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Computer-Aided Design AND APPLICATIONS

Construction of Multi-Object Evaluation Index Tutoring System for Physical Education and Teaching Based on Intelligent CAD

Weisong Bu

Xuchang Electric Vocational College, Xuchang, Henan 461000, China, weisong1593992@126.com

Corresponding author: Weisong Bu, weisong1593992@126.com

Abstract. In the BD (big data) era, compared with the past, what we can collect is not random samples but all data; that is, we adopt the full data mode instead of relying on only a small part of the data. Based on BD theory, this paper constructs a scientific and reasonable MOEIS (Multi-object evaluation index system) for physical education and teaching and analyzes the construction level of practice base in combination with empirical research. In this study, the Ridit analysis method is used to screen the evaluation indexes, which objectively ensures the scientificity and rationality of the existing problems and promotion strategies of the index system for the practice base construction. Communication between sites is realized through serialization, a global FP-tree is constructed, and a global FP-tree is mined to form rules. The results show that the accuracy of the algorithm is increasing, and it tends to be stable after the number of iterations increases to 450, and the final average accuracy reaches 96.52%. The designed algorithm is used to integrate and analyze the data to achieve the evaluation goal of teaching quality.

Keywords: Big data; Graduate students; Teaching quality; Evaluating indicator; Intelligent CAD
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1 INTRODUCTION

BD (big data) and other information technologies have also brought unprecedented development opportunities to education information technology. Online education based on BD is changing traditional education methods, and its advantages of "teaching students in accordance with their aptitude" have attracted great attention in educational circles. The expansion of university enrollment has led to a rapid increase in the number of students, and the multifaceted social demand has also forced the university to add more courses. In order to improve the quality of graduates, all schools are seeking better management mechanisms and teaching systems [1]. With the rapid development of the economy and society and the demand for high-end talents, the number of graduate students, as the representative of the highest degree in the country, has

gradually increased. How to continue to guarantee and improve the quality of graduate students' training has attracted the attention of the whole society.

With the arrival of the third industrial revolution represented by "informatization", the social demand for high-quality workers and innovative talents has put forward new requirements for talent training. The purpose of improving teaching quality and talent training quality is achieved through the supervision of students' learning process. Therefore, the transformation of the university education evaluation system is the core content to solve the problems of teaching management and teaching evaluation, while process management and process evaluation based on BD are the core methods to solve the problems of talent training [2]. As an important carrier of cultivating the practical and professional abilities of graduate students with professional degrees, the practice base plays an important role in cultivating and training the professional ability of graduate students to find problems and solve practical problems. However, as the practice base is an important carrier of the combination of industry, learning, and research jointly established by universities, enterprises, and institutions, the construction of the practice base involves participants from society, schools, enterprises, and students [3]. However, there are still some problems that need to be solved. For example, the results of teaching evaluation are generally fed back to substitute teachers in the form of a 100-percentage system or assessment grade, and teachers are not given any suggestions for improvement. The Academic Affairs Office cannot find some hidden rules from a large number of teaching evaluation data.

Then, how to optimize the evaluation method of physical course teaching, make the evaluation system more reasonable and scientific, really promote the improvement of physical education quality, and guide universities to pay more attention to physical teaching quality and course construction. In recent years, the research results of RS (rough set) theory have been fruitful, and it has been successfully applied to DM (data mining), decision support and analysis, medical and health services, and many other fields. Based on BD theory, this paper constructs a set of scientific and reasonable MOEIS (Multi-object evaluation index system) for physical education and teaching and analyzes the level of practice base construction with empirical research.

Research innovation:

(1) On the basis of following the idea, principle, method, and process of index system construction, this paper comprehensively uses the methods of questionnaire survey, literature analysis, expert consultation, and comprehensive evaluation analysis to carry out research and empirical research on MOEIS of physical education and teaching, so that the research results are more scientific, objective and convincing, and provide reference for the evaluation of physical education practice bases with professional degrees in the future.

(2) In this paper, the association rules mining method based on metadata integration is proposed. Mining association rules can predict and generate knowledge that has a guiding function in the process of university teaching and student management, and it can provide decision-making assistance for university administrators through the results of rule generation.

The structure of the paper is divided into five chapters. The main contents of each chapter are as follows:

The first chapter introduces the background work of the research. The second chapter mainly introduces the present situation of this research. The third chapter puts forward the algorithm model of association rules mining. The fourth chapter verifies the performance of the model studied in this paper. The fifth chapter is the conclusion.

