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An integrated teaching method of college physical education based on multi-classification support vector machine

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ABSTRACT

The purpose of this paper is to evaluate the teaching of university sports physical-educational integration based on multi-classification support vector machine (SVM). Firstly, it introduces the background of the development of university sports physical-educational integration teaching and the current situation of related research, and clarifies the purpose and significance of the study. Then the basic principle of SVM and the theory and application of multi-classification SVM are elaborated in detail, and the application prospect of multi-classification SVM in the field of educational evaluation is discussed. On this basis, the index system applicable to the evaluation of the teaching and learning of the integration of university sports and physical education is constructed, and the data collection and pre-processing methods are introduced. Subsequently, the process of constructing the teaching evaluation model for the integration of university physical education in sports based on multi-classification SVMs is described. Finally, descriptive statistics and analyses of the empirical data were carried out, and the empirical results of the multi-classification SVM were discussed and interpreted to explore the application of the evaluation model in university physical education integration teaching. Finally, the research results and conclusions are summarised, and the future directions and trends of the evaluation research on the integration of teaching and learning in university sports body-education are looked forward to.

Keywords: university sports, physical-educational integration teaching, multi-classification SVM, evaluation model, education reform

1. Introduction

University physical education integration teaching refers to a teaching mode that integrates physical education and subject teaching in university education and improves students' subject literacy and

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comprehensive quality through physical education. With the deepening of the reform of the education system and the gradual enhancement of the public's awareness of sports, the integration of university physical education teaching has ushered in a period of rapid development [1-2]. Traditional physical education teaching is often regarded as only for the purpose of cultivating students' sports skills and physical fitness, while neglecting the cultivation of students' comprehensive quality. University physical education and physical education integration teaching, by combining physical education and subject teaching, gives full play to the role of physical education in cultivating students' innovative spirit, teamwork ability, etc., which contributes to students' all-round development. Relevant studies have shown that the integration of university sports and physical education teaching has a significant effect on the improvement of students' comprehensive quality. Some scholars have found through empirical research that the teaching mode of integrating physical education and subject teaching enhances students' physical and psychological qualities. And in the actual teaching practice, some universities have begun to try to combine physical education and subject teaching, and have gained certain success. However, the current evaluation research on the integration of physical education and teaching in university sports is still relatively weak [3-5]. Although some scholars have already carried out some exploration and practice on it, there is no systematic and mature evaluation system and method on how to scientifically and objectively evaluate the quality of university sports body-teaching integration teaching. Therefore, this study aims to comprehensively and accurately evaluate the university sports body-teaching fusion teaching by constructing a multi-classification SVM model to provide a scientific evaluation means. Through the evaluation of university physical education courses and physical education teaching, it promotes the development of university education system towards a more healthy, scientific and comprehensive direction. At the same time, this study aims to explore the application of SVM in the field of education evaluation on the basis of the theory of SVM, and promote the promotion and depth of SVM algorithm. Through the implementation of this study, it can provide reference for future research and learning in the integration of university physical education.

2. Multi-Classification SVM Theory and Application

2.1. Principle of SVM

SVM is a supervised learning algorithm, and its basic principle is to find the hyperplane that can maximise the interval for classification (Fig. 1). In the feature space, a SVM separates samples of different categories by a separating hyperplane. In other words, a SVM achieves nonlinear classification by mapping the data to a high-dimensional space and finding the optimal dividing hyperplane in it. Then the basic principle of SVM and the theory and application of multi-classification SVM are elaborated in detail, and the application prospect of multi-classification SVM in the field of educational evaluation is discussed.

In real-world problems, a multi-classification SVM is an extension of the traditional bi-classification SVM. While traditional SVMs classify two categories, multiclassification SVMs classify multiple categories [6]. In a multi-classification SVM, a one-to- many (One-vs-Rest) or one-to-one (One-vs-One) strategy is usually used to deal with the multi-classification problem. The One-vs-Rest strategy bisects the target category with all other categories separately to obtain multiple binary classification models, while the (One-vs-One) strategy bisects any two categories to obtain multiple binary classification models. Compared with traditional SVMs, multi-classification SVMs have higher complexity and stronger generalization ability in classification tasks. The multiclassification SVM model can better handle complex multi-category problems and has achieved better results in practice.

