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Design and practice of ideological and political education of computer application basic course in sports colleges and universities based on the introduction of CNN models

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ABSTRACT

As society progresses and science and technology evolve, the need for skilled professionals in the country continues to rise. Ideological and political education (IPE) in courses, crucial for fostering students' overall development, has shifted from theoretical exploration to practical implementation. Sports colleges should incorporate ideological and political elements into professional courses like sports and computers based on their unique characteristics, aiming to develop high-quality, multidisciplinary talents that align with national requirements. Professional courses are often disconnected from IPE in traditional sports college teaching methods. There is excessive focus on knowledge and technology instruction, while insufficient attention is given to guiding students in developing correct values through the courses. Additionally, there is a lack of well-targeted course design and a comprehensive evaluation system. In response to the above problems, this paper studies and constructs a framework that integrates IPE with basic computer application knowledge, and designs a variety of course designs and teaching methods. In addition, a progressive assessment is designed to introduce the Convolutional Neural Networks (CNN) model and the Bidirectional Encoder Representations from Transformers (BERT) model in the early stage of teaching to conduct preliminary assessments of students' basic computer skills and ideological and political qualities. In the later stage of the course, the Long Short-Term Memory (LSTM) network model is introduced to analyze student learning behavior and assess overall student quality based on prior evaluations. The experiment shows that the course design studied in this paper can enable students of the School of Physical Education to learn basic computer knowledge while also receiving certain ideological and political quality education. The designed teaching method is better than traditional offline teaching, online teaching and online and offline mixed teaching. When conducting comprehensive quality assessment, a 40% excellent rate can be achieved. Students are randomly selected to track their growth analysis. After the application of this teaching design, 90% of the students' comprehensive quality assessment remains the same or improves. The findings suggest that the teaching model discussed in this paper not only improves students' computer skills but also plays a crucial role in their

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ideological and political education, effectively achieving the intended teaching goals. The success of the innovative teaching design has been confirmed through practical application, providing a feasible teaching model for sports universities and other specialized institutions.

Keywords: Course Ideology and Politics, Basic Computer Applications, Instructional Design, Progressive Assessment, Comprehensive Quality Assessment

1. Introduction

The organic integration of ideological and political education and professional courses in higher education is not only to improve the comprehensive quality of college students, but also an inevitable requirement for the connotation development of colleges and universities [1-3]. In today's rapid development of information technology, computer application has become an important resource for social development. In this case, the combination of “basic computer application” and ideological and political education is an important way to cultivate high-quality talents adapted to the needs of society [4].

The basic computer application course in sports colleges and universities is a general computer course for the first year of higher education. The first-year students of colleges and universities have a certain computer application foundation, are in the key period of physical and mental development and stereotypes, showing the characteristics of active thinking, strong desire for knowledge, shallow cognition, but also in the formation of professional ethics, with obvious plasticity [5-7]. Through the teaching of computer application course ideology and politics, students can not only master professional knowledge, but also form correct values and sense of responsibility, and cultivate a group of trustworthy technical reserves for China's informationization construction and network security [8-10]. Meanwhile, in the fierce competition of globalization, higher requirements are put forward for high-quality scientific and technological talents. Introducing the element of ideology and politics into the teaching of “Computer Application Fundamentals” allows students to master advanced scientific and technological knowledge, and also enhances their awareness of national security, so as to better protect the interests of the country and safeguard the security of cyberspace [11-14]. In this regard, it is of great practical significance to explore an effective teaching method of ideology and politics in the course of “Basic Computer Application” [15].

This paper studies and designs a teaching framework that integrates computer application foundation with curriculum IPE, and designs a variety of course designs and teaching methods. The course design of this paper is divided into hours, and the basic computer courses are learned from the bottom up. While learning the basic computer knowledge, the ideological and political knowledge related to technology is interspersed. The teaching method combines classic case analysis, group cooperation and ideological and political discussions. Classic case analysis is used as a course introduction before class, and the group cooperation method is used to train students' comprehensive abilities and ideological and political discussions are held at the end of a stage. At the same time, a progressive evaluation method is used to evaluate the teaching quality. Progressive teaching evaluation is to evaluate students' basic computer skills and ideological and political qualities based on the CNN model and the BERT model in the early stage of teaching. In the later stages of teaching, the LSTM model is used to analyze students' learning behavior across the course. At the same time, the overall quality evaluation is combined with the early evaluation to evaluate the overall ability of students. The advantage of this method is that it can evaluate students at different stages, and the evaluation can become more and more accurate as time goes by. After experimental validation, the teaching design explored in this paper successfully incorporates IPE into the basic computer applications course, allowing students to develop their ideological and political qualities alongside their professional learning. The teaching method proposed in this paper offers advantages compared

