



Exploring Online Higher Mathematics Culture Course Examination System Based on Computer Aided Technology

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Abstract. With the rapid development of online education technology, the evaluation of learning effectiveness is also essential. Culture course examination as the most important means of evaluation, its normative, scientific and examination of the organization, management, teaching and evaluation is directly related to the accuracy and objectivity, which also affects the quality of teaching. In this paper, based on the computer aided higher mathematics culture course examination system, research and the realization was analyzed the present network examination which present research situation and the structure. The proposed research method introduced the related technology and the system design thought. Then the system demand analysis, overall design, detailed design and implementation and the key technologies involved in the system are discussed in detail. The system uses the administrator, teachers, students three licensing, to achieve a test database management, automatic intelligent test paper. Online higher mathematics culture course examination, automatic and manual marking, examination results analysis functions, according to the different permissions. It can be divided into three sub-system: administrator subsystem, teacher subsystem, student subsystem.

Keywords: Computer aided; Higher mathematics; Online examination system; J2EE; Papers automatically generated

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1 INTRODUCTION

Computer aided technology has been widely used in the field of education. Gur et al. have some important research results in this field. In this network environment, students want personalized satisfaction, according to their own situation to complement scientific and objective learning [1-3]. It improved the existing examination mode and the efficiency of the educational institutions hope to provide students with more flexible teaching space and services in a variety of ways, and track and evaluate the students in a comprehensive and accurate manner. Brzakovic and Tou put

forward that online examination system meet the needs of the market and development, which aims to explore the Internet-based test mode [4]. Through this new model for the school to create a new examination environment, the examination management breakthrough time and space constraints, it improved the examination efficiency and standardization level, related results can be seen in references from Akhtar et al. [5, 6].

The examination is also an important part of the teaching, which helps the teacher to understand the knowledge of the students. It is also a kind of test to the teaching method, which can improve the teaching. Gainor et al. pointed out that the traditional test mode is often subject to various factors of the examination itself, such as the degree of difficulty of the papers, scoring criteria and cheating [7]. Therefore, in order to promoting the reform of education, examination reform is also an important research topic [8]. At present, the online examination system based on the network has already become the powerful complement and development of the modern examination way. The traditional test was from the title, test papers, printing, paper distribution, answer, winding, and then the volume published results. The entire process requires manual participation, long cycle, workload and error-prone, it also appropriate of the confidential work, making the time cost, examination cost and labor cost [9]. The network examination system should be a real-time processing system based on the network database and Internet processing. The test paper can be randomly generated. The examinee can submit the test paper through the computer automatically grading and the test result can be statistically analyzed. In summary, the network examination system can reduce the examination cost, the volume, the marking, the achievement statistical analysis all completes by the computer automatically [10]. It may exempt the teacher's massive work and enhanced the working efficiency. The low medium examination paper and the reply volume transmission reduced the cost of confidentiality. This method can be drawn by different questions, randomly changing the order of questions, which reduced the chances of cheating. Therefore, how to design a good performance, scalability and security of network test system has become an inevitable trend. Examination as the most important means of evaluation, its normative, scientific for organization, management, teaching and evaluation is directly related to the accuracy and objectivity, which also affects the quality of teaching. In this paper, based on the J2EE technology, higher mathematics examination system was researched and the realized. We first analyzed the present network examination structure and the proposed research method by introduced the related technology and design thought. The system demand analysis, overall design, detailed design and implementation and the key technologies involved in the system are discussed in detail. In order to achieve a test database management, automatic intelligent test paper, online examination, automatic and manual marking, examination results analysis functions, according to the different permissions, it can be divided into three subsystem: administrator subsystem, teacher subsystem, student subsystem.

2 RELATED RESEARCH STATUS AND METHOD OF NETWORK EXAMINATION SYSTEM

2.1 C/S and B/S Structure

Most of the test system structure is mainly based on C/S (Client/Server) structure and B/S (Browser/Server) structure (Figure 1). Test system based on C / S structure was used computer LAN. The contents of the test was on the remote server, the test machine installed the test application. Because of the use of the computer network and its structural characteristics, it only applies to a certain range of network internal (LAN). For each exam or version upgrade, the machine must be installed, the maintenance was difficult. Test applications put on the client, security is also affected easily.

B/S uses three-tier structure, namely: the browser/ server, web database server, structure of the network test system. This B/S structure of the network test system for an examination room or dozens of test centers stand ten thousands of people at the same time. The test system on the client software over-reliance reducing the client software maintenance workload. Test system installation and test questions easily loaded and unloaded, simply by installing the server. B/S

structure of the network examination system will not be time and geographical restrictions, this is the future development direction of the examination system.

