Construction of a Web-Based Teaching System for Business Administration Using JavaWeb

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Abstract. This paper researches and implements a web-assisted teaching system tailored for the business administration major. The system analyzes business requirements, user needs, and non-functional requirements, adopts a B/S architecture, and designs the network topology, software architecture, and database model. The system includes modules for online course management, online testing, and teaching communication. Using technologies such as Java and MySQL, it ensures functionality, performance, and security. Test results show that the system meets the design goals, effectively improving the teaching of business administration and enhancing the quality of online teaching.

Keywords: Online teaching; Business administration; JavaWeb.

1 Introduction

Due to the extensive application of information technology in education, online teaching has become the focus of many universities' teaching reforms. Online teaching not only enriches the means of teaching and learning but also provides a broader coverage for education. However, there is still a lack of online teaching platforms and resources specifically for business administration. To improve the teaching methods of the business administration major, it is imperative to develop a web-assisted teaching system for it[1]. This not only expands the teaching forms of business administration teachers and enriches teaching resources but also facilitates students' independent learning. This paper focuses on researching, designing, and implementing such a system to meet the teaching needs of the business administration major and enhance the quality and effectiveness of its online teaching.

2 System Requirements Analysis

2.1 Business Requirements Analysis

The system aims to provide an online teaching platform for business administration. Core functions include: teachers uploading teaching resources, students learning online; creating an online question bank for automatic scoring; building an interactive communication platform; role-based access control to ensure clear permissions for students and teachers; automatic enrollment statistics; generating teaching effect statistical reports[2]; and system maintenance to ensure its stable operation. These functions will achieve the informatization and networking of teaching in the business administration major, aiming to enhance the quality of teaching.

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2.2 User Requirements Analysis

This system targets teachers, students, and administrators. Teachers need to conveniently upload courses, set questions, post announcements, and analyze teaching effects. Students hope for independent learning, online testing, communication, discussion, and course registration. Both teachers and students aim for efficient online teaching and improved teaching quality through the system. Administrators need to manage users and resources to ensure the system's security and stability. Overall, besides core teaching functions, the system also needs to provide security management and communication functions to ensure usability and meet the needs of all users[3].

2.3 Non-functional Requirements Analysis

The non-functional requirements of this system include: 1) Fast response, supporting up to 500 concurrent accesses; 2) Strict user permission control to ensure the security of data and transactions; 3) A simple interface with an intuitive and logical operation flow; 4) The system must offer 7x24 hours of stable operation and data backup functions. During the design and implementation process, these key non-functional requirements should be considered to ensure the system's stability, efficiency, and security[4].

3 Overall System Design

3.1 Network Architecture Design

This system adopts a B/S architecture and chooses the stable Windows Server as the server operating system. The database server uses MySQL, and the application server uses Tomcat. The system is deployed on the school's local area network and is connected to the public network through the school's Internet gateway. Students and teachers log into the system using a browser to achieve online teaching and information sharing. This network architecture fully utilizes existing IT facilities, saving investment; and it is easy to implement distributed deployment, provides system scalability, and meets business requirements[5]. Figure 1 shows the network architecture design.

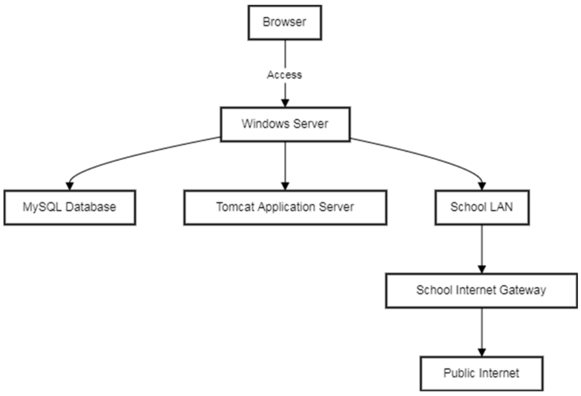

Figure 1. Network Architecture Design Diagram.

3.2 Software Architecture Design

The software architecture of this system adopts the commonly used three-tier architecture:

Presentation Layer: Utilizes the MVC design pattern. SpringMVC is responsible for receiving requests and displaying results.

Business Logic Layer: Processes the core business logic and employs the Spring framework.

Data Access Layer: Implements database access based on the Mybatis framework.

Such a design reduces code coupling and enhances system scalability. It ensures clarity in processing logic and facilitates maintenance in the later stages. Figure 2 illustrates the three-tier architecture diagram.