to traditional offline teaching, online teaching, and hybrid teaching approaches. In summary, the teaching framework proposed in this paper integrates computer application foundation with IPE, combined with diversified teaching methods and progressive evaluation mode. It has achieved the dual improvement of students' professional ability and ideological and political quality, and also provided an operational practical case for the in-depth implementation of IPE in the School of Physical Education.

2. Course Design

2.1. Course Objectives

The objectives of this course design are focused on three key areas: first, enhancing students' ability to apply computer technology; second, deepening their theoretical knowledge of the subject; and third, fostering the development of their ideological, political, and overall personal qualities. The ultimate aim is to help students cultivate a broad range of abilities through comprehensive training, preparing them to become versatile professionals with innovation and a sense of social responsibility, as outlined in Table 1.

Table 1. Course objectives

Target Category	Target content
Knowledge and skills objectives	Basic knowledge
	Programming skills
	Database and Information Management
	Data Structures and Algorithms
Ideological and political quality goals	Social responsibility and moral values
	The guidance of socialist core values
	Combining information technology with social development
Comprehensive quality goals	Critical thinking and innovation
	Teamwork and communication skills
	Self-management and lifelong learning abilities

As shown in Table 1, this paper designs three types of course objectives, including knowledge and skills objectives, ideological and political quality objectives, and comprehensive quality objectives. First, the knowledge and skills objectives focus on students' mastery of basic computer knowledge, the improvement of programming skills, and the cultivation of capabilities in the fields of data structure and database application. The goal of ideological and political quality is to strengthen students' social responsibility and technical ethics awareness, highlight the integration of socialist core values with scientific and technological development, and focus on the deep influence of technological progress on society. The ultimate goal is to develop students' critical thinking, creativity, and teamwork skills, while promoting the enhancement of self-management and a commitment to lifelong learning.

2.2. Course Content and Syllabus

The core of course content design is to ensure that students systematically acquire fundamental knowledge in computer science. Additionally, by incorporating IPE, the goal is to foster students' awareness of social responsibility and scientific ethics, ultimately developing them into well-rounded professionals with both technical skills and a strong sense of social responsibility.

Based on the syllabus, this paper designs the course content allocation, as shown in Table 2. The course implements a bottom-up learning strategy. The initial 10 hours focus on introducing basic computer knowledge and operating systems, while combining topics such as information security and

social responsibility to explore the potential impact of technology ethics on society. In the next 14 hours, the course can focus on learning programming basics and algorithms, and discuss ethical issues in the programming process and the fairness of algorithms in combination with actual situations. The 25th to 36th hours can be spent learning about databases and data processing, and at the same time discussing the relationship between big data and personal privacy. The last 12 hours of class are for comprehensive application and ideological and political reflection. While testing students' basic computer knowledge, they also think deeply about the impact of technology on society through projects and strengthen students' sense of social responsibility.

Table 2. Course content design

School Period	Course Content	Ideological and political integration
Hours 1-10: Computer Basics and Operating Systems	Computer composition and principles, operating system basics, information security basics	Information security and social responsibility; Ethical Discussion
Hours 11-24: Programming Basics and Algorithms	Programming language foundation, data structure and algorithm, algorithm complexity analysis	Procedural Ethics and Responsibility; Algorithms and fairness
Hours 25-36: Database and Data Processing	Database management, data cleaning and analysis, data visualization	Data Privacy and Ethics; Big Data and Society
Hours 37-48: Comprehensive application and ideological and political reflection	Comprehensive project training, discussion on social responsibility in technology application, course summary and reflection	Projects and social responsibility; Reflection on Technological Ethics

3. Teaching Methods

In the teaching process outlined in this paper, a combination of case-based teaching, group cooperative learning, and ideological and political discussions is effectively integrated. Through interactive and exploratory learning methods, students can not only grasp fundamental knowledge of computer applications but also critically reflect on the connection between technology and social responsibility throughout the learning process. This approach enhances their ideological and political awareness while developing their overall abilities.

