Design of Online Network Multi Module Teaching System for ERP Sand Table Simulation Course

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Abstract. In order to provide auxiliary tools for ERP sandbox simulation course teaching, an online network multi-module teaching system was designed and developed. The system database is constructed from conceptual models, logical structures, physical structures, and other aspects to provide storage space for the operational data of the teaching system. In terms of system software, user role division and authorization modules are used to determine the permissions of users in the system. By determining the course arrangement of the ERP sand table simulation course, simulating the role of enterprise operation participation, simulating the ERP sand table business process, and enterprise evaluation, the online teaching module of the ERP sand table simulation course has been designed. By designing and connecting the online network interaction module, network resource query module, and teaching evaluation module, the system software functionality has been completed. Through system testing experiments, it has been concluded that compared to traditional teaching systems, the module teaching cases of the optimized design system have a higher success rate in operation and a 29 s reduction in operation delay, proving that the optimized design system has obvious advantages in functional operation, performance operation, and application performance.

Keywords: ERP Sand Table Simulation Course · Online Network · Multi Module Teaching System

1 Introduction

ERP, Enterprise Resources Plan, is MRP II Next generation manufacturing system and resource planning software. ERP, in addition to production resource planning, manufacturing, finance, sales, procurement and other functions, also includes Quality Assurance, laboratory management, operation flow Administration, product data management, inventory, distribution and transportation management, Human Resources Management and periodic report System. The meaning of ERP in China has been expanded. All kinds of software used in enterprises have been included in the category of ERP [1]. It breaks away from tradition Enterprise boundary, optimize from the scope of supply chain. Enterprise resources is based on internet economy, the new generation of information system of the era. It is mainly used to improve enterprise business processes

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to improve Enterprise core competitiveness. Enterprise resources Planning is a management platform based on information technology and systematic management ideas, which provides decision-making and operation means for enterprise decision makers and employees. ERP System support discrete, process type and other mixed manufacturing environments, scope of application. The ERP sandbox simulation course focuses on cultivating students' ability to apply ERP systems in real scenarios. The online network multi module teaching system can provide a virtual practice environment, allowing students to learn and practice real ERP system applications in simulated enterprise operations, thereby better mastering relevant knowledge and skills. It can enhance interactivity and collaboration, provide personalized learning support, monitor and evaluate students' learning situation in real-time, and provide flexible learning methods. These characteristics make the teaching system important and necessary in cultivating students' practical operational abilities, promoting student interaction and cooperation, and providing personalized learning support. From manufacturing to retail, service banking, telecommunication industry, government agencies, schools and other public institutions, through integration database technology, graphical user interface, the fourth generation query language, client server structure, computer-aided development tool, portable open system, so as to effectively integrate enterprise resources. ERP sand table simulation course is set up for the professional ability, collaboration ability, hands-on ability and innovation and entrepreneurship ability of students majoring in economics and management. ERP sand table simulation course is a professional course of economics and management in higher vocational colleges, a comprehensive course integrating theory and practice, and an important teaching method in innovation and entrepreneurship education.

This course is mainly based on manufacturing enterprises. Students can simulate a set of systematic processes of enterprise operation by playing the roles of general manager, financial director, production director, procurement director, sales director, etc. Through the study of this course, students can learn about enterprises in an all-round way, and carry out business innovation, technological innovation, concept innovation, strategic innovation, etc. in the process of active participation and interaction. In order to improve the teaching effect of ERP sand table simulation course and break the limitations of course teaching in time and space, an online network multi module teaching system for ERP sand table simulation course was designed and developed.

Under the guidance of certain teaching theories and ideas, online network teaching has many applications media and network technique. It is a kind of teaching mode to achieve teaching goals through multi-lateral and multi-directional interaction among teachers, students, media and the collection, transmission, processing and sharing of teaching information in multiple media. The online network multi module teaching system refers to teachers and students. Joint participation aimed at achieving Teaching objectives, Activities for system. From the current research situation of the teaching system, the more mature teaching systems include: the teaching system based on the project teaching method, the teaching system based on the auxiliary teaching mode, and the teaching system based on the hierarchical teaching theory. However, the above teaching systems are mainly targeted at computer professional courses, and are applied to the teaching of ERP sand table simulation courses. There are obvious problems such as poor teaching quality and poor system performance.