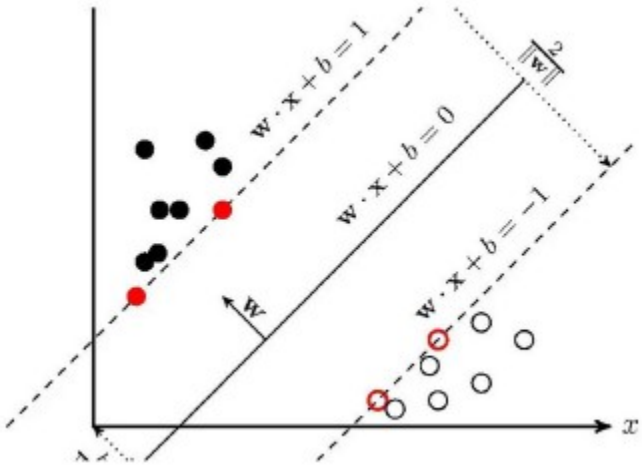

Fig. 1. SVM principle diagram

SVM is a powerful classification algorithm, and multi-classification SVM has good performance and wide application prospects in solving multi-classification problems. In this research paper, based on the theoretical foundation and application technology of multi-classification SVM, the evaluation and analysis of university sports body-education integration teaching will be carried out to provide useful reference and support for the reform and development of university sports teaching. In terms of application areas, the multi-classification SVM evaluation model can be extended to other educational fields and practice scenarios, such as primary and secondary education, vocational education, etc., to explore its applicability and universality in different teaching and learning environments to realize the comprehensiveness and universality of the educational evaluation model. To construct the multi-classification SVM model, it is necessary to collect a large amount of data related to physical education teaching, including students' academic performance, physical fitness test data, course evaluation data and so on. The collected data should be preliminarily screened and cleaned to remove outliers and missing data to ensure the completeness.

2.2. Multi-Classification SVM Model

Multi-classification SVM model is a classifier based on SVM, which has strong advantages in dealing with multi-category problems. In the mathematical model of multi-classification SVM, this paper firstly needs to define the mathematical form of the multi-classification problem [7]. Traditional educational evaluation methods often face problems such as high data dimensionality, complex features, and sample imbalance, while multi-classification SVMs have strong advantages in dealing with these problems. Multi-classification SVMs can achieve accurate classification of multiple categories by constructing appropriate classification hyperplanes, thus improving the accuracy and reliability of educational evaluation. To construct the multi-classification SVM model, it is necessary to collect a large amount of data related to physical education teaching, including students' academic performance, physical fitness test data, course evaluation data and so on. The collected data should be preliminarily screened and cleaned to remove outliers and missing data to ensure the completeness. For a given set of input samples and a set of output categories, the goal is to find a hyperplane such that the hyperplane separates the sample points of different categories efficiently, maximizing the spacing of the classification boundaries while minimizing the classification error.

$$c(x, y, f(x)) = |y - f(x)|_{\varepsilon} \tag{1}$$

$$|y-f(x)|_{\varepsilon}=\max\{0,|y-f(x)|-\varepsilon\} \tag{2}$$

The mathematical model of a multi-classification SVM usually transforms a multi-classification problem into a series of bi-classification problems and achieves multi-classification by combining multiple bi-classification SVM models. Common multi-classification SVM models include the One-vs-One (OvO) method and the One-vsRest (OvR) method.

$$T=\{(x_1,y_1),\cdots,(x_i,y_l)\} \tag{3}$$

Adopting the aforementioned ε - insensitive loss function and limiting the regression estimation function to a set of linear functions, based on the principle of minimizing structural risk. there is no systematic and mature evaluation system and method on how to scientifically and objectively evaluate the quality of university sports body-teaching integration teaching. Therefore, this study aims to comprehensively and accurately evaluate the university sports body-teaching fusion teaching by constructing a multiclassification SVM model to provide a scientific evaluation means.

$$\min\frac{1}{2}\|\omega\|^2 \tag{4}$$

The constraint conditions are:

$$\begin{cases}\{y_i-(w\cdot x_i)-b\le\varepsilon\\(w\cdot x_i)+b-y_i\le\varepsilon\end{cases} \tag{5}$$

The OvO method makes a multi-classification decision by building a binary classifier between every two classes and then using a voting or combining strategy, while the OvR method starts by considering each class as a category and grouping the samples from other categories into one class, and then builds a binary classifier. Compared with traditional SVMs, multi-classification SVMs have higher complexity and stronger generalization ability in classification tasks. The multi-classification SVM model can better handle complex multi-category problems and has achieved better results in practice. In terms of classification strategies for multi-classification SVM models, the commonly adopted methods include two main strategies, "One-vs-One" and "One-vs-Rest", which are used for solving multi-classification problems, respectively [8].