1) The case teaching method plays a crucial role in the course design approach discussed in this paper. By designing and introducing classic computer application cases, students can understand the impact of technology on social ethics, moral responsibility and public interests while learning technology.

The specific teaching practice is as follows: At the beginning of the course, a case background can be introduced to guide students to analyze the application, ethical adjustments and social responsibilities in the case. During the analysis process, students are required to extract the details of the technology and propose possible technical risks and countermeasures in combination with the social background.

2) The role of group cooperative learning in this teaching method cannot be ignored, especially in stimulating students' critical thinking and teamwork ability.

The specific teaching practice is: in each stage of learning, students can be assigned to different groups for cooperative communication and learning. For example, after explaining the data structure and algorithm, the students can be divided into groups. Through the form of division of labor and cooperation, different students in each group can be responsible for the programming of different sections of the gymnasium management system, and finally cooperate to complete the programming task of the gymnasium management system. Through this form of cooperation, students can apply

what they have learned, and can also fill in the gaps through discussion. Group members can help each other grow.

3) Ideological and political discussion is a very important teaching form designed in this paper. The aim is to inspire students to consider their social responsibility, political ethics, and cultural values when analyzing technical issues.

The specific teaching practice is as follows: At the end of each learning stage, an ideological and political discussion meeting can be organized to conduct special discussions in combination with the learning content of computer application basics. During the discussion, students are guided to analyze the problems of technology application from multiple perspectives, focusing on efficiency and convenience, and also thinking about the impact of technological updates and progress on society. After the discussion, each student is required to submit a discussion draft.

Through case teaching, group cooperative learning, and ideological and political discussions, the basic computer application courses can be deeply integrated with IPE. This helps students master solid technical knowledge and also improves their sense of social responsibility, critical thinking, and teamwork ability. This innovative teaching model enables students to pay attention to social ethics and moral responsibilities while using technology, and helps cultivate comprehensive talents with all-round development.

4. Teaching Evaluation

This paper uses progressive and graded evaluation methods to evaluate the course design of this paper. The purpose of progressive evaluation is to assess computer literacy and ideological-political qualities separately in the early stages of teaching practice, and later combine these with learning behaviors for a comprehensive evaluation of the entire course's teaching. The evaluation indicators are divided into four levels: excellent, good, pass and fail.

4.1. Preliminary Evaluation

4.1.1. Evaluation of Basic Computer Ability. In this stage, the programming code assignments and computer operation test results submitted by students are converted into image format and evaluated using the CNN model.

Before using CNN for evaluation, the students' programming work and test results are converted into image format by using screenshots for easy processing, and in order to adapt to the input of CNN, all images are unified into the same size (256*256).

The construction order of the CNN model from input to output is:

1) Input layer: The input data of the input layer is a two-dimensional matrix generated by the code and the test image. The tensor shape of the input image is:

$$X \in R^{256\times256\times3} \tag{1}$$

X is the tensor of the input image, and 3 represents 3 color channels (RGB).

2) Convolution layer: In this layer, local features are extracted from the input image through the convolution kernel. The operation formula for the input tensor and convolution kernel of the input layer is:

$$Y_{i,j,k} = \sum_{m=1}^{F}\sum_{n=1}^{F}\sum_{c=1}^{C} X_{i+m,j+n,c} \cdot W_{m,n,c,k} + b_k \tag{2}$$

$Y_{i,j,k}$ denotes the value at the i, j -th bit and kth channel of the output feature map, X is the input image tensor, $W_{m,n,c,k}$ denotes the weight of the convolution kernel, b_k denotes the bias term of the kth convolution kernel, F denotes the size of the convolution kernel, and C is the 3 channels of the input images.

The output feature map size can change due to the convolution operation, and the change method is:

$$I' = [\frac{I - M + 2S}{P} + 1] \tag{3}$$

I represents the height of the input image, M stands for the size of the convolution kernel, S indicates the padding size, and P refers to the step size, and I' is the output image height (the width change principle is the same).