2 RELATED WORK

2.1 Research on Teaching Quality Evaluation

Wei hopes to train students to develop new talents with active innovation ability by designing relevant evaluation indicators [4]. At the same time, some university scholars pay more attention

to the teacher-student relationship and regard it as the first level indicator in the indicator system. Jahantigh and others believe that the training of physicals in the new situation includes two aspects: course study and the quality of the thesis, and course study runs through the middle part of the training of graduate students [5]. Jiang et al. established an evaluation index system based on four aspects: teaching attitude, teaching content, teaching method, and teaching effect, using the expert consultation method [6].

Liu suggested that the education industry needs to do a top-level design from the perspective of the three-dimensional world when building the learning process evaluation BD, which requires building an independent teaching evaluation BD subset in the construction of a smart campus [7]. Yang discussed the learning evaluation based on a virtual reality system and constructed the evaluation index system from three dimensions: emotion, process, and knowledge [8]. Wonah discussed the learning evaluation under the flipped classroom model of universities under the background of BD and constructed the index system of student evaluation from four dimensions: before class, during class, after class, and learning results, mainly involving learning resources, learning interaction, knowledge feedback, Four aspects of academic performance [9]. Xiong et al. used the questionnaire survey method to construct the management model of the practice based on the four stages of planning, implementation, performance evaluation, and continuous improvement.

2.2 BD Technology-Related Research

Using BD technology, on the premise of ensuring national information security, some information reported by the school will be publicized online within the scope of participating units, and objections from all parties will be accepted, and the objections will be confirmed according to the evaluation criteria.

Shadroo et al. proposed that the BD era of "data-driven schools and analysis to transform education" has come. It is necessary to comprehensively use DM and learning analysis to provide effective support for education and teaching [11]. Asim et al. used learning analysis technology to build a learner model that describes individual learning characteristics, obtains learning preferences, learning effects, and other information, provides a targeted, personalized learning environment, and achieves adaptive and personalized learning [12]. Ding et al. Pointed out that the test of the student academic quality analysis system is strictly based on the requirements of the curriculum standards. It is necessary to ensure the continuity and comparability of the collected data, and the users are mainly educational administrators and scientific researchers [13]. Cole uses RS in the construction process of the decision tree; that is, when selecting a new attribute, the information gain brought by the attribute and the two-layer nodes of the tree should be considered [14].

Yoseph et al. used DM to study the selection of sports talents [15]. Mu et al. improved the ID3DM algorithm and applied the algorithm to the system they developed, which better realized the function of auxiliary decision-making [16]. Shi et al. Studied and analyzed teaching evaluation based on DM technology and established five principles of the university teaching evaluation index [17]. Xie et al. Studied the objectivity of teaching evaluation and used association rules to improve the scientificity of teaching evaluation [18].

3 METHODOLOGY

3.1 MOEIS Construction of Physical Education and Teaching in Universities

At present, among the methods used to evaluate the teaching quality of physical courses are mainly expert evaluation and student evaluation. The evaluation form of physical classroom teaching quality includes attitude, content, ability, method, display, and effect. In this kind of evaluation, there is a lack of teachers' evaluation of learning and social evaluation indicators, especially the objective evaluation of students' learning attitudes. When a certain index evaluation

system is used alone, the evaluation standard is single, and the evaluation quality is not accurate enough. When referring to many index systems, although the evaluation indexes are rich in content, there is serious redundancy, which reduces the calculation efficiency and even fails to get the corresponding accurate results. BD analysis of teaching is to collect a large number of relevant data in the teaching process of various modes, use DM technology to analyze the data, find out the relationship between the data, and form a self-learning and self-diagnosis algorithm mode so as to realize the precision and intelligence of teaching evaluation.

The fundamental purpose of education is to have a clear understanding of the object of evaluation, and so is the evaluation of multi-object evaluation of graduate education and teaching. In addition, MOEIS of physical education and teaching in universities should also have a guiding function, providing a diagnostic and improvement tool for multi-object evaluation activities of physical education and teaching in universities. A comprehensive evaluation index system is a system that includes the configuration of system elements and the arrangement of system structure. Here, every single index is a system element, and the relationship between each index is a system structure. The real value of a comprehensive evaluation scheme can only be reflected when it is put into practice, which requires that every index in the index system must be operable. Due to the rich connotation of multi-object evaluation of physical education and teaching, some factors can't be quantified and can only be studied in a qualitative way. Therefore, it is necessary to pay attention to both quantitative factors and non-quantitative factors in the multi-object evaluation of physical education and teaching and pay attention to the combination of qualitative and quantitative factors in the selection of evaluation indicators, but the final result should be expressed in a quantitative way.