When the distance between some sample points, a relaxation variable is introduced to construct a fault-tolerant penalty coefficient C.

$$\min\frac{1}{2}\|w\|^2+C\sum_{i=1}^{l}(\xi_i+\xi_i^*) \tag{6}$$

$$\begin{cases}y_i-\omega\cdot x_i-b\le\varepsilon+\xi_i\\\omega\cdot x_i+b-y_i\le\varepsilon+\xi_i^*\\\xi_i,\xi_i^*\ge0\end{cases} \tag{7}$$

Introduce Lagrange function to obtain its dual form:

$$\max\sum_{i=1}^{t}y_i(\alpha_i-\alpha_i^*)-\varepsilon\sum_{i=1}^{t}(\alpha_i-\alpha_i^*)-\frac{1}{2}\sum_{i=1}^{t}\sum_{i=1}^{t}(\alpha_i-\alpha_i^*)(\alpha_j-\alpha_i^*)\varphi(x_i)\cdot\varphi(x_j) \tag{8}$$

For the "One-vs-One" strategy, it decomposes the original problem into a number of relatively simple binary classification problems, while for the "One-vs-Rest" strategy, samples of a certain category are

used as positive examples, and samples of all the remaining categories are used as negative examples to construct a number of binary classification problems for classification. Problems for classification. In the future, with the continuous accumulation and diversification of educational big data, multi-classification SVMs will be more deeply applied in educational evaluation. At the same time, combining new technologies such as deep learning will further improve the performance of multi-classification SVMs in educational evaluation, thus providing a more accurate and reliable classification method for educational evaluation. In terms of application areas, the multi-classification SVM evaluation model can be extended to other educational fields and practice scenarios, such as primary and secondary education, vocational education, etc., to explore its applicability and universality in different teaching and learning environments to realize the comprehensiveness and universality of the educational evaluation model

The mathematical model and classification strategy of the multi-classification SVM model are the key to achieve multi-classification. Through the reasonable mathematical model and classification strategy, the multi-classification SVM model can effectively cope with the complex multi-classification problems in the evaluation of the integration of teaching and learning in university sports, and provide effective analysis and decision-making support for educational evaluation. Through empirical analyses of different teaching cases, this paper finds that the multi-classification SVM model can effectively evaluate the integration of teaching and learning in university physical education with high classification accuracy and generalization ability.

2.3. Application of Multi-Classification SVM in Educational Evaluation

As a classification algorithm, multi-classification SVM has a range of application prospects in the educational evaluation [9]. In the field of education, students' learning and performance often need to be evaluated and classified. Traditional educational evaluation methods often face problems such as high data dimensionality, complex features, and sample imbalance, while multi-classification SVMs have strong advantages in dealing with these problems. Multi-classification SVMs can achieve accurate classification of multiple categories by constructing appropriate classification hyperplanes, thus improving the accuracy and reliability of educational evaluation. Multi-classification SVMs can also effectively deal with classification problems under large-scale feature space, which is of great significance for complex data analysis in educational evaluation [10]. Multi-classification SVMs can avoid the dimension disaster problem when dealing with high-dimensional data, multi-classification SVMs will be more deeply applied in educational evaluation. At the same time, combining new technologies such as deep learning will further improve the performance of multi-classification SVMs in educational evaluation, thus providing a more accurate and reliable classification method for educational evaluation. Overall, multi-classification SVM has a broad application prospect in the field of educational evaluation, and its powerful classification ability and its ability to process high-dimensional data provide strong support for the accuracy and effectiveness of educational evaluation. With the continuous development and improvement of related technologies, it is believed that multi-classification SVMs will play an increasingly important role in educational evaluation and make greater contributions to the improvement of the quality of educational teaching and the promotion of educational reform.

3. Evaluation Model Construction of University Sports Body-Education Integration Teaching

3.1. Construction of Index

The index system is a key task in the evaluation of the integration of physical education teaching in university sports. It is necessary to consider the characteristics and requirements of physical education teaching and combine the objectives and contents of physical education teaching to determine the construction framework. Firstly, the scientific and reasonableness of the evaluation indicators need to be considered, that is, whether the selected indicators are in line with the characteristics and objectives of education teaching, and whether they can fully reflect the physical education teaching. Secondly, full consideration needs to be given to diversity and comprehensiveness, i.e., the evaluation indicators should include students' performance in physical education in terms of physical to education literacy, skill level, physical education interests and physical education habits fully reflect the development of students in physical education teaching. In addition, operability and practicality need to be considered, i.e. the determination of evaluation indicators should consider the operability and practicality of the indicators and be able to provide teachers and schools with operable evaluation information for the improvement and enhancement of physical education.