In order to address the issues of poor teaching quality and system performance in the aforementioned transmission teaching system, the ERP sandbox simulation course was taken as the research object and a multi-module teaching approach was adopted to optimize the online network teaching system. This system has designed and developed an online network multi module teaching system, providing auxiliary tools for ERP sandbox simulation course teaching. The system achieves the storage of teaching system data, user permission management, and online teaching functions by constructing a database, determining user permissions, and designing online teaching modules. Compared with traditional teaching systems, the optimized design system has achieved significant improvements in operation success rate, operation delay, and student performance. This innovation makes the ERP sandbox simulation course teaching more convenient and efficient, and improves students' learning experience and performance.

2 Database Design of Online Network Multi Module Teaching System

Database is a warehouse that organizes, stores and manages data according to data structure computer. A collection of large amounts of internal, organized, shareable, and uniformly managed data. In the optimized design of ERP sand table simulation course online network multi module teaching system, the database can provide storage space for ERP sand table simulation course resources, and can also store real-time data generated during the operation of the teaching system. In order to ensure the normal operation of the database, the redesign of the database should follow the principles of practicality, advancement, scalability and security, of which the security principle mainly refers to that when designing the database, the confidential data should be the center, and the authority of each user should be taken into account, and the level should be limited at the same time; The database shall be maintained during infrequent use, and management tools shall be provided to back up the data in the system on a regular basis, so as to prevent the data from being lost. The database shall be able to recover automatically after being damaged [2]. This ERP sand table simulation course online network multi module teaching system database is carried out from the conceptual model, logical structure, physical structure and other aspects. Based on the analysis of the system's needs, the database is designed for conceptual structure, needs are synthesized, summarized and abstracted, and an E-R diagram is designed. The design result of the E-R diagram of the teaching system is shown in Fig. 1.

According to the E-R diagram, the logical structure of the database is designed, and several database tables are constructed according to the characteristics of the system operation. The system database table can be roughly divided into three aspects: basic information table, core business table, and system parameter table. The ERP sand table in the core business table is used to simulate the construction results of the course information database table, as shown in Table 1.

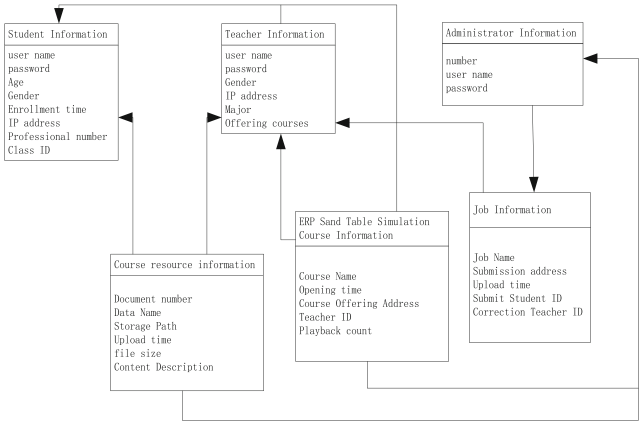

Fig. 1. E-R Diagram of Multi module Teaching System Database

Table 1. ERP sand table simulation course information database

Field Name	Field Description	data type	Storage length	Is it empty
Curriculum_id	Course No	Int	10	no
Curriculum_Name	Course name	Varchar	50	no
Curriculum_OpeningTime	Opening time	Varchar	20	no
Curriculum_url	Course running address	Varchar	100	yes
Curriculum_imageUrl	Course cover address	Varchar	100	no
Curriculum_teacherId	Teacher No	Varchar	100	no
Curriculum_Description	Content introduction	Varchar	250	yes

The construction results of other database tables in the system database can be obtained according to the above methods. In order to ensure the security of the database, effective control needs to be carried out through the database role. When the server is successfully accessed by the user, the user name [3] required is generally queried through the corresponding database role on the server. If the user information is found in the corresponding database role, the user can access the corresponding database name and related dataset list. However, this user can only view related data tables that have been assigned database roles. If the required user name cannot be found in the database role, the user cannot access or query any object on the server. In the process of system operation, real-time data will be generated, so the data in the database needs to be updated according to the operation of the system to facilitate the storage and reading of all data resources in the database.

3 Software Function Design of Online Network Multi Module Teaching System

With the support of the system database, the software functions of the system are optimized by using the multi module teaching method.Through user role division, ERP sand table simulation course implementation, teaching resource sharing and retrieval, teaching process synchronization and other modules, the teaching function of the system is realized.