Education informatization is the key to realizing education modernization, and education modernization cannot be realized without education informatization. Education BD is an important way to implement education information. Education BD will lead education to accuracy, individuality, and demonstration. Compared with traditional educational data, the collection of educational BD is more real-time, coherent, comprehensive, and natural, and detailed data records can achieve more subtle and accurate insights. Teachers' grasp of learning situations mainly depends on experience or a small amount of data, which is difficult to be comprehensive and accurate. Education BD is the aggregation of data from the whole process of education, all objects, and all directions. It can accurately reflect the learning situation, improve the effectiveness and pertinence of pre-learning, and lay a solid foundation for further realizing accurate classroom teaching.

From the perspective of evaluation purpose, the purpose of process evaluation is to correct students' problems in course learning, while process-oriented evaluation is more inclined to course assessment. Similar to the feedback content of constructivist learning theory. At the same time, the connectionist learning theory is based on the assumption that learners have learning initiative. Therefore, in the evaluation dimension, we should also pay attention to students' initiative in forming learning networks, which is similar to the constructivist learning participation initiative.

This section adopts the expert consultation method to design the evaluation index applicability questionnaire and uses the Ridit analysis method to screen the evaluation indicators, which objectively guarantees the scientificity and rationality of the index system for the problems existing in the construction of the practice base and the improvement strategy. In the end, this study obtained the MOEIS of physical education and teaching composed of indicators, as shown in Figure 1.

It can be seen that there are comprehensive and systematic evaluation indexes in every stage of graduate enrollment, from course study, practical operation, thesis reading, and writing to degree awarding, so as to make an objective, fair, and meaningful evaluation of the whole process of graduate education. The results show that only by integrating the results of students' evaluation of teaching, experts' evaluation of teaching, teachers' evaluation of learning, students' self-evaluation, and school evaluation can a course be evaluated fairly and objectively, and the teaching quality of graduate students can be improved.

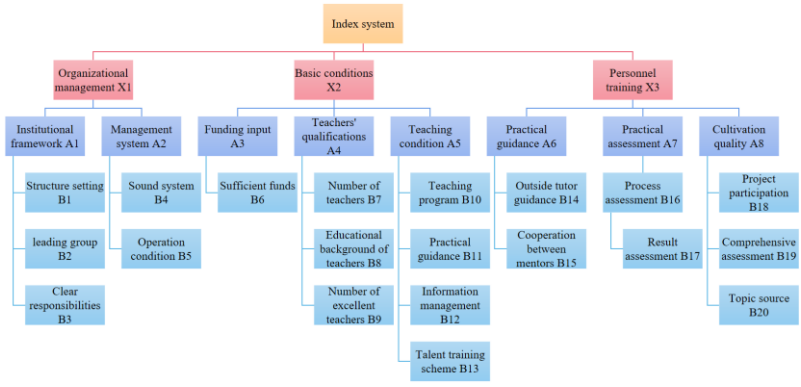

Figure 1: Graduate education and teaching MOEIS.

3.2 Determination of Evaluation Index Weight

DM technology is to solve the problem of extracting hidden useful information from a large amount of data stored in the database. It can make full use of existing historical data and reveal the hidden relationship behind the data. The data that can be used for DM includes many forms, which can be relationships. The data records stored in the database can also be unstructured data information stored in text, Web data information from the network, or even complex multimedia data information [19]. Teaching evaluation is an important part of the school's educational affairs work. The results of teaching evaluation can be used as an important basis for teachers' promotion and various awards, and can also obtain the development trend of the professional level of teachers in various subjects through data statistics and analysis.

