting for 33.4%, and sports theory and exercise awareness are less important, accounting for 17.85% and 8.27%, respectively. Teachers believe that exercise awareness, sports theory, and sports skills are all important, accounting for 24.99%, 26.42%, and 28.72%, respectively. Relatively speaking, physical fitness is not important, accounting for only 19.87%.

As can be seen from Figure 8, in the student teaching evaluation system, the evaluation indicators included in the learning process include preclass preview, classroom atmosphere, learning attitude, and cooperation spirit. Students think that the classroom atmosphere is the most important, accounting for 40.2%, followed by learning attitude, accounting for 29.81%, and cooperation spirit is less important, accounting for only 12.36%. Teachers believe that learning attitude and classroom atmosphere are very important, accounting for 30.69% and 29.1%, respectively, followed by cooperation spirit and preclass preview, which account for 20.34% and 19.87%, respectively. The evaluation indicators included in the learning effect are the same as those in the teacher's teaching evaluation system. Students think that physical fitness is the most important, accounting for 37.26%, followed by motor skills, accounting for 36.03%, and sports theory and exercise awareness are less important, accounting for 16.48% and 10.23%, respectively. Teachers believe that motor skills are the most important, accounting for 33.36%.

Table 3 compares current assessment content, scores, and new methods of assessing physical education in colleges and universities. We can see that current methods of athletic training reflect the concept of collection assessments that focus on fitness and athletic skills from content rating to rating, while focusing on process assessment content such as student involvement in writing, writing behavior, and progress. To ensure the effectiveness of the new assessment method and to test the effectiveness of the assessment method, 10 experts in the field of physical education were surveyed to evaluate the assessment method. As shown in Table 4, 80% of experts believe that the new evaluation method is smart and that 20% is key to understanding. Therefore, the new evaluation method is a key recognition by experts and has great value.

Let teachers and students evaluate the satisfaction and accuracy of the old and new evaluation methods. The results are shown in Figures 9 and 10. Figure 9 shows the satisfaction evaluation of teachers and students for the old and new evaluation methods. Figure 10 shows the accuracy evaluation of the old and new evaluation methods by teachers and students.

Through the analysis of Figure 9, it can be seen that the average score of students' satisfaction with the new evaluation method is 83.68 points, and the average score of the current evaluation method is 73.73 points. The average score of teachers' satisfaction with the new evaluation method is 86.12 points, and the average score of the current evaluation method is 70.62 points. The satisfaction score of the new evaluation method is higher than that of the current evaluation method, both from the perspective of students and teachers.

Through the analysis of Figure 10, it can be seen that the average score for the accuracy of the new evaluation method is 84.54 points, and the average score for the current evaluation method is 77.67 points. Teachers' average score for the accuracy of the new evaluation method was 88.40 points, and the average score for the current evaluation method was 77.52 points. From the perspectives of students and teachers, the accuracy score of the new assessment method is higher than that of the current assessment method.

## 4. Discussion

(1) The current physical education evaluation in colleges and universities in Jilin Province has many problems, such as single subject and model, simple and vague indicators, unscientific methods, lack of individuality