3) Activation function: Apply the $\mathrm{Re}\,LU$ function to introduce nonlinearity to the input value. The formula of $\mathrm{Re}\,LU$ is:

$$\mathrm{Re}\,LU(x) = \max(0, x) \tag{4}$$

In this activation function, negative numbers are set to 0, while positive values remain unchanged.

4) Pooling layer: The pooling layer is used to decrease the size of the feature map, thereby reducing computational load and the likelihood of overfitting. The pooling method used in this paper is the maximum pooling method, and the formula is:

$$P_{i,j} = \max_{m,n} X_{i+m,j+n} \tag{5}$$

Among them, $P_{i,j}$ is the output after pooling, and $X_{i+m,j+n}$ is the value in the pooling window. The pooling operation reduces the size of the feature map while preserving the key features.

5) Fully connected layer: In this layer, the features output by the pooling layer are integrated and the final result is output. The output formula of the fully connected layer is:

$$Z = W \cdot X + b \tag{6}$$

Among them, W stands for the weight matrix, X is the input feature vector to the fully connected layer, b represents the bias term, and Z indicates the output result. Figure 1 illustrates the architecture of the CNN model.

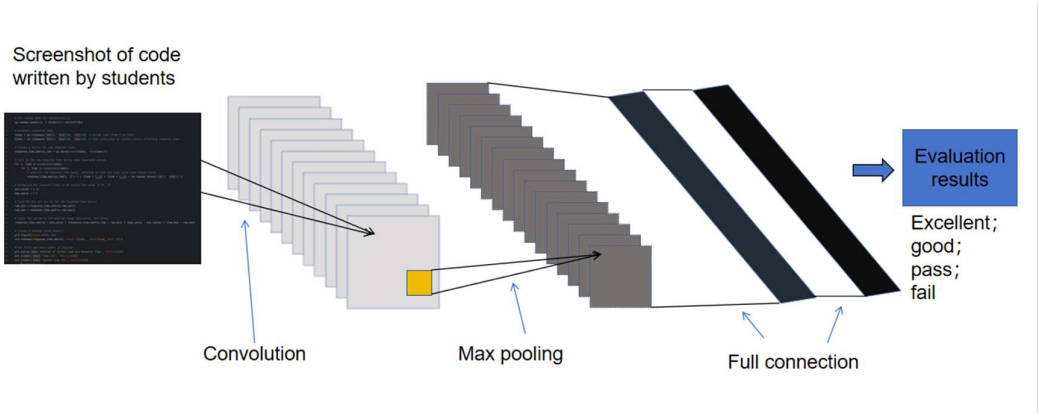

Fig. 1. CNN model structure diagram

To optimize the CNN model, the Mean Squared Error serves as the loss function to evaluate the difference between the model's prediction and the actual value. The formula for Mean Squared Error is expressed as:

$$L = \frac{1}{N}\sum_{i=1}^{N}(A_i - \hat{A}_i)^2 \tag{7}$$

A_i denotes the true evaluation result of the i-th student, $\hat{A}_i$ denotes the predicted evaluation result from the model, and N denotes the number of students.

During model training, the Adam optimizer is used to update model parameters and adjust the learning rate for each parameter automatically.

$$\theta_{t+1} = \theta_t - \eta \cdot \frac{m_t}{\sqrt{v_t} + \varepsilon} \tag{8}$$

Among them, θ_t is the parameter at the current moment, m_t is the first-order moment estimate of the gradient, and v_i is the second-order moment estimate of the gradient. η is the learning rate, and ε is a very small constant used to prevent division by zero.

4.1.2. Ideological and political quality assessment. The discussion drafts submitted at the ideological and political discussion meeting in teaching practice are used as the original input text. The BERT model is used for sentiment classification, and a multi-dimensional analysis is performed on the deep information in the text to explore the students' ideological and political qualities.

The BERT model's input consists of word vectors generated by sub-word segmentation using WordPiece. These word vectors, known as tokens, are mapped to a high-dimensional vector space, capturing the semantic information of words in various contexts.

The subword segmentation formula is:

$$X = WordPiece(T) \tag{9}$$

Among them, X is the token sequence obtained by WordPiece segmentation of the original input text T.