There are many methods for determining the weight of indicators, and the more commonly used methods include principal PCA (principal component analysis), expert scoring method, AHP (analytic hierarchy process), weight factor analysis method, and fuzzy evaluation method. The problem of weight assignment in this paper is complicated. Therefore, this paper chooses this assignment method. This method combines the subjective knowledge of experts with mathematical calculation, to some extent eliminating the subjectivity of the expert scoring method and making the weight conform to the objective situation. The specific process is as follows:

(1) Constructing a judgment matrix: By comparing the indexes of the same level pairwise and according to the importance, according to the Saaty scale, the evaluation matrix is formed according to the evaluation results.

(2) Calculate the maximum eigenvalue and eigenvector. After constructing the judgment matrix according to the results of the expert questionnaire, the square root method is used to calculate an eigenvector. The calculation process is as follows:

Calculate the n-th root of each row of the matrix and get the initial weight vector.

$$W_i = \frac{w_i'}{\sum_{i=1}^{n} w_i'} \tag{1}$$

$W = W_1, W_2, \cdots, W_n{}_r$ is the weight sort vector, and the maximum eigenvalue is calculated.

$$\lambda \max = \frac{1}{n} \sum_{n=1}^{n} \frac{AW}{W_i}{}_i \tag{2}$$

where AW_i represents the i th element of vector AW .

(3) Perform consistency test on the judgment matrix, and calculate the consistency test coefficient:

$$CR = \frac{CI}{RI} \tag{3}$$

When $CR < 0.1$ is used, the degree of inconsistency is within an acceptable range, and the consistency test is passed; when $CR > 0.1$ is used, it means that there is a huge disagreement among experts, and it is necessary to find problems, conduct opinion statistics again, and revise the judgment matrix.

(4) Determine the absolute weight W_i of each evaluation factor, and then multiply the relative weight of the next evaluation factor by the relative weight of the corresponding evaluation factor at the previous level so as to obtain the absolute weight of each evaluation factor relative to the evaluation target, and form the final index weight result.

The fundamental purpose of MOEIS in physical education is to improve the construction level of practice base for physical education with a professional degree, and its effectiveness needs to be tested according to practical application. Through the empirical evaluation of practice base, we can know the overall level of practice base construction for professional degree graduate students at present, find out the main problems existing in the process of practice base construction, master the influencing factors that restrict practice base construction, and put forward targeted countermeasures and suggestions for the construction and development of practice base.

RS is a very practical subject and has achieved fruitful results in many fields. At present, RS theory has been successfully applied in many fields. Knowledge acquisition is to find useful information from analyzing a large amount of raw data, that is, to transform knowledge from a form of raw data expression into a form that is easy for human and computer to understand and process [20]. This paper combines RS and decision tree technology to analyze students' teaching evaluation data.

Given an information system $\langle U, C \cup D, V, f \rangle$, $R \subseteq C \cup D$, $\forall X \subseteq U$ and the division $\pi\ U = X_1, X_2, \cdots, X_n$ of the universe U independent of the equivalence relation R, the importance of knowledge R about the set X is defined:

$$sig_R\ X = \frac{\left|U - bn_R\ X\right|}{\left|U\right|} \tag{4}$$

The importance of knowledge R in dividing $\pi\ U$ is defined as:

$$sig_R\ \pi\ U = \frac{\sum_{i=1}^{n}\left|U - bn_R\ X\right|}{n\left|U\right|} \tag{5}$$

The association rule means that two things have some implicit relations under a rule, which needs to be discovered by the DM algorithm because it is implicit. The concepts of support and confidence are introduced into the association rule algorithm, and the calculation formula is:

$$P\ A\middle|B = \frac{P\ AB}{P\ B} \tag{6}$$

The relationship between support and confidence can be converted by probability calculation:

$$Conf = Y|X = P\ Y|X = \frac{P\ XY}{P\ X} \tag{7}$$

The significance of mining frequent item sets is to find out the implicit association information between items in transactions, which is the association rule information and the basis of the association rule DM algorithm.

Association rule mining has been widely used in the BD environment. When the original association rule mining algorithm is applied to BD, the algorithm's overall efficiency is greatly reduced. In order to ensure the data security of each site, considering the large capacity of each site's data, the data can't be integrated for mining, so it is of great significance to study association rules mining in a distributed environment. This section puts forward the theoretical framework of an association rule mining algorithm based on metadata integration, which is convenient for readers to understand the specific steps of this algorithm more clearly. The framework is shown in Figure 2.