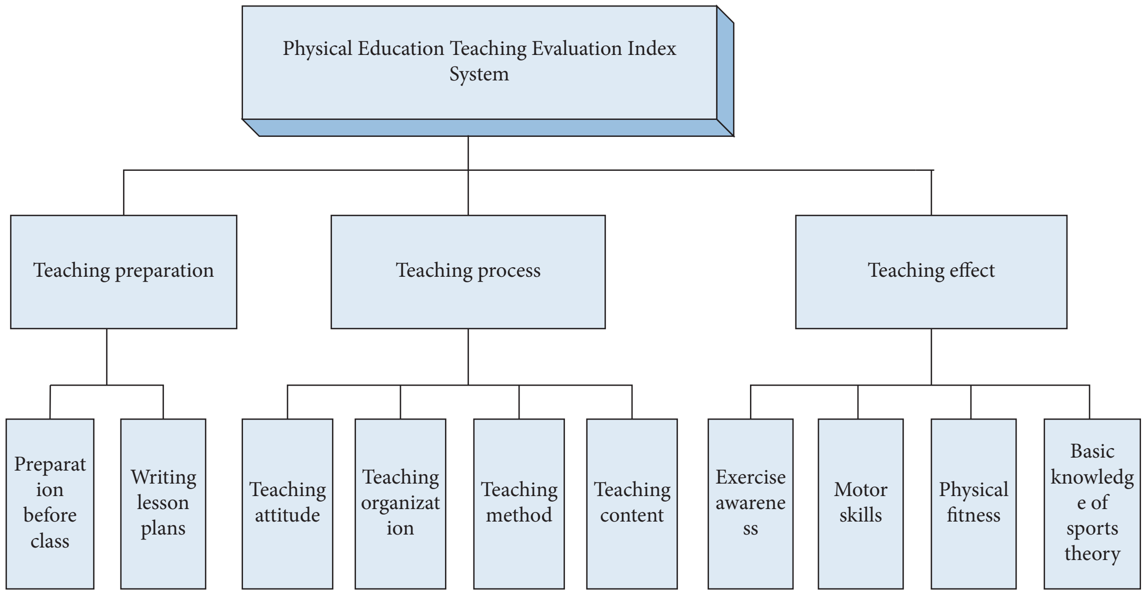


Figure 5: Physical education teaching evaluation index system framework.

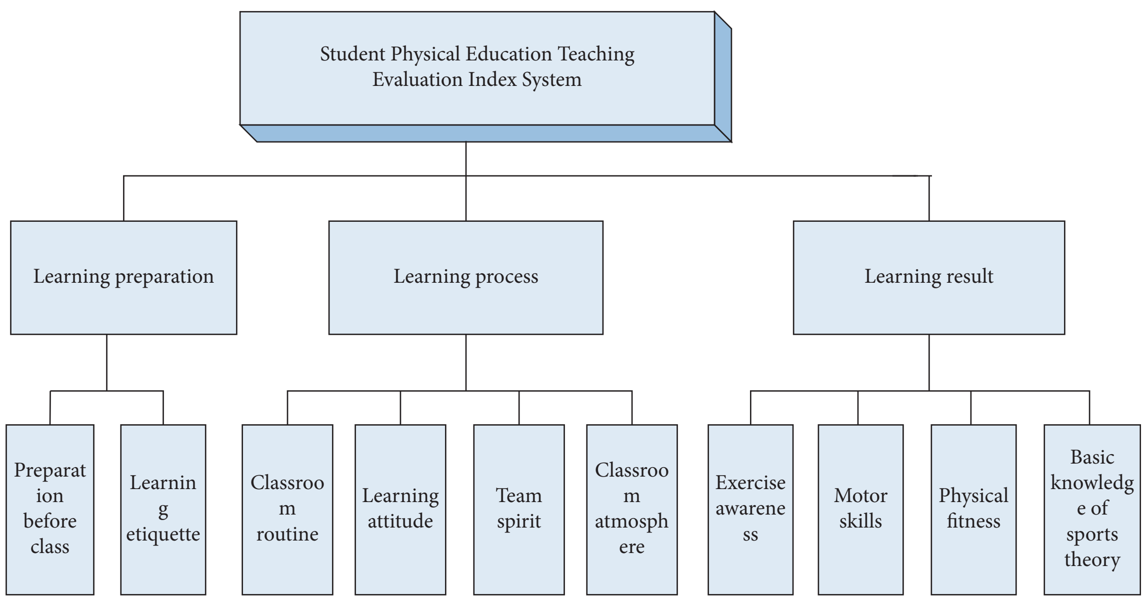


Figure 6: The framework of student physical education teaching evaluation index system.

in standards, imperfect guarantee mechanism, and imperfect feedback mechanism. To a large extent, it deviates from the original intention of physical education evaluation, which has a great relationship with China's long-term centralized and unified administrative management system in education.

(2) This study integrates relevant information of knowledge graph and documents released by the Department of Education and constructs a PE education assessment metric series from the viewpoint of faculty and students. The series is separated into three metric levels, preparation, process, and effect, and each metric level contains corresponding evaluation contents. The university PE instruction assessment framework explored and constructed has certain accuracy and feasibility of applying knowledge graphs to university PE instruction assessment in comparison with the existing one.

(3) The establishment of a physical education evaluation system in colleges and universities should be based on the results of students' experimental research on the content of the evaluation and the index of physical education activities and should demonstrate the purpose of evaluating the overall development of students and continuous training of teachers, to promote the comprehensive development of students. We must not only pay attention to the physical and mental health of students, but also develop