The index system also requires the determination of specific evaluation indexes based on physical education curriculum objectives, teaching content and evaluation requirements. In terms of the objectives of the physical education programmed, the cultivation and development objectives should be clearly defined, and the evaluation indicators for students' physical education literacy, skill level and physical quality should be determined based on these objectives. In terms of teaching content, it is necessary to fully consider the characteristics and requirements of the course content and determine the relevant evaluation indicators, for example, according to different sports and teaching content to determine the corresponding evaluation indicators. In terms of evaluation requirements, it is necessary to combine the needs and requirements of physical education teaching to determine the abilities and performance that students need to achieve in teaching to determine the corresponding evaluation indicators. In view of the characteristics of the integration teaching of university sports and education, the construction of the evaluation index system also needs to take into account the needs of interdisciplinary integration, that is, it should be combined with the characteristics of cultural courses and physical education courses to determine comprehensive evaluation indexes so as to comprehensively reflect the development of students in physical education teaching and their comprehensive ability. Index system should also determine certain personalized indexes, and the corresponding personalized evaluation indexes should be determined [11].

3.2. Data Collection

Data collection is an important part of the evaluation research on the integration of teaching and learning in university sports. In view of the characteristics and the integrated teaching of university, this paper adopts a variety of data collection methods, including questionnaire surveys, student performance records, teaching video recordings and other forms of data acquisition. Among them, the questionnaire survey is the main means for this paper to obtain students' attitudes. Through the design of scientific and reasonable questionnaire content, this paper can be more objective to understand the actual feelings and feedback. Multi-classification SVMs can avoid the dimension disaster problem when dealing with high-dimensional data, which accuracy of classification, and thus has a broad in the field of educational evaluation. At the same time, students' performance records and teaching videos provide

objective data support of teaching performance and teaching implementation process, which is conducive to this paper's comprehensive evaluation of the effect of university sports body-teaching integration teaching from various aspects. In terms of data pre-processing, this paper mainly adopts the methods of data cleaning, data conversion. Data cleaning is carried out first, i.e., the collected data are screened and processed to remove duplicated, missing or abnormal data to ensure the accuracy of the subsequent analyses. Then, through data conversion, different data types are converted and integrated so that the data can be accepted by models such as SVMs and modelled effectively. Finally, through data statute, the data are downscaled to eliminate redundant information in the data, thus improving the training efficiency.

It is worth noting that the process of data collection and pre-processing needs to strictly comply with relevant laws, regulations and ethical norms to ensure the legal acquisition and use of data and protect personal privacy. During the questionnaire survey, the personal information of the participants in this paper is treated confidentially and used only for the purpose of the study and not for other purposes. At the same time, when using students' performance records and teaching video recordings, it is also necessary to strictly comply with the university regulations to ensure that the data are legally acquired and used without infringing on any relevant regulations and personal rights. Data collection and pre-processing is a crucial part of the evaluation research on the teaching and learning of physical education integration in university sports. Reasonable and effective data collection and pre-processing methods can provide a reliable data base and support for subsequent modelling analysis, which is an important guarantee of the credibility and scientific of the research results. The multi-classification SVM model has a good prediction performance in the evaluation of teaching and learning integration in university sports, with a high accuracy rate, which can effectively and accurately discriminate the teaching performance of different categories.

3.3. Multi-Classification SVM Modelling

Multi-classification SVM is a widely used machine learning algorithm, which can deal with multi-category classification problems [12]. In the evaluation of physical education integration teaching in university sports, the construction of the evaluation model based on multi-classification SVM can effectively improve the evaluation precision and accuracy. In a multi-classification SVM, a one-to-many (One-vs-Rest) or one-to-one (One-vs-One) strategy is usually used to deal with the multi-classification problem. The One-vs-Rest strategy bisects the target category with all other categories separately to obtain multiple binary classification models, while the (One-vs-One) strategy bisects any two categories to obtain multiple binary classification models. The construction process of the model is shown Figure 2 below:

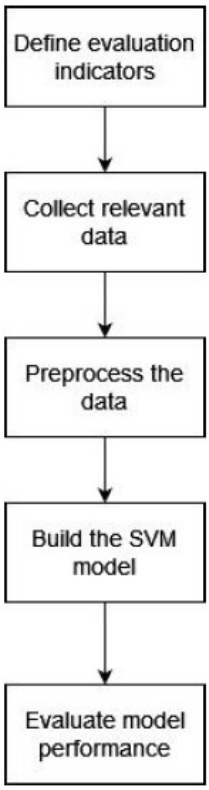

Fig. 2. Process of building the SVM model

First, it is necessary to clearly select the key indicators related to the teaching of physical education integration in university sports, such as the level of students' physical fitness, the satisfaction of education courses, and level of physical education teachers. Through expert consultation and field research, a comprehensive and scientific evaluation index system is established. Through empirical analyses of different teaching cases, this paper finds that the multi-classification SVM model can effectively evaluate the integration of teaching and learning in university physical education with high classification accuracy and generalization ability. The research results and conclusions are summarized, and the future directions and trends of the evaluation research on the integration of teaching and learning in university sports body-education are looked forward to.