3.1 User Role Division and Authorization Module

Users in the system can be divided into three types: administrator, teacher and student. Set an administrator account in the system. This role is set manually. Only the system administrator can access the system background, and other users are prohibited from accessing. During system initialization, the system administrator can create a new user for the experimental instructor, modify the instructor's user password, and delete the user. The new user created has all permissions except the system management module. The teacher role has the authority of student information management, course opening, question reply, etc., while the student user has the authority of personal information management, resource retrieval, resource download, ERP enterprise role simulation, etc. In order to prevent illegal access to the system, the default user of the system must be a registered student. Before starting the teaching of ERP sand table simulation course, the student must, according to his/her student ID. The system can only be used after the name and other information are registered as official users of the system, which also provides guarantee for the safe operation of the system [4]. To facilitate the system's management of users, user information is recorded in the form of Formula 1.

$$u = \{b, \chi, \omega\} \tag{1}$$

Variables in Formula 1 b, χ and ω They correspond to the user name, user type, and user permission. Quantify all users in the system according to formula 1 and input them into the system database.Teachers can make preparations for courses on the system, such as making courseware, writing teaching plans, building relevant curriculum resources and test question database, and uploading reviewed multimedia video, audio, pictures, text and other material resources; Teachers can also prepare lessons for traditional teaching, assign and wholesale homework, and provide synchronous or asynchronous tutoring to students through the network through this platform. Students can understand, preview, study and review courses under the system, complete online homework provided by teachers, complete online tests of units and courses, use the network to help online, and communicate with teachers or classmates online. The administrator can manage users and resources on this platform, understand teachers' teaching and guidance as well as students' comprehensive learning situation, and master students' learning effects through online examinations, online feedback and other forms.

3.2 Online Teaching Module of ERP Sand Table Simulation Course

The course teaching function is the core part of network teaching, which serves as a bridge between teachers, students and system administrators. Teachers design teaching courses according to teaching objectives, develop corresponding courseware, create corresponding courses and determine teaching plans by analyzing students' learning characteristics. After the course is created, you can properly select some related resources to add to the course. This teaching resource is not optional, but should be closely related to the curriculum, and it is necessary to explain, introduce and supplement the specific curriculum content. The curriculum teaching management in the design system mainly includes curriculum management, teaching management, teaching materials, homework and examination, teacher-student interaction and other related functions. Students can solve their own problems by inquiring about the course introduction, selecting the teaching course suitable for them, improving their learning ability, and meeting course problems directly through the interactive program between teachers and students, and sending an email to the teaching mailbox [5]. The teacher is the organizer and implementer of the online teaching process. The whole process of online teaching starts with the establishment of a course for a certain teaching, and has supplemented and explained the relevant materials and data, making the course more rich and interesting, and then providing it to students for learning and downloading, students actively study and explore according to the online teaching of teachers. In addition, the course created by the teacher is also the basis of all the follow-up links of online teaching. It should be classified according to the relevant information of the course to provide greater convenience for students to download and search.

3.2.1 Determine the ERP Sand Table Simulation Course Schedule

ERP sand table simulation course consists of five parts: sand table teaching aids, course design, teaching subject, ERP sand table simulation course software and ERP sand table simulation learning guide. ERP sand table teaching takes a set of sand table teaching aids as the carrier. The sand table teaching aids mainly include sand table surface, various logos and other parts. The sand table surface is divided into functional centers according to the functional departments of manufacturing enterprises, including marketing and planning center, production center, logistics center and financial center. Each functional center covers all the key links of enterprise operation: strategic planning, marketing, production organization, procurement management, inventory management, financial management, etc. It is the epitome of a manufacturing enterprise [6]. Figure 2 shows the construction result of the sand table surface.

The ERP sand table simulation course is divided into six stages: organization preparation, basic situation description, market rules and enterprise operation rules, initial state setting, enterprise operation competition simulation, and on-site case analysis. Among them, organizational preparation is the first step of the ERP sand table simulation course. The first step is to group students into groups. Each group is usually 5–6 people, including CEO, Marketing Director, Business Director, Purchasing Director, Financial Director, etc.; From this, 6 to 8 competitive simulation enterprises are formed. On this basis, it is necessary to explain the basic situation of the enterprises with the same conditions

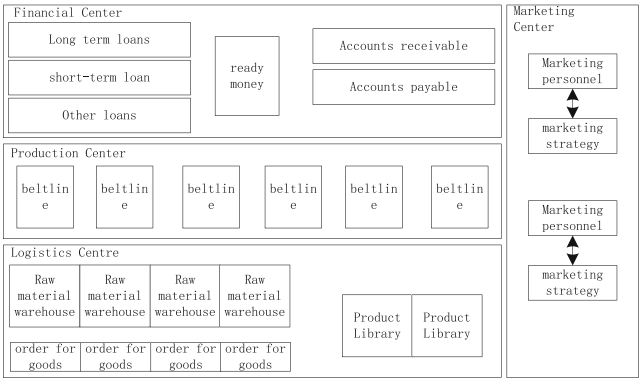

Fig. 2. ERP Sand Table Construction Results

that each simulation enterprise is ready to take over, including shareholders' expectations, the current financial situation of the enterprise, market share, products, production facilities, profitability, etc. In addition, enterprise operation competition simulation is the main part of ERP sand table simulation course, which is carried out according to the enterprise operation year. At the beginning of each year, according to the market forecast data, make a forecast on the overall demand, unit price and development trend of each product in the relevant market, and determine the enterprise strategy and business strategy. The forecast formula of demand and unit price is as follows:

$$\begin{cases} W = W_0 + \eta_W \Delta t \\ p = p_0 + \eta_p \Delta t \end{cases} \tag{2}$$