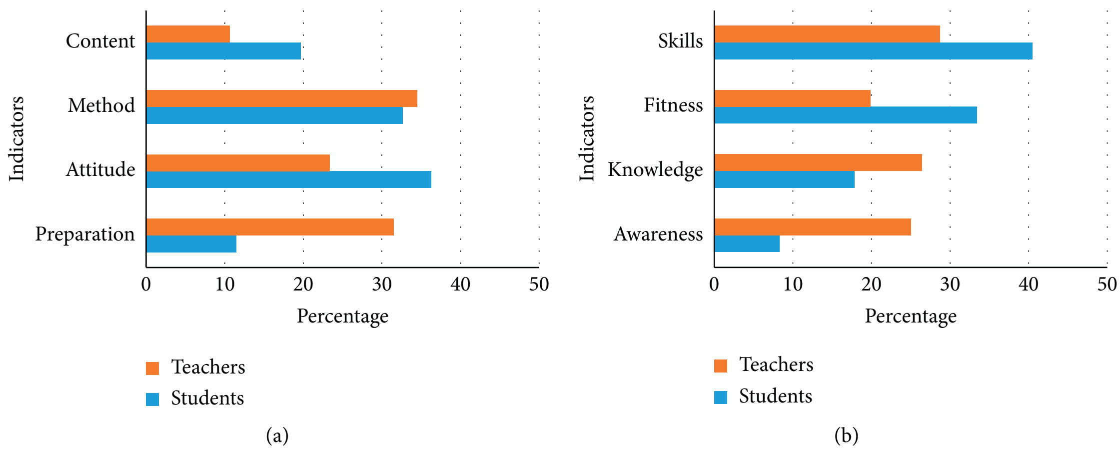


FIGURE 7: The survey results of the importance of the evaluation content in teacher's teaching evaluation system. (a) The importance proportion of each evaluation index in the teaching process in the teacher's teaching evaluation system. (b) The importance proportion of each evaluation index of teaching effect in the teacher's teaching evaluation system.

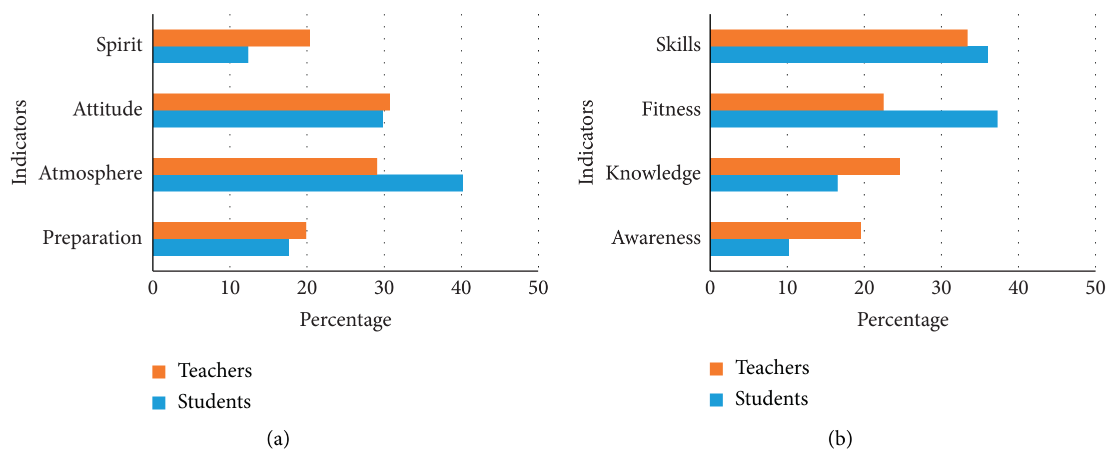


FIGURE 8: The survey results of the importance of the evaluation content in student's teaching evaluation system. (a) is a diagram showing the importance ratio of each evaluation index in the learning process in the student teaching evaluation system. (b) shows the importance ratio of each evaluation index of learning effect in the student teaching evaluation system.

TABLE 3: New and current sports evaluation method and score table.

| Evaluation method | Evaluation content and scores | | | | |
|---|---|---|---|---|---|
| New method | Physical skills 20 | Physical skill progress 30 | Theoretical knowledge 20 | Learning attitude 20 | Team spirit 10 |
| Current method | Technical part 50 | Quality part 20 | Theoretical part 20 | Attendance performance 20 | |

TABLE 4: New evaluation method validity scale.

| | Number | Proportion |
|---|---|---|
| Reasonable | 8 | 80% |
| Basically reasonable | 2 | 20% |
| Unreasonable | 0 | 0 |

students' abilities in many areas and not consider the performance of the game as the most important method of evaluation.