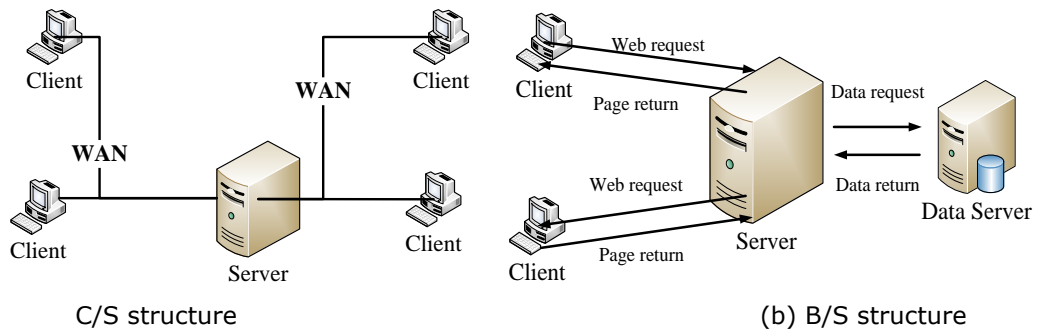


Figure 1: C/S and B/S structure.

2.2 J2EE Specification

Three versions have their own advantages and disadvantages for different users.

2.2.1 J2EE containers

(1) Web container: the server-side container, including two components JSP and Servlet. JSP and Servlet are Web server function extension to accept Web requests to return the dynamic Web page. Components in the Web container can use complex components of the EJB container to implement complex business logic.

(2) EJB container: the server-side container contains the components for the Enterprise JavaBeans, it is one of the core J2EE, which mainly for the server-side business logic to achieve. The EJB specification defines a framework for developing and deploying distributed business logic to simplify the development of enterprise applications, making it easier to have scalability, portability, distributed transaction processing, multi-user, and security.

(3) Applet container: Applet is embedded in the browser in a lightweight client, it effected when the use of Web pages cannot fully express the data or application interface. Applet is a means of alternative Web pages, we can only use J2SE development Applet, Applet cannot use the J2EE service and API, which is for security considerations.

(4) Application client container: the client container contains the components for the application client. Application client is a relatively heavyweight client relative to applet, which can use most of the J2EE service and API.

2.2.2 J2EE components

(1) Servlet

Servlet is the Java platform CGI technology. Servlet run on the server side, dynamically generated Web pages. Compared to traditional CGI and many other CGI-like technologies, Java Servlets are more efficient and easier to use. For Servlet, repeated requests will not lead to the same procedure for multiple loading, they rely on the way to support concurrent access of thread.

(2) JSP

The Java server page is a technology that implements a mix of normal static HTML and dynamic page output. Web page production tasks can be more easily divided into page designers and programmers, which easily through the JSP synthesis. In the run-time, JSP will be the first to convert Servlet, Servlet form to compile and run, so there is no efficiency and functionality difference compared with Servlet.

(3) EJB

EJB defines a set of reusable components: Developers can use these components, like building blocks to build distributed applications.

2.2.3 Poisson distribution used for examination paper constructing

In the elaboration of the difficulty distribution algorithm, first needed to understand the test question bank and test the structure of attribute code. The attribute code of examination questions mainly includes chapter code, title code, difficulty coefficient, test score, number of times t and so on. The title type code indicates the type of questions, including multiple choice questions, multiple choice questions, determine the title, fill in the blanks, respectively by the code "1, 2, 3, 4". The degree of difficulty is divided into five difficulty levels, marked with the numbers "1, 2, 3, 4, 5". "4" represented difficult questions, "5" represented that the difficulty of the test is too large.

Different types of difficulty extraction are independent of each other, that it did not affect each other. From the randomly selected topics, it can be seen the difficulty of papers variable is subject to Poisson distribution, such as type (1):

$$P_k = P(d = k) = \frac{\lambda^k}{k!} e^{-\lambda}, k = 1, 2, 3, \dots \quad (1)$$