In the above formula W_0 and p_0 They are the demand quantity and unit price of the current enterprise's products, Δt Is the forecast time, η_W and η_p It corresponds to the change rate of demand quantity and unit price.Under the leadership of the CEO, we carried out business activities throughout the year in accordance with market rules and business operation rules [7]. Field case analysis is an important part of the sand table simulation course. According to the annual business results, enterprise managers should analyze the success and failure of their own enterprises, investigate the situation of competitors, and make necessary adjustments to the enterprise strategy. The teacher combines the overall situation of the classroom, finds out the problems that everyone is confused about, and analyzes the typical cases that appear on the scene. With the support of the ERP sandbox simulation course software and the ERP sandbox simulation learning guide, determine the implementation process of the ERP sandbox simulation course, as shown in Fig. 3.

Thus, the implementation process of ERP sand table simulation course is arranged.

3.2.2 Role Simulation of Enterprise Operation Participation

When students form a group to operate an enterprise, they need to serve as CEO of the general manager of the enterprise, CMO of the marketing director, COO of the

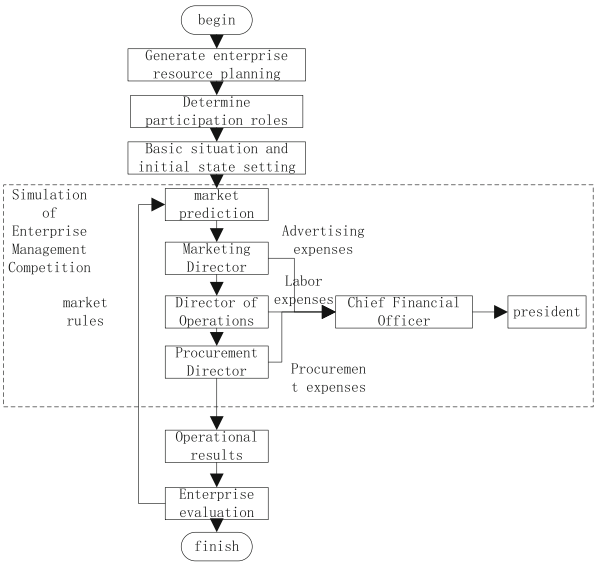

Fig. 3. ERP Sand Table Simulation Course Implementation Flow Chart

production director, CFO of the financial director, CLO of the logistics director, CIO of the information director, HR of human resources management and other positions, register users according to different identities, and operate different enterprise function modules.Table 2 shows the setting of enterprise operation participation roles.

Table 2. Roles of Enterprise Operation Participation

Enterprise management participates in teaching	Operation Center	Operation permission content
general manager	CEO cockpit	Decision making
Chief Financial Officer	Enterprise Decision Query	Loan, A/R and A/P management, report query
Marketing Director	Business Settlement Center	Product quotation, bidding, delivery
Logistics Director	Marketing Center	Purchase and transfer of raw materials
Production Director	Purchase and Production Center	Raw material procurement and product production
Product Director	Purchase and Production Center	Product design and R&D
HR Director	Product R&D Center	Human Resources Management

The general manager can preside over the annual work plan and summary meeting; Assist the Chief Financial Officer to make financing decisions according to the company's needs and the information provided by the Chief Information Officer; According to the annual task list, guide the heads of functional departments to complete the work in the year on time; According to the results of financial analysis, point out the problems existing in the company's operation and propose improvement measures; Be responsible for the implementation of job rotation. The chief financial officer's main responsibilities include: preparing the detailed statement of comprehensive expenses; Annual financial statements, including preparation of balance sheet and annual profit statement; Formulate the dividend distribution plan for shareholders. Similarly, we can get the simulation results of the role of enterprise management participation.