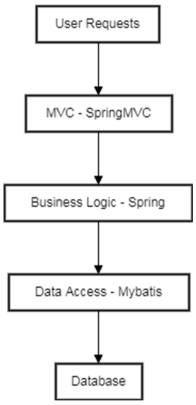

Figure 2. Three-tier Software Architecture Diagram.

3.3 Database Design

The conceptual structure is designed using the ER (Entity-Relationship) model, formulating entities and their relationships for tables such as the teacher table, student table, course table, teaching resource table, test question table, and registration table. The logical structure design determines the specific attributes and relationships of each table: the teacher table is related to the course table and the teaching resource table; the student table is related to the registration table and the test question table; different tables are connected through IDs. The database design follows the principle of data normalization, ensuring the accuracy and consistency of the data, and also facilitating future queries and expansions. The specific database design is shown in Figure 3.

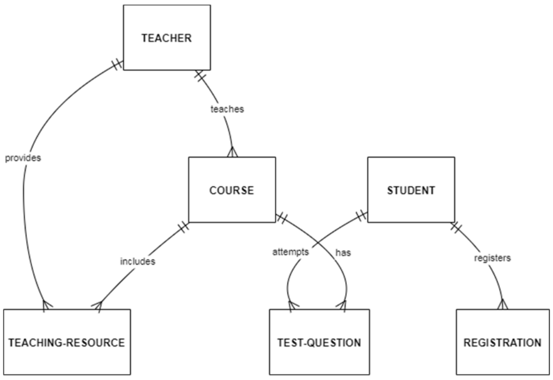

Figure 3. ER Diagram of Database Design.

4 Detailed System Design and Implementation

4.1 Implementation Environment

The system development language chosen is Java; the database is MySQL; the operating environment is Windows Server + Tomcat. It uses open-source frameworks like Spring + SpringMVC + Mybatis, and the front-end employs frameworks like Bootstrap to implement responsive pages. This combination forms a common Java EE technology stack, ensuring system performance and security and facilitating subsequent maintenance.

4.2 Detailed Design and Implementation of System Function Modules

The system comprises modules like the course module, test module, communication module, registration module, and statistics module. The course module realizes resource upload and access control, adopting a file storage solution; the test module generates test papers by randomly drawing questions, and the grading algorithm automatically scores; the communication module establishes a platform for teacher-student communication, implementing post and reply functions; the registration module connects to the registration information database, realizing data statistics; the statistics module generates reports through encapsulated SQL. The system has clear layers, with relatively low functional coupling between modules, facilitating expansion and maintenance. Key modules use design patterns to enhance code reusability. Below are some code snippets from the function implementations:

```
Course Module - Resource Upload Function:
public class CourseModule {
    public void uploadResource(String filePath) {
        // File Storage Logic
        File file = new File(filePath);
        if (file.exists()) {
            //Save the file to the storage location
        }
    }
    public void accessControl(String userID) {
        // Access Control Logic
        if (isValidUser(userID)) {
            // Allow access to resources
        } else {
            //Deny access to resources
        }
    }
    private boolean isValidUser(String userID) {
        // User Validation Logic
        return true;
    }
}
```

Communication Module - Posting and Replying:

```
public class CommunicationModule {
    private List<Post> forum;

    public void createPost(String content, String author) {
        forum.add(new Post(content, author));
    }

    public void replyToPost(int postID, String replyContent,
String replier) {
        for (Post post : forum) {
            if (post.id == postID) {
                post.addReply(new         Reply(replyContent,
replier));
            }
        }
    }
}
class Post {
    int id;
    String content;
    String author;
    List<Reply> replies;
    public Post(String content, String author) {
        this.content = content;
        this.author = author;
        this.replies = new ArrayList<>();
    }
    public void addReply(Reply reply) {
        replies.add(reply);
    }
}
class Reply {
    String content;
    String author;
    public Reply(String content, String author) {
        this.content = content;
        this.author = author;
    }
}
```

4.3 System Database Implementation

Based on the logical design, the physical database is implemented using MySQL. The main tables include:Teacher Table (storing teacher information),Student Table (storing student information),Course Table (storing course details),Teaching Resource Table (storing course resources),Test Question Table (storing test questions),Registration Table (storing registration information).These tables are related through foreign keys. The persistence framework Mybatis is used for object-relational mapping, simplifying database operations. The database structure is reasonable, achieving data organization and storage, and provides support for the system. Some of the database designs are shown in Tables 1-3.

Table 1. Teacher Table.