P_k is the average difficulty of the test paper, k is the difficulty value of the test questions at all levels, when $k = 0$, said that no difficulty of the questions, and when $k > 6$ represented the great difficulty of questions. As the questions in the test questions are divided into "1, 2, 3, 4, 5", to ensure the five levels of questions difficulty, the sum of the proportions satisfies as the follow formula (2-9):

$$P_1 + P_2 + P_3 + P_4 + P_5 = 1 \quad (2)$$

$$P_0 = \frac{\lambda^0}{0!} e^{-\lambda} \quad (3)$$

$$P_1 = \frac{\lambda^1}{1!} e^{-\lambda} \quad (4)$$

$$P_2 = \frac{\lambda^2}{2!} e^{-\lambda} \quad (5)$$

$$P_3 = \frac{\lambda^3}{3!} e^{-\lambda} \quad (6)$$

$$P_4 = \frac{\lambda^4}{4!} e^{-\lambda} \quad (7)$$

$$P_5 = \frac{\lambda^5}{5!} e^{-\lambda} \quad (8)$$

$$P_K = P_0 + \sum_{k=6}^{20} \frac{\lambda^k}{k!} e^{-\lambda} \quad (9)$$

Table 1 is the average difficulty, λ take different values percentage for the degree of difficulty questions in the group of papers. From the data in Table 1 and Figure 2, it can be seen that the difficulty types of the vast majority of test papers are distributed in the vicinity of the specified average difficulty value λ .

The average difficulty of the paper λ	Distribution of difficulty level —k				
	S1 percent	S2 percent	S3 percent	S4 percent	S5 percent
1	58.25	29.13	9.71	2.43	0.49
2	31.91	31.91	21.28	10.64	4.26

3	17.24	25.86	25.86	19.40	11.64
4	9.55	19.11	25.48	25.48	20.38
5	5.53	13.82	23.04	28.80	28.80

Table 1: Distributing scale table of examination paper.

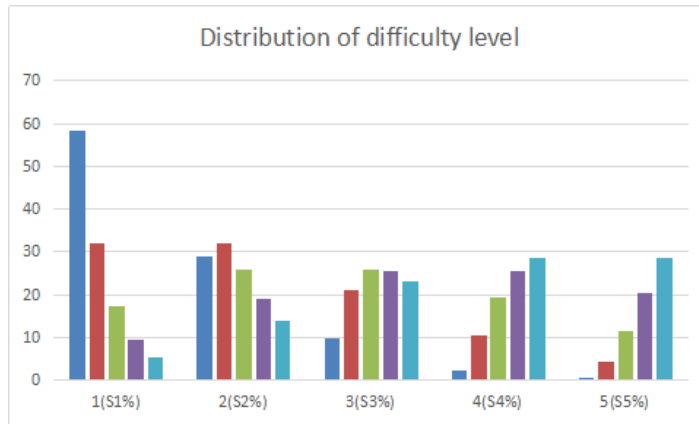


Figure 2: Distribution of difficulty level.

3 SYSTEM STRUCTURE AND FUNCTION

3.1 System Functional Architecture

Online mathematics examination system achieves the functions: test entry, online production of papers, online examinations, online test control, automatic score, performance query, system management, student management, test management. The overall function of online higher mathematics examination system structure was shown in Figure 3.

There are two types of users in this online examination system, namely the identity of the login system which is divided into two kinds, one is the administrator (general teacher), the other is the student.

(1) Rights management: the system needs to be validly logged on. The user's identity and the system resources are different. Students take online exams and query results, administrators (general teachers) can produce online papers, the candidate management, control examinations, query candidates, management papers, management, and so on.

(2) Candidates online examination function: Candidates enter the quasi-number registration system and then select the corresponding examination papers. After completion of the answer, the candidates within the examination limit can manually submit papers. The system can automatically limit if over time is passed, when system automatically scored, candidates can search test scores.

(3) Test paper management functions: administrators can make online papers, you can also query all the papers in the system, and the corresponding papers set whether to publish papers or to delete or modify.

(4) Control the examination function: the administrator can set the test time. If the time limit has been reached, the candidates will not be able to continue to answer the question, the system will automatically submit the candidate papers. If the time limit is not reached, the candidates can continue to answer, if the answer is finished, candidates can manually submit papers.

(5) Student management functions: administrators can add candidates query and modify the candidates' personal information.

(6) Performance management functions: the system provides candidates with the details results of various subjects for administrator view.

(7) System management functions: Admin login can change the login password, query and add test subjects.

(8) Test library management functions: administrators can conduct online examination of the production, and can query, delete and modify the related questions in the exam.