3.2.3 ERP Sandbox Business Process Simulation

Take the role of CFO in ERP sandbox as an example to simulate the ERP sandbox business process [8]. The financial part of ERP sand table business is divided into two parts: accounting and financial management. Accounting mainly records, calculates, reflects and analyzes the capital in the enterprise economic activity. The simulation result of enterprise economic general ledger is:

$$M_{\text{ledger}} = M_{\text{income}} - M_{\text{pay}} + M_{\text{x}} + M_{\text{fixed assets}} \tag{3}$$

Variables in Formula 3 $M_{\text{income}}, M_{\text{pay}}, M_{\text{x}}$ and $M_{\text{fixed assets}}$ They respectively represent the income amount, expenditure amount, cash and fixed assets of the enterprise. Where variable M_{income} and M_{pay}. The calculation formula of is as follows:

$$\begin{cases} M_{\text{income}} = M_{\text{bill}} + M_{\text{bills due}} + M_{\text{order}} \\ M_{\text{pay}} = M_{\text{material}} + M_{\text{check}} + M_{\text{other}} \end{cases} \tag{4}$$

among $M_{\text{bill}}, M_{\text{bills due}}$ and M_{order} Invoices, arrears and order payments, $M_{\text{material}}, M_{\text{check}}$ and M_{other} The corresponding costs are production material costs, operation and management costs and other costs. Substitute the calculation result of Formula 4 into Formula 3 to get the general ledger calculation result of accounting. The business process simulation results of other roles in the ERP sandbox can be obtained according to the above methods.

3.2.4 Enterprise Evaluation

Evaluate the operation status of the ERP sand table simulation target enterprise from multiple dimensions such as finance, customer, and internal operation capability. The financial dimension indicators can provide a certain guarantee for the realization of other related dimension goals. It is necessary to invest in raw materials and plants reasonably, and manage effectively. On this basis, it can win the market through reliable products, improve their comprehensive competitiveness, actively attract customers to obtain funds, and then use the information system and improve their capabilities, improve the coordination of the organization, and reasonably improve the skills of employees to meet the relevant management requirements [9]. The goal of the customer dimension is to

improve customers' recognition of products and promote the further development of the enterprise. The performance of the enterprise's customer dimension is investigated from two aspects: customer satisfaction and brand market value. The specific measurement indicators of customer satisfaction are: on-time delivery rate, product qualification rate, etc. The calculation formula of the on-time delivery rate is:

$$\mu_{\text{delivery}} = \frac{N_{\text{delivery}}}{N_{\text{order}}} \times 100\% \tag{5}$$

In the above formula N_{delivery} and N_{order} They are the quantity of orders completed on time and the total quantity of orders within the enterprise. In addition, the solution result of product qualification rate index is:

$$\mu_{\text{qualified}} = \frac{N_{\text{qualified}}}{N_{\text{product}}} \times 100\% \tag{6}$$

among $N_{\text{qualified}}$ and N_{product} They correspond to the quantity of qualified products and the total quantity of produced products. From the perspective of brand market value, specific measurement indicators include market share, service quality, sales ratio, etc. After determining the financial dimension and customer dimension, the enterprise needs to focus on the corresponding internal process dimension. In the process of management, enterprises can provide support for the realization of financial objectives on the basis of optimizing and improving the corresponding internal business processes. The internal process dimension indicators include marketing capability, production volume, etc. The calculation formula of marketing capability is:

$$\psi = \gamma \cdot z \cdot (\psi(i) + M_{\text{advertisement}}) \tag{7}$$

among γ and z It indicates that the enterprise has relevant market certification and access qualification coefficient, $\psi(i)$ For employees in the enterprise i Marketing capabilities, $M_{\text{advertisement}}$ It is the sum of advertising expenses invested by enterprises in the market. The production measurement structure is:

$$Q = \sum_{j=1}^{n_{\text{farm}}} q_j \tag{8}$$

where q_j For workshop j Production, n_{farm} Indicates the number of workshops included in the enterprise. Based on the above indicators, the evaluation results of the enterprise are as follows:

$$f = \varpi_1 \mu_{\text{delivery}} + \varpi_2 \mu_{\text{qualified}} + \varpi_3 \psi + \varpi_4 Q \tag{9}$$

In the above formula ϖ_1, ϖ_2, ϖ_3 and ϖ_4 Corresponds to the weight value of the above evaluation indicators. The enterprise evaluation output results can be obtained by substituting the calculation results of each indicator into Formula 9. Through the above process, complete the implementation of the system ERP sand table simulation course module.