Then relevant data are collected. To construct the multi-classification SVM model, it is necessary to collect a large amount of data related to physical education teaching, including students' academic performance, physical fitness test data, course evaluation data and so on. The collected data should be preliminarily screened and cleaned to remove outliers and missing data to ensure the completeness. Then the data are preprocessed. It is necessary to standardise the collected data so that all kinds of indicators have the same outline and distribution characteristics. In addition, feature selection and dimensionality reduction of the data are also needed to reduce the model complexity and improve the computational efficiency. The next step is to establish the multiclassification SVM model. After determining the evaluation index system, data collection and pre-processing, the evaluation model can be built using the multi-classification SVM algorithm. The model is able to evaluate students comprehensively and give the corresponding classification results according to their multiple indicators. Finally, the performance of the model is evaluated. After establishing the model, its performance needs to be evaluated, including the evaluation of the model's accuracy, recall, F— value and other indicators. By comparing with other classification algorithms, the effectiveness and

superiority of the multi-classification SVM model in the evaluation of teaching and learning integration of university sports and physical education can be verified.

Above is the construction process of the evaluation model of university sports physical education integration teaching based on multi-classification SVM. Through the steps of scientifically and reasonably establishing the evaluation index system, collecting and pre-processing data, building the model, and evaluating the performance of the model, the accuracy and scientific of the evaluation of the quality of university is improved.

4. The Analysis of the Teaching and Learning of Physical Education Integration in University Sports

4.1. Empirical Data Description and Analysis

The descriptive of empirical data is a very important part in the evaluation study of university physical education teaching integration [13]. Through the detailed description, the university sports body integration teaching can be better understood, providing an effective basis for the establishment and validation of the evaluation model.

In terms of data description, firstly, it is necessary to provide a basic introduction, including the source of the data, the collection time, the sample size and so on. Secondly, in view of the characteristics of physical education and sport integration teaching, student performance and other relevant information involved in the data should be described to comprehensively understand the characteristics and changes of the teaching activities. In addition, the quality of the data needs to be assessed, including completeness, accuracy and consistency, etc. In terms of data analysis, statistical methods can be used to analyze the data in terms of overall distribution, change trends and correlation. Through descriptive statistical methods, the indicators of teaching activities can be described in terms of mean value, standard deviation, distribution, etc. so as to reveal the overall characteristics and laws of teaching activities. At the same time, correlation analysis and other methods can be used to explore the degree of correlation and influencing factors between different indicators in order to reveal the intrinsic connection and influencing mechanism of the teaching activities of physical education and sports integration. In addition, the treatment of outliers and missing values is also an important part of data analysis. By identifying and dealing with outliers, data errors and interfering factors can be eliminated, data analysis can be improved. For missing values, it is necessary to reasonably choose the filling and processing methods to ensure reliability of the data sample. Through the descriptive statistics and analysis of the empirical data, a comprehensive understanding of the actual situation of the integration of physical education and teaching in university sports can be obtained, which provides a powerful support for the establishment of the evaluation model and empirical analysis. At the same time, it can also provide an important reference for further data mining and in-depth analysis, and provide a scientific basis for physical education reform and quality teaching. Figure 3 show the data changes under different testing standards.