Then BERT embeds these tokens and calculates the context-related representation of each token:

$$E = BERT(X) \tag{10}$$

E is the vector representation of each token output by the BERT model.

The core of BERT relies on the Transformer encoder, which uses the self-attention mechanism to capture long-range dependencies and understand the contextual relationships between words. The self-attention mechanism can be represented as follows:

$$Attention(Q, K, V) = soft\max(\frac{QK^T}{\sqrt{d_k}})V \tag{11}$$

Among them, Q is the query matrix, K is the key matrix, V is the value matrix, and d_k represents the dimension of the key, which is used for scaling calculation.

Specifically, the BERT model designed in this paper uses multi-head attention to calculate multiple attention weights in parallel, and the calculation formula is:

$$MultiHead\ (Q, K, V) = Concat\ (head_1, head_2, ..., head_h)W^o \tag{12}$$

h is the number of self-attention heads and W^o is the weight matrix.

BERT produces contextual representations for each token by stacking several Transformer encoder layers. The result includes the meaning of the whole sentence. Assuming that the result of a student's text after BERT encoding is represented as h_{CLS}, the result is input into a Softmax classification layer to get the student's emotional category:

$$S_{sentiment} = Soft\max(wh_{CLS} + b) \tag{13}$$

Among them, $S_{sentiment}$ is the result of the sentiment category analysis of the student, and the weight matrix and bias term of the classification layer are denoted as w and b, respectively.

Based on the results of sentiment classification, the ideological and political quality of the student is analyzed by matching keywords in the text of the student's discussion draft. For example, to analyze the student's sense of social responsibility, first identify the keywords in the student's discussion draft

text ("poverty alleviation", "environmental protection", "public welfare", etc.), and then get a social responsibility analysis and evaluation result through the following formula to evaluate the student's sense of social responsibility:

$$S_{SR} = \sum_{i=1}^{N} SR_i \cdot Sentiment_i \tag{14}$$

N is the number of relevant keywords in the text, SR_i is the weight of the i-th keyword (the greater the importance, the higher the weight). Other ideological and political qualities can also be analyzed by this method, and S_{SR} is the evaluation result of the student's sense of social responsibility.

4.2. Post-evaluation

In the later evaluation, based on the CNN model processing image data and the BERT model analyzing text data, the LSTM model was introduced to conduct comprehensive behavioral analysis of students' learning throughout the course, and the data of the three models were multimodally fused. The final output results can accurately reflect the comprehensive ability of the students in this course, help teachers understand the development of students in different dimensions, and provide data support for subsequent teaching and evaluation.

The CNN model and the BERT model have been described above, so this paper can not go into details. The LSTM model is mainly used in this paper to process students' learning behavior data, which is collected according to the practice sequence. The LSTM model can effectively capture the temporal relationship in these data and help analyze students' participation patterns and learning dynamics. The specific LSTM model is constructed as follows.

1) Input layer: The input layer receives time series data in matrix form, where each row represents a time step of data and each column represents a feature:

$$X = \{X_1, X_2, ..., X_T\} \tag{15}$$

T is the number of time steps of the data, and X_t is the behavior data of the tth time step.

2) LSTM layer: This layer captures the long-term dependencies in the time series by memorizing party members and generates hidden state outputs at each time step. The structure of the LSTM layer is as follows:

(1) The forget gate controls how much of the previous memory is kept and passed on to the current moment

$$f_t = \sigma(W_f \cdot [h_{t-1}, X_t] + b_f) \tag{16}$$

f_t is the output of the forget gate, W_f and b_f are the weights and biases of the forget gate, σ is the activation function, h_{t-1} represents the hidden state at the previous moment, and X_t is the input at the current moment.

(2) Input gate controls the amount of the current input that is incorporated into the cell state:

$$i_t = \sigma(W_i \cdot [h_{t-1}, X_t] + b_i) \tag{17}$$

i_t is the output of the input gate.

(3) The candidate memory cell determines the extent to which the cell state has been updated at a given moment:

$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, X_t] + b_C) \tag{18}$$

Among them, $\tilde{C}_t$ is a candidate memory cell.