3.3 Course Online Network Interaction Module

When the logged in user clicks the online question answering hyperlink on the home page of the course learning system, the learning exchange platform interface will be launched. The learning and exchange platform interface should provide links for users to further view the details of messages, post messages, return to the home page, modify user information and user passwords and other functions. The main task of the online question answering interface is to establish a link to the database, retrieve all article records from the database in chronological order, and display several records in the front according to the page size, and generate pagination links for the rest. After the student user uploads the interactive information, it will be received by the teacher through the communication network. The online network interaction process can be quantified as:

$$x_{\text{receive}} = x_{send} \times \kappa_{m-d} \times \varsigma \tag{10}$$

In Formula 10 κ_{m-d} and ς They are modulation and demodulation coefficient and communication channel parameter respectively. After receiving the interactive information, the teacher end can enter the page for posting messages, which should provide a complete interface for writing message titles, message content, uploading pictures, picture descriptions and publishing time; In order to ensure the integrity of the record, the system needs to verify the legitimacy of the content entered by the user; Provide the submit message button and insert it into the BBS article table, and give the user the corresponding prompt according to whether the insertion is successful or not; If the user does not want to leave a message at this time, the "Back to the previous page" option is also provided, allowing the user to return to the online question answering interface at this time.

3.4 ERP Sand Table Simulation Course Network Resource Query Module

When setting up ERP sand table simulation course, teachers upload relevant resources of the course to the system database and extract the characteristics of the course resources $\tau_{\text{resources}}(i)$ As a tag item for a resource. When students enter the system, input keywords according to the resource query content, and extract the query keyword features using Formula 11.

$$\tau_{\text{keyword}} = \sqrt{\frac{1}{N_{\text{keyword}}} \sum_{i=1}^{N_{\text{keyword}}} (x_i)^2} \tag{11}$$

among N_{keyword} Is the number of keywords, x_i It represents the input keyword content.The specific feature matching process can be expressed as follows:

$$s = \frac{\tau_{\text{keyword}} \cdot \tau_{\text{resources}}(i)}{\left\| \tau_{\text{keyword}} \right\| \cdot \left\| \tau_{\text{resources}}(i) \right\|} \tag{12}$$

If calculated s The value of is above the threshold s_0, describe the current keywords and teaching resources i Consistency, i.e. teaching resources i It is the query result of online network resources of the current course. If the calculation result of Formula 12 is lower than the threshold value s_0, you need to match the next teaching resource, and finally output all the matching results that meet the conditions in a certain order to complete the resource query task of the system.

3.5 Online Online Teaching Assessment Module of Sand Table Simulation Course

In order to ensure the online network teaching effect of the system, in addition to the basic teaching module, it is also necessary to set up a teaching assessment module, which outputs the final assessment results of online network teaching of ERP sand table simulation courses from three aspects of students' daily learning behavior, written examination results and practical assessment results. The output results can be expressed as:

$$H = H_{\text{daily}} + H_{\text{written}} + H_{\text{practice}} \tag{13}$$

among H_{daily}, H_{written} and H_{practice} Respectively corresponding to the scores of daily learning behavior, written examination results and practice assessment results[10]. Finally, the teaching assessment results of all students in the system will be output visually and displayed in the system interface.

3.6 System Background Load Balancing Control

In order to avoid uneven load distribution, service request blocking, computing resource waste and other situations in the case of multi concurrent operation of the system, it is necessary to further improve the design of system load balancing. In the process of system load balancing control, first calculate the congestion probability of the server, and the calculation result is:

$$P = \frac{N_b}{\sum G} \tag{14}$$

among N_b Is the number of concurrent users in the system, G The total number of resources contained for the system. It is calculated that the higher the congestion probability is, the greater the load of the current system server is, and the request submitted by the user needs to be dynamically allocated to other servers for processing. This completes the load balance control of the system background, and ensures the running performance of the online network multi module teaching system of ERP sand table simulation course.

In summary, the design process of the online network multi module teaching system for ERP sandbox simulation course is shown in Fig. 4.

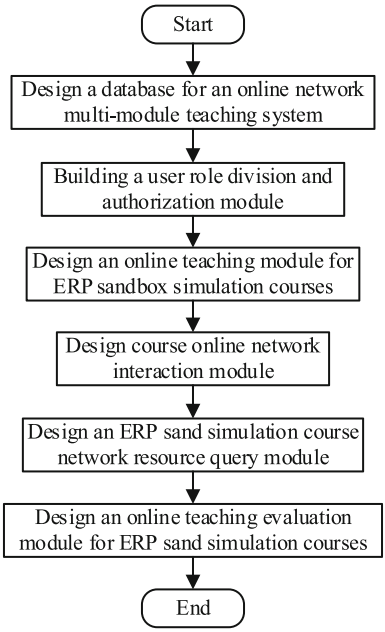

Fig. 4. Design flowchart of online network multi module teaching system for ERP sandbox simulation course

4 System Test

After completing the previous software code design and interface design, the next unit must be the necessary system test. System test is not only to test software code, but also to test various aspects such as data verification. Like software code development, system testing is also a highly demanding and technical content, without many principles and skills. System testing is the main component of developing application software quality assurance. The system test experiment is divided into two parts: function test and performance test. The function test is mainly to test whether the program module has achieved the functions required in the software design. The performance test is to judge whether the optimized design system can achieve the expected functions under different operating conditions.

