# Research on the Model of Cultivating Students' Comprehensive Ability of Practical Training Based on Virtual Simulation Technology

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**Abstract**—In the process of national economic development, the progress of science and technology has brought a qualitative leap to various industries in China, promoting the rapid development of each industry and greatly improving people's quality of life. Along with the continuous investment in education, our universities have made great progress and development and cultivated a number of excellent talents, but at the same time, there are still some problems in university education, which restrict the cultivation and construction of talents in our universities. In the process of reforming higher education, the traditional talent cultivation mode gradually reveals many drawbacks, which is not conducive to the future employment development of students and the influence of our universities on society. In order to better improve the quality of talent cultivation, we must explore and practice new methods. This paper proposes a training mode of students' practical comprehensive ability based on virtual simulation technology. Firstly, virtual simulation technology is used to analyze students' comprehensive ability. Secondly, it studies the design of students' practical training comprehensive ability cultivation system. Through this system, it can better realize the role of virtual simulation technology in the cultivation of students' practical training comprehensive ability. Finally, it tests the function and performance of the system to ensure the safe operation of the system.

**Keywords**-Virtual simulation technology. Practical training for students. Training comprehensive ability training model

## 1 INTRODUCTION

With the continuous development of computer technology, virtual simulation technology has been widely used in the field of education to promote the reform and innovation of talent training mode [1]. At present, there are still many problems in teaching methods in China, and the traditional teaching mode cannot adapt to the requirements of modern technology and education development, and virtual simulation teaching is a new teaching tool and method that works well. In China's colleges and universities, there are common problems of inconsistency between practical training courses and practical training contents and students' ability cultivation goals, and lack of practical training platform. The reform of talent cultivation mode based on virtual simulation technology can effectively solve the above problems, and also promote the integration of curriculum and practical training platform. Therefore, the talent cultivation method supported by virtual simulation technology is the development trend in

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education field, and this paper explores and practices the reform of talent cultivation method based on virtual simulation technology [2].

# 2 ANALYSIS OF STUDENTS' COMPREHENSIVE ABILITY BASED ON VIRTUAL SIMULATION

## 2.1 Virtual Simulation Technology

Virtual simulation technology refers to the comprehensive ability to simulate the real environment of the real world by computer, using professional software for simulation, and with the help of relevant theoretical analysis, calculation and other aspects. In this process, a large number of complex and tedious and with certain regularity and typical characteristics of the project modeling methods need to be used to describe the entity model or the relationship existing between the object properties. At the same time, we have to use some advanced ideas and concepts to abstract the virtual system and then apply it to the real scene to realize the simulation of the real world, so as to achieve the purpose of virtual simulation technology. Students' practical training comprehensive ability training mode mainly refers to simulating the real environment through software, modeling the system on the computer, and then analyzing the virtual reality by using professional knowledge and related theories, and finally simulating the real environment on the computer, so as to achieve the purpose of practical training [3].

## 2.2 Comprehensive Student Ability Analysis Based on Decision Tree

### 2.2.1 Data Mining Technology

Data mining technology refers to the process of collecting massive, unstructured and unstructured data and extracting potentially useful information from a large amount of valuable information through certain algorithms according to user requirements, which is an important research direction in information science and one of the most active and widely used interdisciplinary disciplines in the field of computer technology and artificial intelligence. At present, techniques such as data mining clustering have been used to analyze students' performance and suggest improvements based on the analysis results, but students' enthusiasm to participate in practice is generally low because the mode of cultivating students' practical training ability is not yet mature [4]. Therefore, this paper designs and develops an integrated management system of practical training for secondary school students based on virtual simulation technology from the teaching objectives.

### 2.2.2 Data Mining Process

The data mining process is a complex engineering that deals with a large amount of information, it includes the analysis of the original data, but also the generation and prediction of unknown variables before using new methods under these features and classifying them to help us better understand the problem under study. The data mining process is shown in Figure 1.