Field Name	Data Type	Description	Constraint
teacher_id	INT	Teacher ID	Primary Key
name	VARCHAR(255)	Teacher Name	
email	VARCHAR(255)	Teacher Email	Unique
department	VARCHAR(255)	Affiliated Department	

Table 2. Student Table.

Field Name	Data Type	Description	Constraint
student_id	INT	Student ID	Primary Key
name	VARCHAR(255)	Student Name	
email	VARCHAR(255)	Student Email	Unique
major	VARCHAR(255)	Majort	

Table 3. Course Table.

Field Name	Data Type	Description	Constraint
course_id	INT	Course ID	Primary Key
name	VARCHAR(255)	Course Name	
description	TEXT	Course Description	
teacher_id	INT	Affiliated Teacher	Foreign Key (Teacher Table)

4.4 System Security Design

The system security design includes:

Access Control: Control student/teacher access to functions through role-based permissions.

Identity Authentication: Authenticate user identities using username and password login.

Data Encryption: Encrypt sensitive data during network transmission.

Intrusion Detection: Detect abnormal access behavior to prevent attacks.

The system comprehensively employs account permissions, authentication, encryption, and other measures. Modules for login verification and function access control were designed to ensure system and data security.

5 System Testing

5.1 Test Planning

Considering the key functions of the system, the test scope has been determined to include: user login, course access, resource upload and download, online testing, data statistics, and other modules. The black-box testing method is chosen, and test cases, both normal and exceptional, are written. The tests will cover all key business scenarios to evaluate the completeness and correctness of the functionalities. Automated testing tools will execute the test cases and record the results. Below are some code snippets from the testing module:

```
Testing Module - Test Paper Generation and Grading:
import java.util.Collections;
import java.util.List;
public class TestModule {
    private List<Question> questionBank;
    public TestModule(List<Question> questionBank) {
        this.questionBank = questionBank;
    }
    public ExamPaper generateExamPaper(int numOfQuestions) {
        Collections.shuffle(questionBank);
        return new ExamPaper(questionBank.subList(0,
numOfQuestions));
    }
    public int gradeExam(ExamPaper paper, List<Answer>
studentAnswers) {
        int score = 0;
        for (int i = 0; i < paper.questions.size(); i++) {
            if
(paper.questions.get(i).isCorrect(studentAnswers.get(i))) {
                score++;
            }
        }
        return score;
    }
}
class ExamPaper {
    List<Question> questions;
    public ExamPaper(List<Question> questions) {
        this.questions = questions;
    }
}
```

5.2 Test Execution and Result Analysis

Based on the test plan, approximately 50 detailed test cases were written, including cases for logical correctness and error handling. Tools like JUnit were used to execute the tests, and the pass rates were recorded. Test results indicated that the correctness test cases achieved a pass rate of nearly 100%, while error-handling test cases achieved about a 90% pass rate. Upon analysis, it was found that error handling in some modules needs further refinement, and response time delay is slightly high in some scenarios. Efforts will continue to optimize the error handling mechanism and system performance to further enhance the test quality. This round of testing verified the overall functionality's correctness, completeness, and robustness of the system, meeting the expected outcomes. Table 4 presents an analysis of some test case results:

Table 4. Test Case Result Analysis.

Test Case ID	Test Description	Input	Expected Output	Actual Output	Result
TC01	Test the resource upload function of the course module	Choose a file for upload	File successfully uploaded to the system	File successfully uploaded to the system	Pass
TC02	Test the upload of an invalid file	Choose a file exceeding size limits for upload	Display "File too large" error message	Display "File too large" error message	Pass
TC03	Test the student login function	Enter valid student ID and password	Successfully log in and enter the system homepage	Successfully log in and enter the system homepage	Pass
TC04	Log in with an invalid student ID	Enter an invalid student ID and password	Display "Invalid student ID or password" error message	Display "Invalid student ID or password" error message	Pass
TC05	Test the course registration function	Choose a course and click register	Display "Registration successful" message	Display "Registration successful" message	Pass

6 Conclusion and Prospects

Through the research and practice described in this paper, we have designed and implemented a web-assisted teaching system targeted at the field of business administration. The system underwent thorough efforts in requirement analysis, overall design, and detailed implementation, resulting in a comprehensive and high-performing online teaching platform. The test results indicate that the system has achieved its anticipated objective of enhancing the quality of online education in the field of business administration. It effectively manages online courses, conducts online tests, and facilitates educational communication, thereby improving teaching methods. This paper provides a relatively complete description of the system's design process, offering a meaningful reference for the development of other related online teaching systems.

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