4.1 Preparation for System Test Experiment

Before the experiment begins, the experiment is prepared from two aspects: system operation and test environment, as well as test cases.

4.2 System Test Environment

In order to ensure the efficiency and reliability of the system operation, the system server should generally have a high software and hardware configuration. The operating system

uses Ubuntu 12.04 and Apache + Pssenger to provide application services. MySQL 5.0 is used as the database, Solr is used as the retrieval server, Memcache is used as the cache server, Apache Bench is used as the load generator, mainstream Firefox, Chrome and IE browsers are selected for the interface display, and multiple versions of the above browsers are tested. The network teaching platform software system is developed based on B/S mode, so the network requirements are the most basic configuration. Generally, all servers use static IP addresses, while clients can use either manually set static IP addresses or obtain dynamic IP addresses through dedicated DHCP servers. The optimized ERP sand table simulation course online network multi module teaching system is developed with HTML language, which is a hypertext markup language that can connect information files on different servers in the Internet.

4.3 System Test Cases

Generate multi module test cases for user login, course teaching, resource retrieval, etc. Take the resource retrieval module test as an example, and the specific case preparation is shown in Table 3.

Table 3. Test Cases of System Resource Retrieval Module

Case number	Search keywords	Expected retrieval quantity/piece
J01	financial analysis	102
J02	Marketing Center	95
J03	Production Center	87
J04	Logistics services	113
J05	Material procurement	98

Similarly, test cases of other modules of the system can be obtained. In order to ensure the credibility of the experimental results, the number of test cases prepared for each teaching module is 200.

On this basis, evaluate whether the system has the necessary functions, including course management, learning material sharing, learning progress tracking, homework submission and evaluation, to ensure that the system can meet teaching needs. Evaluate the stability and reliability of the system, including its response speed, operation delay, etc.

4.4 System Test and Experiment Process

In the configured system test environment, complete the development of the online network multi module teaching system for the optimized design of ERP sand table simulation course. This system test adopts the test method of combining black box and white box. The black box test is mainly used to test the performance of the system, while the white box test is used to test the function of the teaching module of the

system.Input the prepared system test cases into the corresponding running program of the developed online network multi module teaching system, and obtain the test output results of module functions. Figure 5 shows the test run interface of the ERP sandbox business process simulation module.

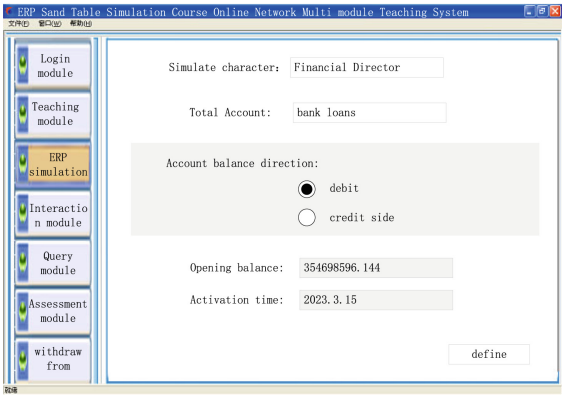

Fig. 5. Operation interface of ERP sandbox business process simulation module

Similarly, the operation test results of other module functions of the system can be obtained. The quantitative test index of system functions is set as the success rate of module teaching case operation η_{suc} The numerical results of this indicator are as follows:

$$\eta_{suc} = \frac{n_{suc}}{n_{\text{Use case}}} \times 100\% \tag{15}$$

In the above formula n_{suc} and $n_{\text{Use case}}$. It respectively represents the number of successful use cases of module functions and the total number of use cases set in the experiment. In addition, the system performance test is mainly divided into two parts: running performance test and application performance test. The main principle of running performance test is to adjust the concurrent number of system running tasks, and observe the change of system response speed under different concurrent conditions. The quantitative test results of running performance in system performance are as follows:

$$\Delta\tau = t_{in} - t_{out} \tag{16}$$

among t_{in} and t_{out} They are the start time and output time of the system task. The application performance test is to judge the change of students' scores after the application of the ERP sand table simulation course online network multi module teaching system. The test results of system application performance can be directly obtained through the statistics of students' scores. Final calculation η_{suc} The higher the value of, the better the function of the corresponding system teaching module, $\Delta\tau$ The larger the value is, the higher the student's score is, which means the better the operation performance of the corresponding system is. In order to reflect the advantages of the optimized design system in terms of function and performance, the traditional project-based teaching system

and the teaching system based on the auxiliary teaching mode are set as the two comparison systems of the experiment. The development of the comparison system is realized under the same experimental environment, and the corresponding operating results are obtained.