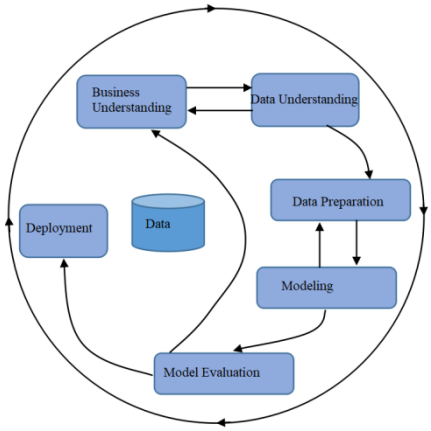


**Figure 1.** Data mining process

As shown in Figure 1, the specific process of data mining is as follows:

- Business understanding: students' business understanding means that teachers analyze the content of knowledge to be taught during the course of instruction, draw conclusions, and combine the results with their expected goals, so as to achieve improved quality and effectiveness of teaching, which can provide more development opportunities for students and thus improve the quality of teaching [5].

- Data comprehension: Data comprehension refers to the analysis and processing of the information collected by students in their ordinary studies and its application to real life, thus realizing an effective improvement of students' learning ability.

- Data preparation: Data preparation is to develop a plan according to the actual situation of the students. Firstly, we need to investigate and analyze the research problem to be studied; secondly, we should enter the relevant information into the network before making a questionnaire design. Then by searching online with the corresponding options to choose the appropriate content of the topic they are interested in or have the ability to complete, and finally then start collecting data after determining the final goal in conjunction with the existing conditions and resources of the school, and organize the collected data to produce the corresponding results [6].

- Building a model: A model is built to quantify the various abilities of students in the learning process so that they can be better evaluated, and a decision tree is a model that combines qualitative and quantitative analysis together, and the results are obtained by processing the data.

- Model evaluation: The model of students' comprehensive ability evaluation is established to help colleges and universities to make correct and scientific analysis and prediction when making enrollment decisions, and the evaluation results can show whether students' learning interests and school training goals are reasonable, so as to evaluate students' comprehensive ability.

- Deployment is to run the model and deploy the model to the application.

### 2.2.3 Data Pre-processing

Data pre-processing is the process of analyzing and calculating the results obtained based on the student's actual situation to determine if they meet the objectives needed to achieve each aspect of the decision tree algorithm. Before data mining, a certain amount of extraction is done, and then Excel is used to transform this information into attribute types, feature categories and other relevant variables to build a classification model, which is used as a training set for the subsequent processing; finally, depending on the actual situation of the students, the corresponding measures are applied to the obtained results to ensure that the final result is consistent with the real ability.

### 2.2.4 The Construction Process of Decision Tree

In a statistical test, z represents the knowledge points, Q(z) represents the test questions containing z knowledge points, and T (Q(z)) represents the students' correct answers to the test questions containing z knowledge points, where the percentage of mastery of knowledge points is calculated as shown in Formula (1).

$$P(z) = number(T(Q(z))) / number(Q(z)) \tag{1}$$

This paper first takes students' learning ability as an example, and the results are shown in Table 1, where knowledge points 1, 2, 3 and 4 represent students' ability to understand different knowledge. Where A means "excellent", B means "good", and C means "poor". When a student has two poor understandings of the four knowledge points, /* means that the student's understanding ability is relatively poor; when less than or equal to one poor, it means that the student has basic understanding ability. In addition, the student can solve the problems in the learning process independently, rather than relying on others. Through data analysis, it is concluded that students' lack of understanding ability of their own knowledge is the cause of their low comprehensive quality, lack of teamwork and innovative spirit and backward way of thinking.

**Table 1.** Correspondence Table of Knowledge Points and Understanding Ability

| Serial number | Knowledge point 1 | Knowledge point 2 | Knowledge point 3 | Knowledge point 4 | Comprehension |
|---|---|---|---|---|---|
| 1 | B | A | C | B | Have |
| 2 | B | A | A | A | Have |
| 3 | A | B | B | A | Have |
| 4 | A | B | A | A | Have |
| 5 | B | B | A | B | Have |
| 6 | B | C | A | C | Lacking |
| 7 | B | C | B | C | Lacking |
| 8 | B | A | A | A | Have |
| 9 | B | B | B | B | Have |
| 10 | B | C | A | A | Have |
| +11 | C | A | B | A | Have |
| 12 | A | B | C | C | Lacking |

| | | | | | |
|---|---|---|---|---|---|
| 13 | B | B | A | B | Have |
| 14 | B | B | A | C | Have |