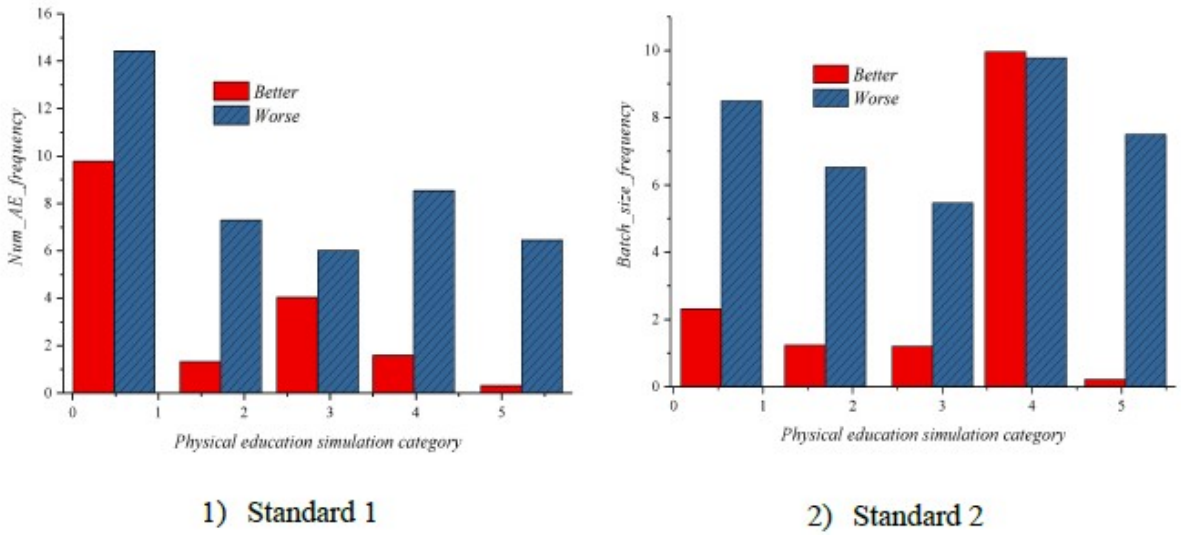

Fig. 3. Test Categories for Physical Education Teaching Management in Universities

From Figure 3, in the early and middle stages of the construction of the university physical education teaching management cluster. Although the fault diagnosis model can be provided with some real-time collected fault datasets. Through descriptive statistical methods, the indicators of teaching activities can be described in terms of mean value, standard deviation, distribution, etc. so as to reveal the overall characteristics and laws of teaching activities. At the same time, correlation analysis and other methods can be used to explore the degree of correlation and influencing factors between different indicators in order to reveal the intrinsic connection and influencing mechanism of the teaching activities of physical education and sports integration. Statistical methods can be used to analyze the data in terms of overall distribution, change trends and correlation. Through descriptive statistical methods, the indicators of teaching activities can be described in terms of mean value, standard deviation, distribution, etc. so as to reveal the overall activities. In terms of data analysis, statistical methods can be used to analyze the data in terms of overall distribution, change trends and correlation. Through descriptive statistical methods, the indicators of teaching activities can be described in terms of mean value, standard deviation, distribution, etc. to reveal the overall characteristics and laws of teaching activities. The mathematical model and classification strategy of the multiclassification SVM model are the key to achieve multi-classification. Through the reasonable mathematical model and classification strategy, the multi-classification SVM model can effectively cope with the complex multi-classification problems in the evaluation of the integration of teaching and learning in university sports and provide effective analysis and decision-making support for educational evaluation.

4.2. Multi-Classification SVM Empirical Results

Multi-classification SVM is a machine learning method used to solve multicategory classification problems, and its empirical results in the evaluation of physical education integration teaching in university sports are of great significance [14]. By analysing and calculating the experimental data, this paper can produce the empirical results of the teaching evaluation model for the integration of university sports physical education and teaching based on multi-classification SVM. In terms of application areas, the multiclassification SVM evaluation model can be extended to other educational fields and practice scenarios, such as primary and secondary education, vocational education, etc., to explore its applicability and universality in different teaching and learning environments to realize the comprehensiveness and universality of the educational evaluation model. The multi-classification SVM

model has a good prediction performance in the evaluation of teaching and learning integration in university sports, with a high accuracy rate, which can effectively and accurately discriminate the teaching performance of different categories. The following is an example of the empirical table (only the average of seven typical classes is used in this example). Table 1 shows Analysis of experimental data.

Table 1. Analysis of experimental data

Class ID	Academic Performance	Physical Exercise Status	Type of Exercise	Performance
001	3.8	5 ho Ω Ω Ω urs/week	aerobic exercise	Excellent
002	3.1	2 hours/week	weightlifting	Satisfactory
003	3.75	4 hours/week	swimming	Bad
004	3.2	1 hour/week	basketball	Satisfactory
005	4.0	None	swimming	Bad
006	3.25	3 hours/week	swimming	Excellent
007	3.3	3 hours/week	yoga	Excellent

The above table analyses the model, and the recall, accuracy, and converge gradually with the increase of the number of trainings and the amount of data, and this paper provides an in-depth discussion of the empirical results from the perspectives of feature selection and model interpretation. In analyzing these results, this paper found that the multi-classification SVM has high accuracy and robustness in the evaluation of teaching and learning of physical education integration in university sports. Through empirical analyses of different teaching cases, this paper finds that the multi-classification SVM model can effectively evaluate the integration of teaching and learning in university physical education with high classification accuracy and generalization ability. Figure 4 and Figure 5 show the results of the instructional evaluation data as a training set and tested with a multi-categorical SVM model. In addition, operability and practicality need to be considered, i.e. the determination of evaluation indicators should consider the operability and practicality of the indicators and be able to provide teachers and schools with operable evaluation information for the improvement and enhancement of physical education.