4.5 System Test Results

4.5.1 System Teaching Function Test

Through the statistics of relevant data, the test results reflecting the teaching function of the system module are obtained through the calculation of Formula 15, as shown in Fig. 6.

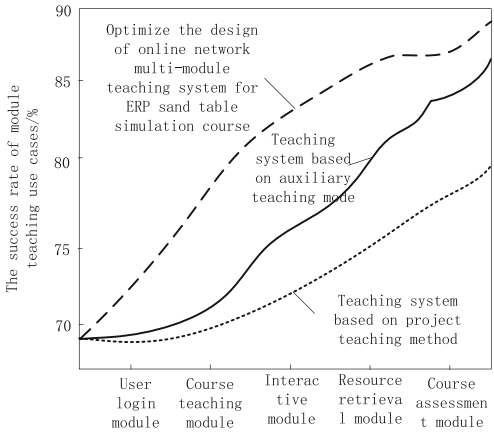

Fig. 6. Comparison curve of teaching function test of system module

It can be seen intuitively from Fig. 6 that, compared with the two comparative teaching systems, the module teaching use cases of the optimized design ERP sand table simulation course online network multi module teaching system have a higher success rate, that is, the teaching function of the optimized design system is better.

4.5.2 System Operation Performance Test

Under different concurrent conditions, the running time of each teaching task is counted, and the test results reflecting the running performance of the system are obtained through the calculation of Formula 16, as shown in Fig. 7.

It can be seen from Fig. 7 that under different concurrency conditions, the average response delay of the optimized design system is 10.4 s, while the average response delay of the comparison system is 42.3 s and 36.5 s respectively, which proves that the optimized design system has higher operation performance.

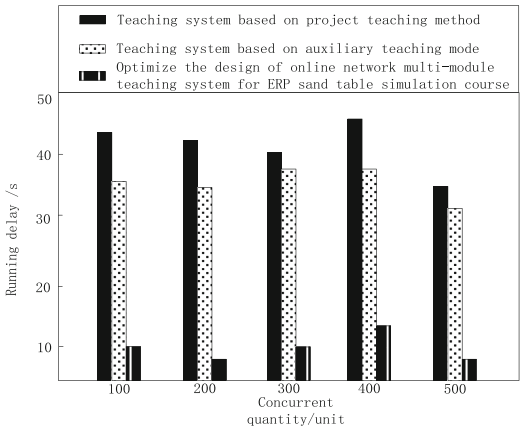

Fig. 7. System Operation Performance Test Results

4.5.3 System Application Performance Test

The two contrast teaching systems and the optimization design system are respectively applied to the actual teaching work of ERP sand table simulation course, and the test results of system application performance are obtained through the statistics of scores of multiple students, as shown in Table 4.

Table 4. Data Sheet of System Application Performance Test

Student ID	Student assessment scores/points of the teaching system based on project-based teaching method	Students' assessment scores/scores by applying the teaching system based on the auxiliary teaching mode	Student assessment score/score of applying optimized design of multi module teaching system
1	86.6	90.2	97.5
2	89.2	91.4	98.6
3	78.5	85.7	94.4
4	73.4	84.2	92.9
5	80.9	86.5	93.5
6	85.5	88.1	96.2
7	84.3	87.6	97.4
8	89.8	92.1	98.8

Through the calculation of the average value, it can be concluded that the average value of the students' assessment scores of the two comparison teaching systems is 83.5 and 88.2 respectively, while the average value of the students' assessment scores of the online network multi module teaching system of the application optimization design

ERP sand table simulation course is 96.2, which shows that the optimization design system has higher application performance.

5 Conclusion

ERP sand table simulation training course has been offered for many years, but there are still many problems in the teaching process. Through the design and development of the online network multi module teaching system of ERP sand table simulation course, it will be beneficial to improve the teaching effect, and ultimately achieve the teaching purpose of improving students' comprehensive quality and cultivating students' application ability.

In future research, the functionality and performance of each module in the system will be further optimized and improved to enhance user experience and teaching effectiveness. For example, improving the realism and interactivity of the sandbox simulation module, and increasing the functionality and operability of the ERP system module.

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