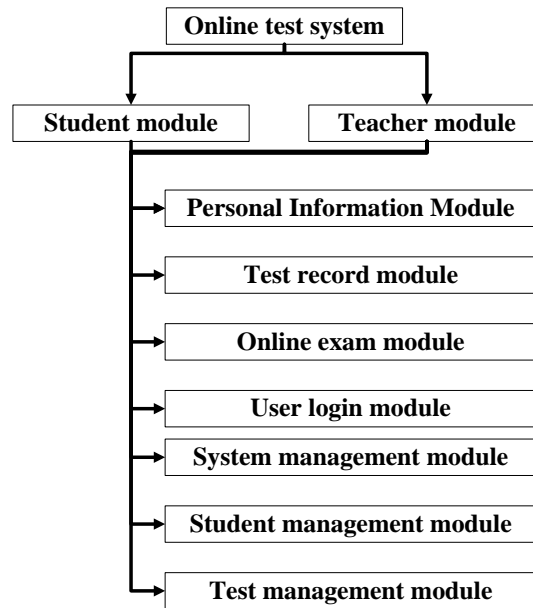


Figure 3: The overall function of online higher mathematics examination system structure.

3.2 User Personal Information Module

Online higher mathematics examination system of personal information module includes three functions: user personal information query, user's personal information modify, personal password changes. User's personal information query module is the basis of the system, including the user password changes, personal information can be updated according to individual circumstances, especially with the student's academic year. The same account not needed upgrade for every new create account, another advantage is that you can track the individual's previous examinations, so more detailed understanding of the previous learning situation can get. Personal password modification is a key part of the system, the user can login in according to different periods of password changes, thereby increased the security of the system.

When the user access to personal information module, there are three options. When click on the personal information query, you can display the basic information of individuals. When click on personal information changes, you can click the modified information which can be saved. When click on personal password changes, it will prompt the user to enter the current password, when enter the new password two times, click modify, the system will first detect the user's new password and alert user to re-enter the new password. The same link database will detect the user's existing password. If not correct, then return to prompt the user to re-fill, if correct, then submit the system to be updated.

3.3 The User Logs Module

User login module entranced to the online higher mathematics examination system for teachers and candidates to provide login interface. The requirements was simple and convenient. User login need to enter the user name and password, online examination system is security needs, user can set a random verification code to achieve. After the user enters the user name and password, select the login role, and then submit the login, login will first test the user input data is legal. Illegal prompts the user to re-enter, legitimate inspection, submitted to the background processing, if the user's user name and the password is correct, the user role will jump to the appropriate interface, if the user name or password is wrong, it will remind the user to re-enter. User login module flow chart was shown in Figure 4:

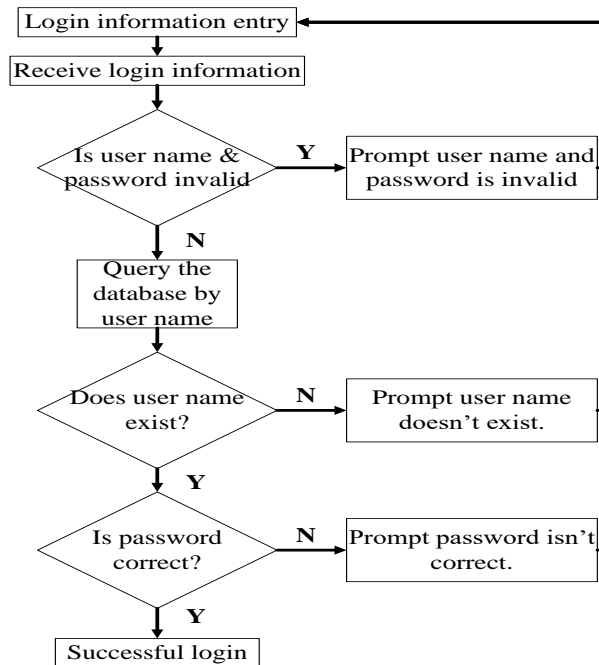


Figure 4: User login module flow chart.

3.4 Online Mathematics Examination Module

Online higher mathematics examination module is not only the core module of the system, but also the functional focus of the system. After user logs in the system, click on the left to obtain the test paper, the system will automatically receive the electronic test paper from the database, and then the test time begins. If the user answer time exceeds the system time, the system will automatically submit the user's higher mathematics examination paper. If the user clicks on the submit button, the right and wrong of each question and the correct answer to remind the user to review the chapter content. The biggest feature of the system test module is the assessment of selective, you can ask the teacher to conduct multiple examinations, so you can deepen the understanding of knowledge points and learning. Each test item in the same subject may be different. The specific higher mathematics examination system flow chart was shown in Figure 5.