The entropy definition of S's classification relative to c states is shown in Formula (2):

$$Entropy(S) = \sum_{i=1}^{c} - p_i \log_2 p_i \tag{2}$$

The information Gain(S, A) of an attribute A relative to the sample set S is defined as shown in Formula (3) :

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v) \tag{3}$$

For category attribute S (with/without), the number of positive example S and negative example S is 11 and 3 respectively, then P(S1)=11/14, P(Sz)=3/14, and the information of category attribute is shown in Formula (4) :

$$I(S_1, S_2) = I(11,3) = -\sum_{i=1}^{2} p_i \log_2(p_i) = 0.752 \tag{4}$$

The specific process of calculating the information gain of the test attribute is shown as follows:

Taking the attribute "Knowledge Point 1" as an example, the values are excellent, good and poor. In fact, the number of cases is 3, 10 and 1 respectively. Among them, it is the basic information of students, and the result is the same with the analysis conclusion. The result is consistent with the analysis conclusion, indicating that the knowledge and ability level of students are different in different schools, and the reasons are different. Then, the information gain of attribute "Knowledge Point 1" is shown in Formula (5):

$$\begin{aligned} E(Z_1) &= \frac{3}{14}\left(-\frac{2}{3}\log_2\frac{2}{3} - \frac{1}{3}\log_2\frac{1}{3}\right) + \frac{10}{14}\left(-\frac{8}{10}\log_2\frac{8}{10} - \frac{2}{10}\log_2\frac{2}{10}\right) \\ &+ \frac{1}{14}\left(-\frac{1}{1}\log_2\frac{1}{1} - 0\right) = 0.707 \\ Gain(S, Z_1) &= I(S_1, S_2) - E(Z_1) = 0.045 \end{aligned} \tag{5}$$

Taking the attribute "Knowledge Point 2" as an example, the value is excellent, good and poor. In fact, the number of cases is 4, 7 and 3 respectively, which are sorted according to the students' basic knowledge and ability level. The information gain of attribute "Knowledge Point 2" is shown in Formula (6):

$$\begin{aligned} E(Z_2) &= \frac{4}{14}\left(-\frac{4}{4}\log_2\frac{4}{4} - 0\right) + \frac{7}{14}\left(-\frac{6}{7}\log_2\frac{6}{7} - \frac{1}{7}\log_2\frac{1}{7}\right) \\ &+ \frac{3}{14}\left(-\frac{1}{3}\log_2\frac{1}{3} - \frac{2}{3}\log_2\frac{2}{3}\right) = 0.478 \\ Gain(S, Z_2) &= 0.274 \end{aligned} \tag{6}$$

Taking the attribute "Knowledge Point 3" as an example, the values are excellent, good and

poor. In fact, the number of cases is 8, 4 and 2 respectively. Then, the information gain of attribute "Knowledge Point 3" is shown in Formula (7):

$$E(Z_3)=\frac{8}{14}(-\frac{6}{8}\log_2\frac{6}{8}-\frac{2}{8}\log_2\frac{2}{8})+\frac{4}{14}(-\frac{3}{4}\log_2\frac{3}{4}-\frac{1}{4}\log_2\frac{1}{4}) \\ +\frac{2}{14}(-\frac{1}{2}\log_2\frac{1}{2}-\frac{1}{2}\log_2\frac{1}{2})=0.696 \\ Gain(S,Z_3)=0.056 \tag{7}$$

Taking the attribute "Knowledge Point 4" as an example, the values are excellent, good and poor. In fact, the number of cases is 6, 4 and 4 respectively. The information gain of attribute "Knowledge Point 4" is shown in Formula (8):

$$E(Z_4)=\frac{6}{14}(-\frac{6}{6}\log_2\frac{6}{6}-0)+\frac{4}{14}(-\frac{4}{4}\log_2\frac{4}{4}-0) \\ +\frac{4}{14}(-\frac{1}{4}\log_2\frac{1}{4}-\frac{3}{4}\log_2\frac{3}{4})=0.311 \\ Gain(S,Z_3)=0.441 \tag{8}$$

Step by step, you can finally construct a decision tree from Table 1. The final tree is shown in Figure 2.