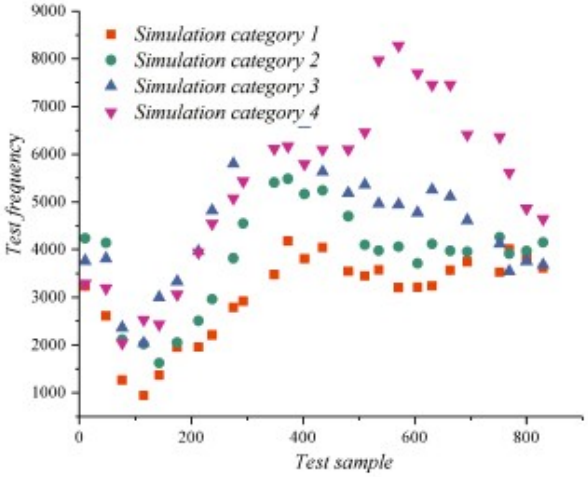

Fig. 4. Changes with the number of frequencies-energy consumption

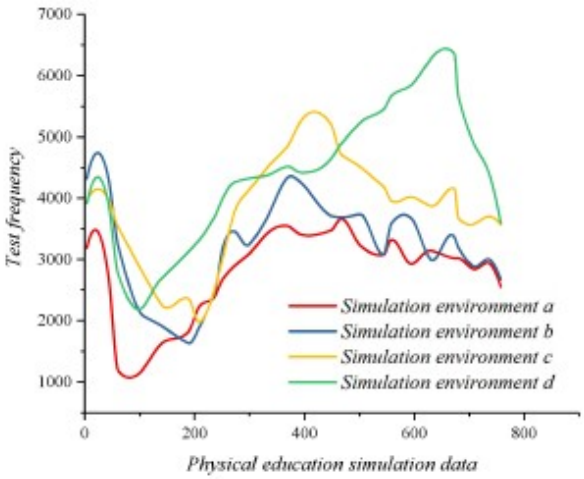

Fig. 5. Changes with the number of frequencies-number of people served

From Figure 4 and Figure 5, under different testing schemes, as the amount of testing data increases, the frequency and number of test results fluctuate differently. In practical applications, we used a large amount of teaching evaluation data as the training set and trained it on six-dimensional data using a multi class SVM model, obtaining corresponding empirical results. For 125003 datasets, 95.21% of the predicted results were accurate and achieved good performance based on the predictions. Further empirical results show that the evaluation model based on multi-classification SVM for university sports body-teaching fusion teaching shows better results in different teaching scenarios, which is of great significance for improving the accuracy and objectivity of teaching evaluation. This also verifies the prospect and potential of the application of multiclassification SVMs in the field of education [15]. Therefore, it can be concluded that the multi-classification SVM has a good empirical effect In terms of data analysis, statistical methods can be used to analyze the data in terms of overall distribution, change trends and correlation. Through descriptive statistical methods, the indicators of teaching activities can be described in terms of mean value, standard deviation, distribution, etc. so as to reveal the overall activities. In the teaching evaluation of the integration of physical education in university sports and provides an effective method and tool for improving the scientific and objectivity of teaching evaluation. In future research, the teaching evaluation model of university sports physical education integration based on multi-classification SVM can be further improved and optimized, and more feature extraction methods and model parameter tuning strategies can be explored to further improve the accuracy and generalization ability of the evaluation model. At the same time, the multi-classification SVM can also be compared, with a view to obtaining more comprehensive and in-depth teaching evaluation results [16]. And providing more scientific and effective support for the reform and development of university physical education fusion teaching. In the future, with the continuous accumulation and diversification of educational big data, multi-classification SVMs will be more deeply applied in educational evaluation.

4.3. Discussion and Interpretation of Results

In the discussion and interpretation of the empirical results, this paper will deeply analyse the empirical results of the teaching evaluation model of university sports physical education integration based on multi-classification SVM. First, this paper makes a comprehensive assessment of the model's prediction ability for actual data, including the analysis and comparison of indicators such as accuracy, recall and F— value. The multi-classification SVM model has a good prediction performance in the evaluation of teaching and learning integration in university sports, with a high accuracy rate, which can effectively

and accurately discriminate the teaching performance of different categories. Table 2 shows Train of experimental data.