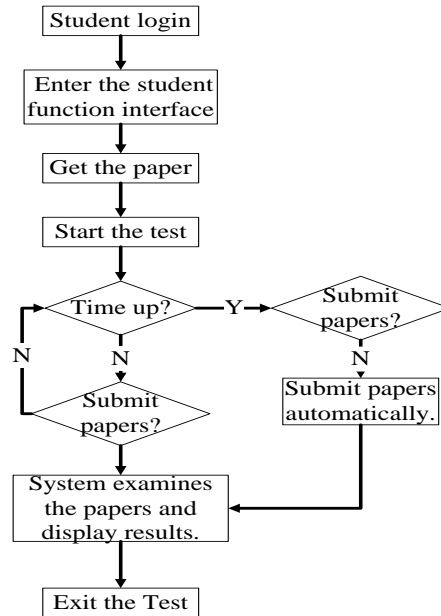


Figure 5: Higher mathematics examination system flow chart.

4 EXPERIMENTAL AND RESULTS

4.1 Main Data Layer Design

Data layer bear the task of storing data, taking into account the current popular operating system and the actual situation of the school, the system data layer used Microsoft's SQL Server. According to the system needs, the table structures used are as follows:

Field name	Type	Description
teachid	int(4)	Teacher ID, automatically increase, main key
name	char(10)	Name
password	varchar(20)	Password

Table 2: Teacher info table.

Field name	Type	Description
stuid	int(4)	Student ID, automatically increase, main key
name	char(10)	Name
password	varchar(20)	Password
grade	char(20)	The grade of the student

Table 3: Student info table.

Field name	Type	Description
typeid	int(4)	Type ID, automatically increase, main key
typename	char(20)	Type name

typemode	char(10)	Subjective, objective
typecent	int(4)	Scores of the questions of this type.
typenum	int(4)	Amount of the questions of this type.

Table 4: Question type table.

Field name	Type	Description
stid	int(4)	Question ID, automatically increase, main key
content	varchar(50)	Question content
option1	varchar(50)	Option 1
option2	varchar(50)	Option 2
option3	varchar(50)	Option 3
option4	varchar(50)	Option 4
answer	varchar(50)	Question answer

Table 5: Question basic info table.

Field name	Type	Description
sjid	int(4)	Paper ID, automatically increase, main key
sjname	varchar(50)	Paper name
total_cent	int(4)	Scores.
sjdiff	int(4)	Paper difficulty
chapter_start	int(4)	Chapter start
chapter_end	int(4)	Chapter end
crea_time	datetime	Set-up time
upda_time	varchar(50)	Update time
teacherid	int(4)	Teacher ID
ans_time	int(4)	Answer time
sjtype	char(10)	Midterm, end, test.
zjtype	char(10)	Composing way
chapter	int(4)	Chapter
type	int(4)	Question type
diff	int(4)	Difficulty

Table 6: Papers basic info table.

Field name	Type	Description
ksid	int(4)	Test ID, automatically increase, main key
ksname	varchar(50)	Test name
sjid	int(4)	Test paper
kstime	datetime	Test time
grade	varchar(20)	Test class
flag	bit	Test marker

Table 7: Exam basic info.

Field name	Type	Description
stuid	int(4)	Student ID
ksid	int(4)	Test ID

cnet	int(4)	Scores
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Table 8: Student score table.

The change of online processing time, offline average processing time and average function time is shown in Figure 6.

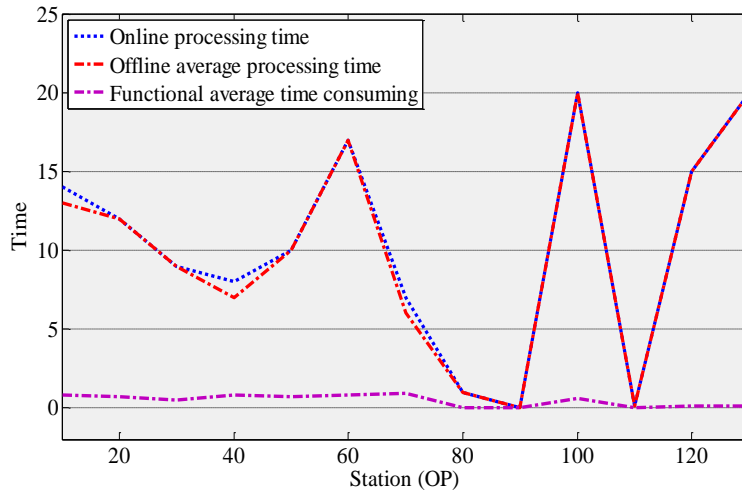


Figure 6: Comparison of online processing time, offline average processing time, and functional average time consumption.