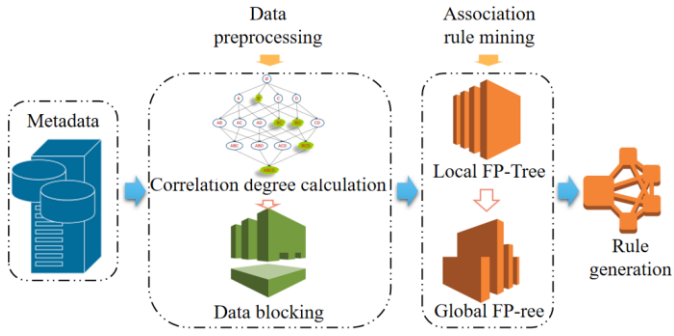

Figure 2: Association rule mining algorithm framework based on metadata integration.

As the guiding knowledge of DM, global metadata is used to standardize the scope of further data sampling when calculating the attribute correlation degree of data. In this paper, the sampling algorithm is improved by introducing a bit matrix. Converting data into a bit matrix can reduce the data dimension, reduce the amount of data, and improve the memory processing efficiency. As shown in formula (8):

$$D_j = d_{j1}, d_{j2}, \cdots, d_{jm}\ , d_{ji} = \begin{cases} 1, & I_i \in T_j \\ 0, & I_i \notin T_j \end{cases} \tag{8}$$

Among them, D_j is the j th row in the bit matrix, and d_{ji} represents the i th column of the j th row. If the transaction item contains an item, it is converted to 1; if the transaction item does not contain an item, it is converted to 0.

In the decision table $U, C \cup D$, the quotient $U / D = D_1, D_2, \cdots, D_l$ determined by the decision attribute set D , where $D_i \cap D_j = \varnothing, i \neq j$. The lower approximation $\underline{R}\ X$ for set X is:

$$\underline{R}\ X = x|x \in U, [x]_R \subseteq X \tag{9}$$

Similar to similarity, different types of data have different calculation methods for the dissimilarity between their data objects, but their similarity can be mutually transformed. Min's distance

formula can be transformed into not only Euclidean distance, but also Manhattan distance and supremum distance through transformation. The following is min's distance formula:

$$d\ x,y\ = \left(\left(\sum_{k=1}^{n} x_k - y_k \right)^r \right)^{\frac{1}{r}} \tag{10}$$

In the formula, r is the parameter, when $r=1$ is the Manhattan distance; when $r=2$ is the Euclidean distance; when $r \to \infty$ is the supremum distance. Therefore, the parameter r is different, and the distance represented by the above formula is also different.

Whether the evaluation results of the student evaluation system can truly reflect the teaching level of teachers, the key lies in the establishment of evaluation index items. Because evaluating the teaching quality of teachers is a very complicated task, it is easily affected by various factors. In the process of teaching evaluation, firstly, the administrator generates the teaching evaluation scheme according to the teaching assignment, then the students grade the teachers of this semester according to the scoring standard and finally, record all the scoring results. Teachers can view their own evaluation results, and administrators can obtain the summarized evaluation results.

4 EXPERIMENT AND RESULTS

An important link in the establishment of the index system is the determination of the relevant weights. Although each factor constitutes an index in the system, it plays a different role and has a different impact on the entire system. This paper mainly uses AHP to establish university graduate education. Teaching multi-object evaluation evaluation index weight system.

The scale method of 1-9 and its reciprocal was used to conduct a comprehensive survey of more than 20 experts for the evaluation indicators. The questionnaire is detailed in the appendix, and a judgment matrix was constructed. Then, the arithmetic mean of the weight values of the ten experts is further calculated. Finally, the weight value of the evaluation index of the professional degree graduate practical education base is obtained, as shown in Fig. 3 and Fig. 4.

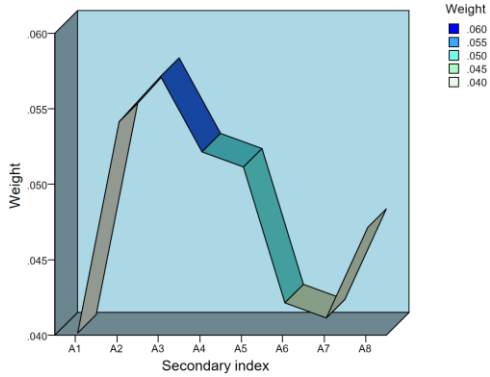

Figure 3: Weight value of secondary indicators.