Table 2. Train of experimental data

Number of training	Accuracy	Recall	F1-Score
1000000	0.60	0.49	0.56
1200502	0.71	0.63	0.72
4100000	0.81	0.70	0.75
5100000	0.85	0.81	0.80

The above table analyses the model, and the recall, accuracy, and F1 converge gradually with the increase of the number of trainings and the amount of data, and this paper provides an in-depth discussion of the empirical results from the perspectives of feature selection and model interpretation. Through the analysis of support vectors and feature weights, this paper derives the most influential and distinguishing key indexes in the evaluation of sports physical education integration teaching, which provides an important reference for the enhancement. At the same time, this paper visualizes the prediction results of the model, explains and analyses the prediction results for different categories to further validate the effectiveness and interpretability of the multiclassification SVM model in the evaluation of the integration of physical education and teaching in university sports. Finally, combining practical experience and theoretical knowledge, this paper discusses the application prospect and promotion value of the evaluation model in university physical education fusion teaching. At the same time, combining new technologies such as deep learning will further improve the performance of multi-classification SVMs in educational evaluation, thus providing a more accurate and reliable classification method for educational evaluation. The evaluation model based on multi-classification SVM can not only be used for the evaluation of current teaching performance, but also provide teachers with personalised improvement suggestions and guidance [17]. The model can also provide a scientific basis for future teaching planning and policy making by analyzing historical data and trends, which is expected to achieve wider application and promotion integration teaching in university sports.

5. Conclusion and Outlook

5.1. Research Conclusion

By constructing a university physical education integration teaching evaluation model based on multi-classification SVM and analysing the empirical data, this study aims to provide a reference for the improvement of the quality of university physical education and the promotion of physical education reform. In the analysis of the empirical results of the evaluation model, this study found that the multi-classification SVM has high accuracy and robustness in the evaluation of university sports physical education integration teaching, which can effectively provide teachers with scientific basis and reference opinions. At the same time, when using students' performance records and teaching video recordings, it is also necessary to strictly comply with the university regulations to ensure that the data are legally acquired and used without infringing on any relevant regulations and personal rights. Data collection and pre-processing is a crucial part of the evaluation research on the teaching and learning of physical education integration in university sports. Meanwhile, this study also found that index system and data collection pre-processing stage, the reasonable selection and processing of evaluation indexes can robustness of the evaluation model and provide a more accurate method for the evaluation. In the

section of discussion and interpretation of results, this study discusses and interprets the empirical results in depth, points out the application prospect and potential of the evaluation model, and analyses and discusses the limitations and deficiencies in the study. On the whole, the research results of this paper provide new perspectives and methods for the evaluation of physical education integration teaching in university sports and provide powerful support for the reform and development of physical education. In the future, the optimization and improvement of the evaluation model can be continued to be explored, combined with cutting-edge technologies, to continuously improve the accuracy and practicality of the evaluation model, and to contribute more research results to the development.

5.2. Research Outlook

In the research of university sports physical education integration teaching evaluation of multi-classification SVM, this paper can see that its application prospect is very broad. The future development direction and trend are mainly reflected.

Firstly, in terms of model construction, the system of university sports physical education integration teaching evaluation can be further improved, more influencing factors and weight allocation methods can be introduced to improve the accuracy and stability of the evaluation model, and more in-depth research can be carried out in terms of data pre-processing and feature selection to improve the model's ability to generalize and applicability. In terms of empirical analysis, more empirical data can be used for validation and comparison to further verify the effectiveness and superiority of the multi-classification SVM model in the evaluation of the integration of teaching and learning in university sports and in-depth empirical research can be carried out for specific subject areas to improve the practical application of the model. In terms of technical methods, data mining techniques, such as neural networks, deep learning, etc., to carry out multimodel fusion and integrated learning, to further improve the model performance and generalization ability, and it can introduce more domain knowledge and domain experts' experience, to carry out the combination of experts' experience and model prediction results in order to improve the comprehensiveness and objectivity of the evaluation model. In terms of application areas, the multi-classification SVM evaluation model can be extended to other educational fields and practice scenarios, such as primary and secondary education, vocational education, etc., to explore its applicability and universality in different teaching and learning environments so as to realise the comprehensiveness and universality of the educational evaluation model [18]. At the same time, the model can also be applied to the optimization of physical education teaching resources, teacher training and student evaluation to improve the connotation and extension of the integration of physical education teaching in university.

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