(4) The output gate controls the amount of the current output that is forwarded to the next layer:

$$o_t = \sigma(W_o \cdot [h_{t-1}, X_t] + b_o) \tag{19}$$

(5) Hidden state:

$$h_t = o_t \tanh(C_t) \tag{20}$$

h_t is the output of the LSTM layer, which is passed to the next layer or between layers as the final structure.

3) Output layer: The output from the LSTM layer is fed into the fully connected layer, where the extracted features are mapped to the final result:

$$P = Dense(h_T) \tag{21}$$

h_T is the last hidden state of the LSTM layer. P is the result of behavior analysis. The LSTM model structure is shown in Figure 2.

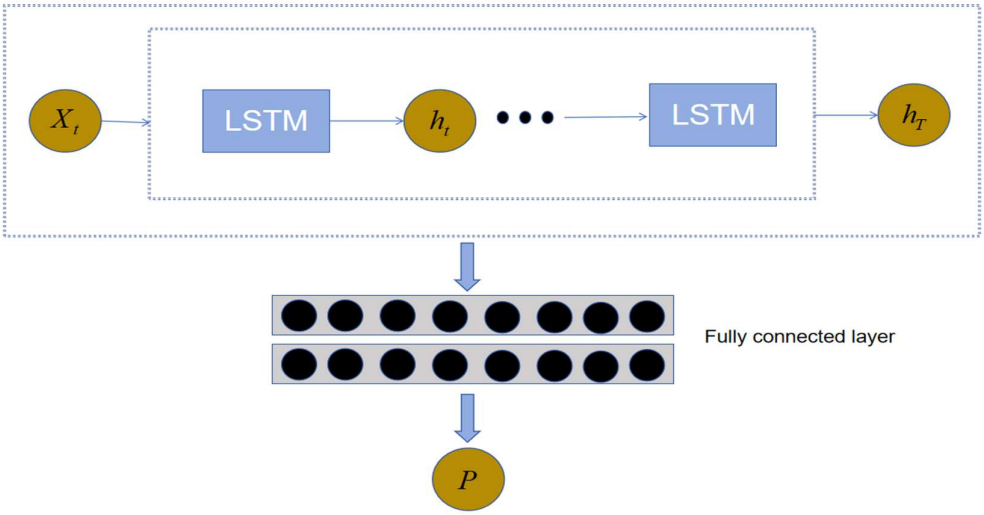

Fig. 2. LSTM model structure diagram

In the later stage of evaluation, the students' computer basic ability, ideological and political quality and learning behavior are comprehensively integrated and evaluated. Assuming that a student's computer basic ability is evaluated as A, ideological and political quality is evaluated as S, and learning behavior is evaluated as P, the formula for the integrated evaluation of the student is:

$$T = \omega_1 A + \omega_2 S + \omega_3 P \tag{22}$$

ω_1, ω_2 and ω_3 are the weight indicators of the three evaluations, and T is the final comprehensive evaluation result.

5. Results and Analysis

5.1. Evaluation Distribution

The research method of this paper is applied to a class of 50 people. The course and teaching methods are strictly designed according to this paper. The course evaluation results are as follows using progressive evaluation.

Figure 3 shows the evaluation results of a class of 50 students using the research method in this paper. Sub-graphs A, B, and C correspond to the basic computer skills evaluation, ideological and political quality evaluation, and overall quality evaluation in the later evaluation. In the basic computer skills evaluation, 10 of the 50 students in the class were rated as excellent, 15 as good, 15 as passed, and 10 as failed. In the ideological and political quality assessment, 8 students were excellent, 12 were good, 20 were passed, and 10 were failed. The overall quality assessment results showed that only 7

students were excellent, 15 were good, 20 were passed, and 8 were failed. Judging from the data, the overall assessment results of the class are relatively ideal. Most students can be promoted to an upper-middle level through the course model, covering computer basic skills and ideological and political quality. However, there is still a polarization phenomenon, and the number of students who received excellent evaluations is relatively small, indicating that the course design needs to be further optimized to help more students reach an excellent level.