The main method of RS-based teaching quality evaluation of data science and BD technology majors is to comprehensively analyze the original teaching quality evaluation indicators of relevant majors in the College of Information Management and then compare and analyze the relevant performance indicators. After the qualitative and quantitative data are processed, a discretized data table is formed. As shown in Table 1.

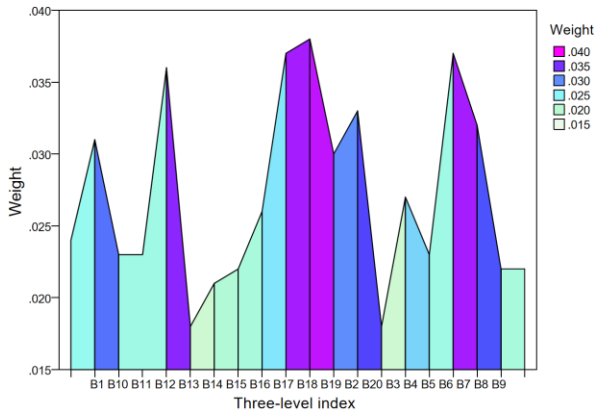

Figure 4: Three-level indicator weight value.

Expert	*Instructional objective*	*Instructional design*	*Practical teaching ability*	*Teaching structure*	*Teaching method*	*Overall evaluation*
1	9	9	8	6	5	Excellent
2	6	7	7	7	8	Excellent
3	6	8	8	5	5	Excellent
4	8	9	6	9	9	Excellent
5	7	7	8	9	7	Excellent
6	7	7	5	5	8	Good
7	7	7	5	3	5	Qualified

Table 1: Comprehensive table of teaching quality evaluation.

To measure the teaching quality of data science and BD technology in higher education, it is necessary to use the RS model to process the collected data because of its long data collection cycle, difficulty in collecting opinions, and asymmetric information. By using the attribute reduction method in RS, the redundant indexes are deleted to simplify the index system. Intuitively, this method can reduce the number of relevant columns in the decision table so that specific indicators of teaching quality evaluation can be efficiently discovered.

The field inspection of the practice base mainly focuses on the construction of the two bases and the arrangement of internship students. It also communicates and discusses with the person in charge of the organization and management of the practice base and the management of internship students. For the index weight of liberal arts courses, it needs to be investigated separately for the teachers of liberal arts. Therefore, the following index weight calculation is mainly for the weight assessment of science and engineering courses or practical courses.

Each indicator is converted into an equivalent of 100 points. Secondly, experts compare the ideal state of the index with the actual situation and give specific scores. Finally, according to the scores and index weights of the indicators of the 10 practice bases, the comprehensive scores and rankings of the 10 practice bases are obtained after the scores of the experts are unified. The specific results are shown in Fig. 5 and Table 2.

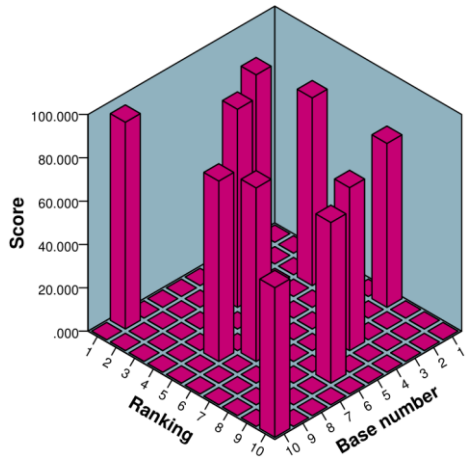

Figure 5: Comprehensive score and ranking of professional degree graduate education practice bases.

It can be seen that the scores of practice bases are hierarchical, and the index system can intuitively reflect different base construction levels. Two of the 10 practice bases scored above 90, and there were two practice bases between 80 and 90. This shows that practice bases of different majors have different construction levels.

Practice base No	*Organization management*	*Basic conditions*	*Personnel training*
1	89.642	91.905	79.938
2	68.79	70.079	81.797
3	83.84	92.011	94.351
4	68.675	79.5	83.067
5	81.836	88.71	97.35
6	67.547	91.616	84.992
7	66.721	69.697	85.237
8	73.855	95.292	91.101
9	83.741	80.482	81.807

Table 2: Score of each indicator.