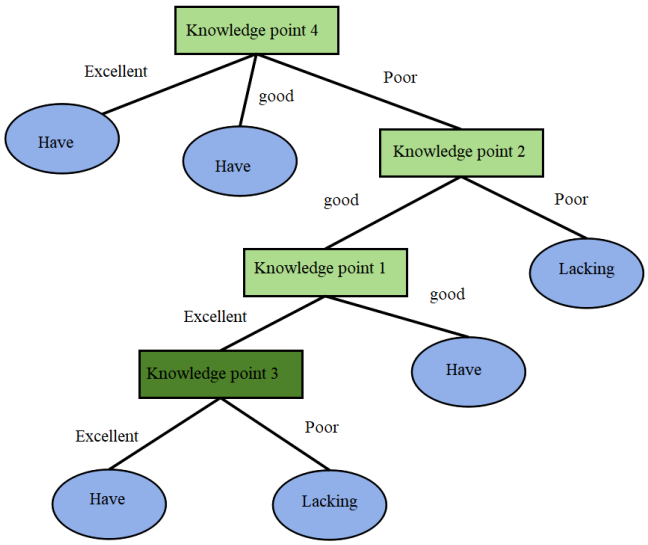


**Figure 2.** Decision tree

# 3 OVERALL DESIGN OF STUDENTS' PRACTICAL TRAINING COMPREHENSIVE ABILITY CULTIVATION SYSTEM

## 3.1 System Structure Design

College students' comprehensive quality management information system adopts integrated development mode, based on Delphi platform and Access database software, through virtual simulation technology, with computer and CAD tools as the core, using SSH framework and database development environment and application software to realize the comprehensive management of students' practical training ability. The main characteristic of the training mode of students' practical training comprehensive ability is computer simulation technology as the core, using virtual reality software to simulate the training of students, through practice assessment to improve the teaching effect, so as to realize the modernization of education and teaching [7].

The system mainly adopts C/S (client/server) three-layer structure mode (as shown in Figure 3), which mainly includes three service layers: client service layer, application service layer and data service layer. The client service layer is the core layer of the virtual simulation system, which mainly completes the hardware connection of the virtual simulation system. The application service layer is the data collection and analysis of the virtual simulation system, and meets the needs of users through the front-end hardware. The application layer is an important part of the virtual simulation system, which mainly solves the problems encountered by users during the practical training and analyzes the data. The data service layer is the basic layer of the virtual simulation system, which mainly completes the processing and storage of various data involved in the practical training process.

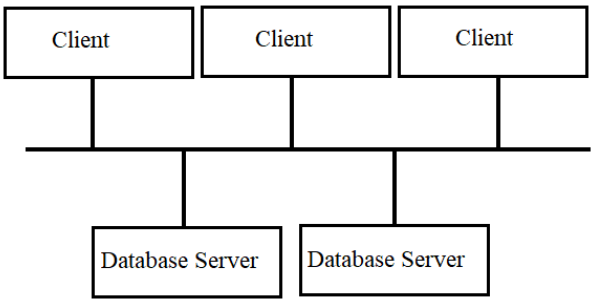


**Figure 3.** C/S three-layer structure model

## 3.2 System Module Function Diagram

The system modules in the cultivation mode of students' practical training comprehensive ability include student association management module, student social practice module and student science and technology innovation module, as shown in Figure 4:

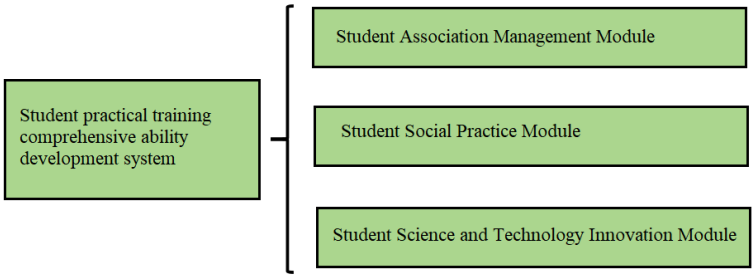


**Figure 4.** System module diagram

# 4 SYSTEM TEST

## 4.1 Test Objectives

According to the experimental requirements, it is determined that this topic mainly uses the black box and the white board as the basic framework of each functional module in the simulation laboratory. According to the design, the teaching course content and related technical data in the real scene are simulated well, and the simulation model is completed through virtual reality technology in the actual classroom situation. In this paper, the students' practical training system environment, hardware facilities and software application platform were tested, and the experimental results were analyzed to find the shortcomings of the course practical training and put forward effective improvement plan, so that students' practical training ability can be further improved [8].