4.2 Related Software Interface

When the administrator logs in, first select the user type was the administrator, enter the administrator ID and password, click the "login" button, the system will automatically search the database administrator table to find out whether the administrator information exists. If the login fails, it will go to the administrator's main management page and remind error message page. The login page for administrator was shown in Figure 7.

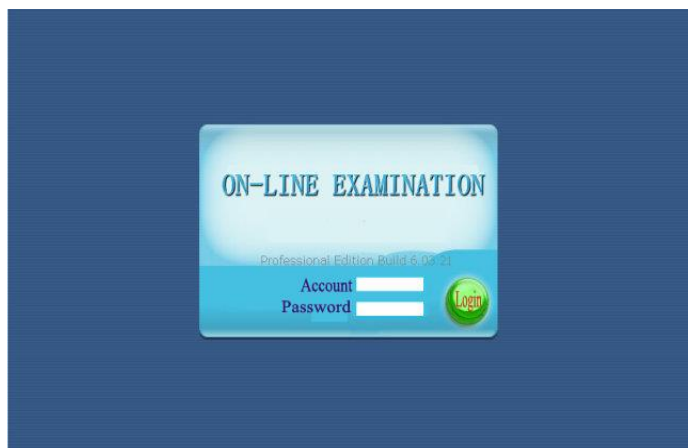


Figure 7: The login page for administrator.

The interface of information management was shown in Figure 8.

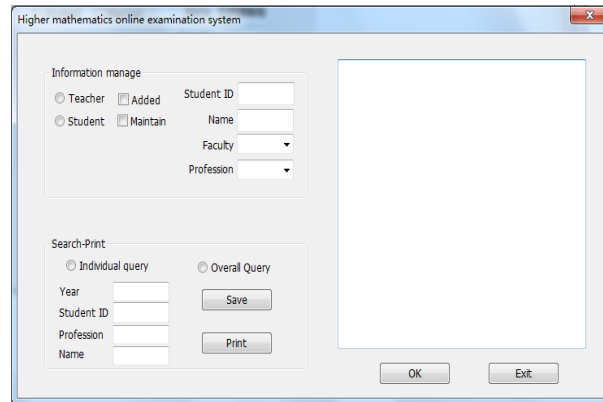


Figure 8: The information management interface.

Higher mathematics examination platform is the role of the candidates for system. The intermediary module, not only for the candidates called examination questions, but also accurate records of examination information. In order to achieve this effect, the platform in the interface design and functional structure not only take into account the simple and clear functional style, but also the introduction of a user-friendly design. Figure 10 is the simulation test platform interface structure. In Figure 9, there mainly displayed three parts of the test platform, that is, test time zone, test content display area and test control area. The test control area is the core part of the test platform.

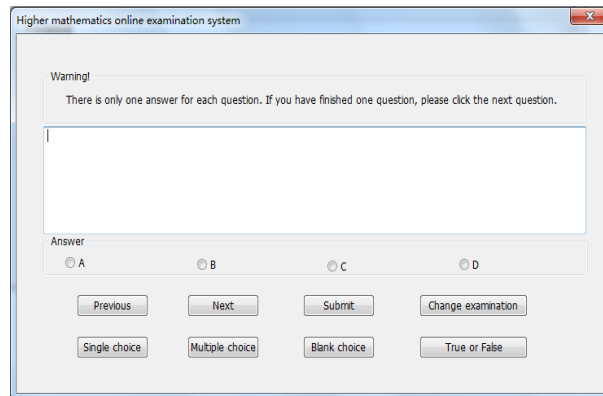


Figure 9: The simulation test platform interface structure.

5 CONCLUSIONS

In this paper, for the basic requirements of higher mathematics examinations, we developed a stable, convenient examination system. The system used B/S architecture and three-tier architecture which were user interface layer, business layer and database persistence layer. This architecture has a good security, users do not need to install the client program, it can be

convenient used just in the browser. According to the development mode of J2EE, the system adopts Microsoft SQL Server database and tomcat as the application server. In B/S mode, the online examination system is realized based on the basic idea of software engineering, this paper gives the system requirements and analysis by using case model and software structure diagram, and introduces some key problems of the solution, including test time control and automatic generation of test papers and so on. As a result of pure Java technology, the system has good portability, it can be easily ported to other operating system platforms.

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