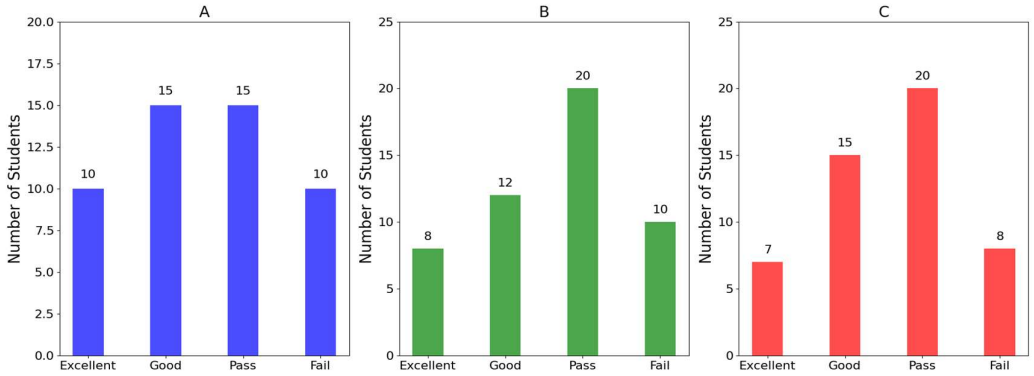

Fig. 3. Distribution of student assessment

(A) Distribution of computer basic ability assessment (B) Distribution of ideological and political quality assessment (C) Distribution of overall quality assessment

5.2. Different Teaching Methods

To assess the effectiveness of the teaching method presented in this paper, the research compares it with traditional offline teaching, online teaching, and a hybrid of online and offline methods. These approaches are applied to four different classes at the School of Physical Education, each with similar overall student scores, and the final results of their overall quality are evaluated.

Figure 4 is an analysis of the results of applying four different teaching methods. Columns of different colors represent different teaching methods. The green column represents the teaching method studied in this paper, the yellow column represents the traditional offline teaching method, the orange column represents the online teaching method, and the red column represents the online and offline hybrid teaching method. Some students fail in all four teaching methods, but the method explored in this study results in the highest percentage of students achieving excellent grades, making up 40% of the total student population. In comparison, the traditional offline teaching method has the lowest percentage of students achieving excellent grades, at 20% of the total. The online teaching method sees 24% of students earning excellent grades, while the hybrid online-offline approach has 30% of students achieving excellent grades. This study demonstrates that the teaching method explored in this paper can significantly enhance students' overall performance and contribute to more students receiving excellent evaluations.

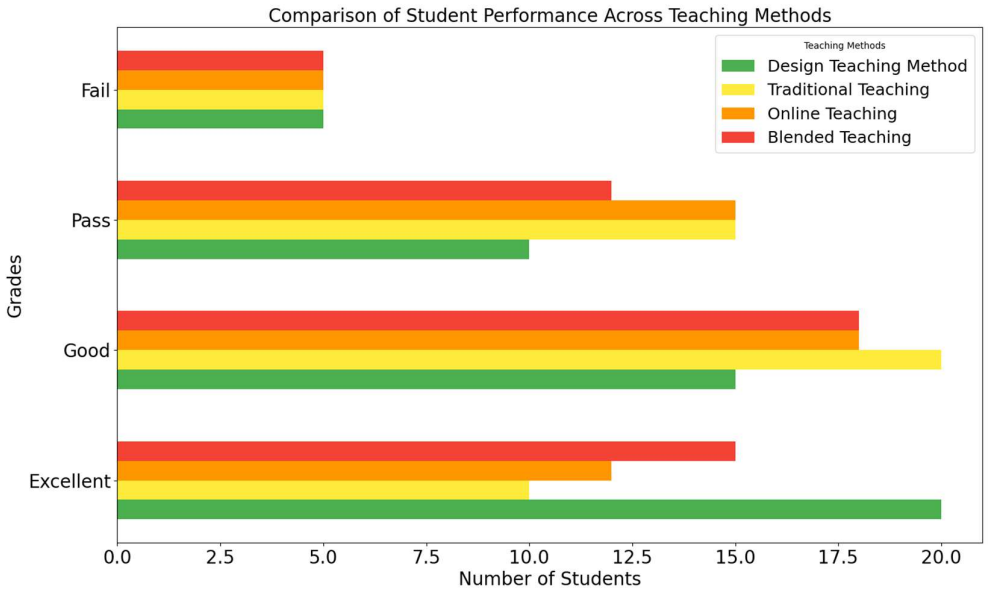

Fig. 4. Comparative analysis of different teaching methods

5.3. Student Growth Analysis

To achieve teaching objectives and track students' learning progression and depth, 20 students were randomly selected from the student group that applied the teaching design studied in this paper, and the overall quality evaluation changes of their class were tracked during the application of the teaching design studied in this paper and after the application for a period of time, so as to evaluate the role of the research method in students' growth.