It can be seen from Table 2 that practice base 3 and practice base 5 have the highest scores in talent training and have also made good achievements in scientific research results, which is very consistent with the results of our field research. However, due to the constraints of teachers and insufficient funds for laboratory construction, there is a serious lag in the introduction of new technologies, new processes, and new materials required for the practice of this specialty, and there are obvious deficiencies in practical teaching. As a result, the comprehensive score of this practice base is lower than that of other practice bases.

Through the data analysis of teaching evaluation, this paper sets up 10 index items to describe teaching evaluation and establishes the DM model analysis table of "teaching evaluation index classification." Figure 6 shows the statistics of sample classification accuracy.

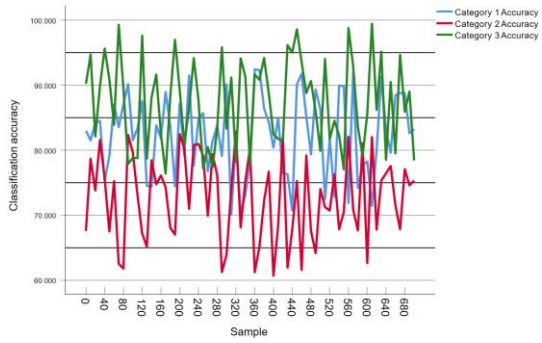

Figure 6: Sample classification accuracy.

It can be seen that the accuracy rate of the calculation results is increasing and tends to be stable after the number of iterations increases to 450, and the final average accuracy rate is 96.52%. After that, with the increase in iteration times, the accuracy decreases.

Since the recommendation of educational resources is based on user ratings, the dataset used in this algorithm comes from Group Lens to simulate educational resources. Selecting different users in the data set to compare the algorithm performance on the movie rating data, as shown in Figure 7.

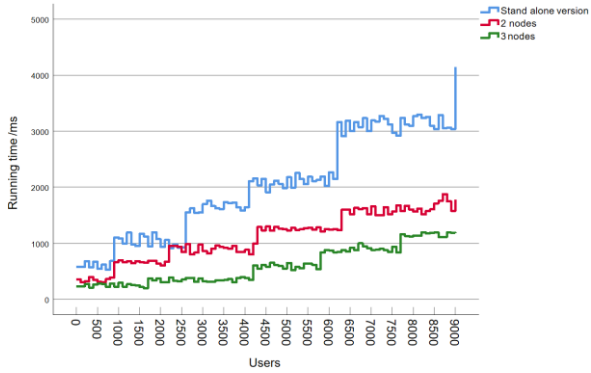

Figure 7: Comparison of operating efficiency of different node algorithms.

The analysis shows that the running time of the algorithm increases exponentially with the linear increase of the number of users in the stand-alone environment. When the number of users, that is, the scoring data, increases to a certain amount, the performance of the algorithm decreases significantly. Compared with the cluster with 3 nodes and 2 nodes, it is found that the algorithm performance is similar when the data volume is small, but when the number of users increases to 400, the calculation time of 3 nodes is significantly lower than that of 2 nodes. This is because the data copy and data transmission are the main factors affecting the algorithm performance when the data volume is small in the parallel environment. Therefore, the larger the data volume in the parallel environment, the more advantages.

5 CONCLUSIONS

Teaching quality evaluation mainly focuses on the comprehensive quality of professional students, the whole process of teaching and training, the implementation of teaching objectives of majors and courses, and the specific effect of teaching implementation on the teaching process. This

paper takes the construction of MOEIS for physical education and teaching as the main line and makes a deep analysis of the multi-object evaluation of physical education and teaching. The Ridit analysis method is used to screen the evaluation indicators, which objectively guarantees the scientificity and rationality of the indicator system to address the problems existing in the construction of the practice base and the improvement strategy. Data will be used to conduct multi-dimensional dynamic analysis and display the level of regional academic quality. RS and decision tree technology are combined to analyze students' teaching evaluation data. This paper attempts to find out the relationship between the quality of teachers and the evaluation results of each evaluation index from the evaluation data. The decision tree constructed can classify the evaluation results and generate rules, and can also predict the evaluation results of teachers according to the evaluation indicators. The correct rate of the algorithm operation results is increasing, and it tends to be stable after the number of iterations increases to 450, and the final average correct rate reaches 96.52%. After that, the accuracy rate decreased with the increase in the number of iterations.

Weisong Bu, https://orcid.org/0009-0002-1505-3650

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