## 4.2 Test Case

Test cases are the process of software testing to do a systematic, scientific summary, it is an important part of the software testing work, its main purpose is to find the error in the software, analysis and find out the problem, improve the reliability and security of the software system. This paper mainly uses user login case and system performance test case to test.

### 4.2.1 User Login Use Case

The main function of the user login case is to manage the user rights of each user, to provide a virtual simulation platform for the students of the training center, and to conduct simulation teaching, so as to improve the learning efficiency. The user login usage is shown in Table 2.

**Table 2**. User Login Use Cases

| Use Case Number | Enter data | Expected results | Expected results |
|---|---|---|---|
| YHDL_001 | Enter the correct user name and password | Login to the system | Login to the system |
| YHDL_002 | Enter user name without password | Prompt "Please enter your password" | Prompt "Please enter your password" |
| YHDL_003 | Enter password without user name | Prompt "Please enter your user name" | Prompt "Please enter your user name" |

| | | | |
|---|---|---|---|
| YHDL_004 | Enter incorrect user name and password | Prompts "Please enter the correct user Please enter the correct user name or password" | Prompts "Please enter the correct user Please enter the correct user name or password" |
| YHDL_005 | Username and password are not entered | Prompt "Please enter your user name and password Password" | Prompt "Please enter your user name and password Password" |

### 4.2.2 System Performance Test

In order to verify the performance of the design system, improve the comprehensive practical ability of students and achieve the teaching objectives, virtual simulation technology as the theoretical guidance, through the practical training platform to simulate the real environment. The performance test of the system is to realize the simulation operation and debugging of each functional module in the design task through the method of virtual simulation technology after the completion of the functional test, and compare the test results with the actual data to verify the shortcomings of the system in the practical training process of students' ability, knowledge structure and other aspects [9 -10]. The test report is shown in Table 3.

**Table 3.** Performance Test Report

| Use Case Number | Test Content | Test results |
|---|---|---|
| YHDL_001 | Configuration Test | Satisfactory |
| YHDL_002 | Response Time Test | After increasing the database records to 800,000, the query speed of LAN users is slightly slow, and the query speed of remote users is slower |
| YHDL_003 | Capacity Test | System dedicated server CPU speed is 6G, memory is 4G, hard disk 500G, stress test performance is good |
| YHDL_004 | Security Test Recovery Test Backup Test | Simultaneous development of 400 users capacity test performance is good |
| YHDL_005 | Security Testing | Security is good |
| YHDL_006 | Recovery Testing | Good recovery performance |
| YHDL_007 | Backup Test | Good performance of code and database backup |

### 4.3 Test Results

In the process of practical training, students can complete the comprehensive training of knowledge, theory and skills learned in the course mainly through the operation of simulation software. Therefore, we need to strengthen the construction and development of the training platform and related equipment and facilities to improve the work. At the same time, we should also pay attention to how students solve problems in the learning process and summarize the experience and lessons, so as to improve their own ability level, so that they can better adapt to the development trend of social needs and market requirements.

## 5 CONCLUSION

At present, many colleges and universities have carried out in-depth research in the field of computer virtual simulation technology, and made some achievements. However, due to the general experimental teaching environment in colleges and universities, the scale of the laboratory is generally small and the equipment is insufficient, which limits the application of computer virtual simulation technology to a certain extent. Therefore, it is of great practical significance to study the application of virtual simulation technology in experimental teaching. Through the research of virtual simulation technology and training mode of comprehensive ability, it can provide better environmental conditions and technical support for experimental teaching, so as to promote the development of experimental teaching to a high level and professional direction. On this basis, further research and explore the role of computer virtual simulation technology in cultivating students' comprehensive ability, so as to adapt to the new requirements of the society for talents.

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