Figure 5 is a growth analysis chart of 20 randomly selected students from the School of Physical Education. The blue bars indicate the overall quality evaluation level of students prior to applying the teaching design discussed in this paper, while the green bars represent the evaluation level after implementing the teaching design presented in this paper. If the evaluation level has improved, a green line can be used to connect the front and back columns. If the evaluation level has decreased, a red line can be used to connect the columns. Among the 20 randomly selected students, 18 students' overall quality evaluation levels remained the same or improved, and only 2 students' overall quality evaluation levels decreased. This shows that the teaching design studied in this paper has a positive effect on improving the overall quality of most students, proving that the teaching design in this paper is effective. However, the decline in the evaluation level of individual students also reminds that people need to pay more attention to individual differences among students and further optimize teaching methods to ensure that every student can benefit from the new teaching environment.

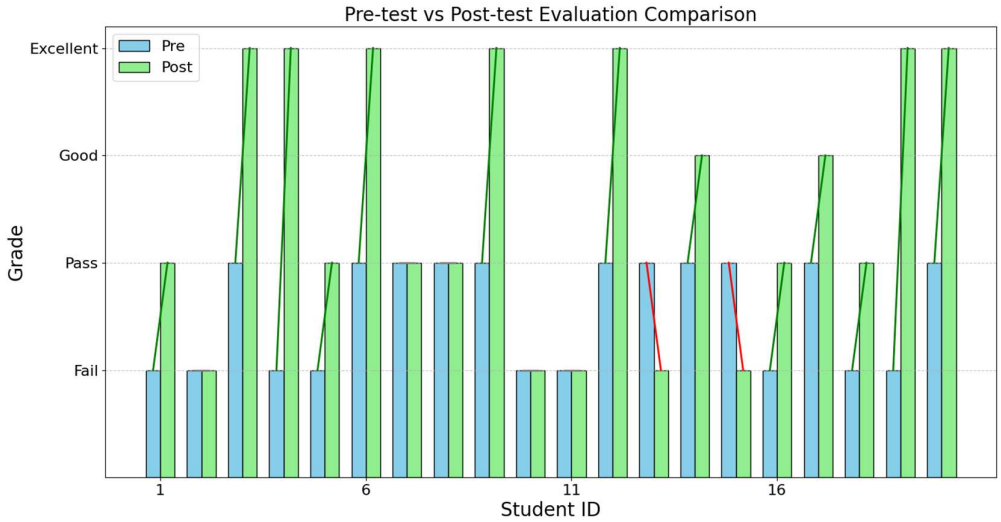

Fig. 5. Growth Analysis Chart

6. Conclusions

In response to the problems existing in traditional sports colleges, this paper studies and designs a variety of curriculum designs and teaching methods, and adopts a progressive evaluation method to evaluate the teaching quality, which is to evaluate computer basic skills and ideological and political qualities separately in the early stage, and then comprehensively evaluate learning behavior and early evaluation in the later stage. The experimental results indicate that this study not only enhances the basic computer learning skills of middle school students in sports colleges but also effectively improves their ideological and political qualities. It has, to some extent, facilitated the effective integration and enhancement of ideological and political courses within professional courses, as well as the innovation of teaching methods and evaluation systems in sports colleges. However, this study still has some shortcomings. Although this study designed courses and teaching methods, and designed a progressive evaluation system, the experiment was only conducted in some classes, and the scale and representativeness of the experiment were limited. In addition, although the teaching method designed in this paper is innovative, it has certain difficulties in actual teaching. Therefore, the future research direction is to promote this experiment to more places, conduct more experiments to verify the universality of this study, and study how to solve the practical difficulties of the implementation of teaching methods.

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