(4) In the age of big data, the main objectives of physical education evaluation in colleges and universities should cover all physical education teachers,

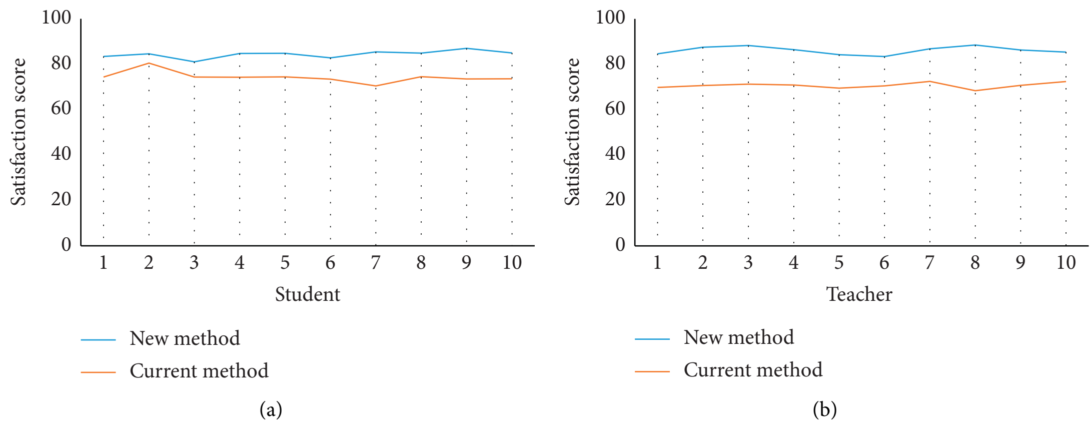


Figure 9: Satisfaction score of old and new evaluation methods. (a) shows the students' satisfaction scores for the old and new evaluation methods. (b) shows the satisfaction scores of teachers for the old and new evaluation methods.

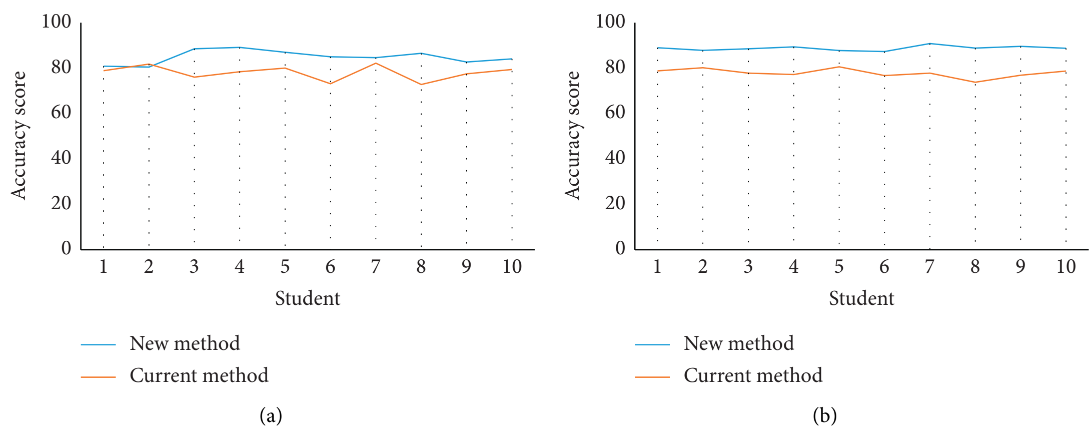


Figure 10: Accuracy scores of old and new evaluation methods. (a) shows the accuracy scores of students for the old and new assessment methods. (b) shows the accuracy scores of teachers for the old and new assessment methods.

students, peers, and staff of the specialized physical education department in schools. The grading system should consist of the physical education teachers 'grading system and the students' physical education grading system.

## 5. Conclusion

This study refers to the National Guidelines for Teaching PE Courses in Institutions of Higher Education and seeks to construct a more complete assessment mechanism for PE instruction in institutions of higher education with certain academic and practicable implications by promoting the educational concept of continuous development of both faculty and students. The establishment and execution of the new PE education assessment mechanism require the renewal of teachers' ideology, promoting the transformation of teachers' educational philosophy and making the formulation and execution of the assessment mechanism a kind of conscious behavior of teachers, so as to promote quality education and improve teaching quality. Assessment of PE education in institutions of higher education serves PE teaching as well as students' development; it is a tool for feedback, diagnosis, and motivation. The study in this article is limited by the object, scope, and time of the study, and the conclusions drawn have certain limitations and shortcomings, which have to be summarized, completed, and optimized in the future practice of PE education. The limitation of this research is that the evaluation index system of physical education teaching in colleges and universities constructed by using the knowledge graph cannot handle complex knowledge.

## Data Availability

The experimental data are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that this research has no conflicts of interest. The authors confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

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