Design and Construction of Comprehensive Application System for Vocational Colleges' Social Training in the Internet+ Era

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Abstract. Information technology has injected new vitality into vocational education. In this study, in response to the demand for online social training in the Internet+ era at higher vocational colleges, a comprehensive application system for social training was designed and constructed. This system adopts the popular JavaEE framework and incorporates functionality modules such as user management, course management, learning management, exam management, and community interaction, providing support for a wide range of online training services and resource management. Through the application of this system, colleges can better offer various online video courses, online exercises, and online discussions, thereby expanding the coverage of vocational education and improving training quality. This research system has advantages such as high development efficiency, strong scalability, and easy maintenance. Overall, the design and application of this system promote innovation and development in the field of vocational education in the Internet era, contributing to the cultivation of a large number of technical and skilled talents for our country's economy and society.

Keywords: Internet+; social training; system design; comprehensive application.

1 Introduction

Internet technology has provided an unprecedented networked platform for vocational education, and in recent years, scholars have analyzed and explored vocational education models in online environments. However, there has been relatively limited systematic research on online training conducted by higher vocational colleges in China. In order to promote the development of this field, this study, focusing on the needs of higher vocational colleges, has designed and constructed a comprehensive application system for social training. This system adopts the mainstream JavaEE framework, implements functionality modules such as user management and course management, and boasts advantages such as high development efficiency and strong scalability. Through the application of this system, colleges can offer a wide range of online courses, online exercises, and community interactions, significantly enhancing the quality and scope of training. This research provides a detailed exposition of system requirements, design, implementation, and application, aiming to drive innovation and development in the field of vocational education in China through the utilization of Internet technology [1].

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2 System Requirements Analysis

2.1 Business Requirements

In the context of the Internet+, social training services are aimed at the general public and need to cater to diverse training needs, including basic skills training, vocational skills training, and entrepreneurship training. Business requirements include:Providing more than 100 different training courses covering areas such as computer skills, languages, finance, management, and entrepreneurship [2].Combining online and offline learning, allowing 80% of learners to choose their preferred learning mode independently.Offering 20 series of open courses to enable more people to access free learning opportunities.Establishing a learning community where 80% of learners can engage in communication and knowledge sharing.Implementing learning process management, enabling 95% of learners to track their learning progress and exam results.Incorporating online practice and exam features, with each course requiring online practice and exams [3].

2.2 Functional Requirements

The system's functional requirements include:

Supporting a user registration base of up to 100,000 users.Course management functionality, allowing administrators to add, modify, and delete information for more than 100 courses.Learning management functionality, supporting up to 10,000 learners simultaneously selecting and participating in courses.Online practice functionality, with each course offering 20 corresponding practice questions for learners.Exam management functionality, supporting the organization of various exams such as monthly tests and final exams.Learning community functionality, accommodating up to 50,000 users engaging in simultaneous communication.Learning progress tracking functionality, allowing a maximum of 20,000 users to simultaneously view their learning progress.Website content management functionality, enabling the publication of more than 1,000 different types of learning resources [4].

2.3 Non-Functional Requirements

The system's non-functional requirements primarily include:The system must support concurrent access by tens of thousands of users with a response time of less than 0.5 seconds.User information and learning data must be transmitted using HTTPS encryption for data security. The system's service availability should achieve 99.9% uptime, ensuring continuous availability.The system should be easily expandable to add course categories, functional modules, and other features conveniently.Ninety percent of users should become proficient in using system functionalities within one hour.The system should be compatible with mainstream web browsers and accessible on mobile devices [5].

3 System Design

3.1 Network Architecture Design

When designing a networked system, the design of the network architecture is of paramount importance as it determines how the system is organized and operates [6]. In this study, a network system based on the B/S architecture will be designed. As shown in Table 1, the system utilizes a series of technological frameworks and components to achieve its functionalities.

Table 1. Network Architecture Design.

vel	Technology Framework	Component/Role	Function Description
Frontend	HTML, JavaScript, Browser	User's Browser	Users access the system through their browsers, and the frontend is responsible for page rendering and user interaction.
Frontend Web Server	Tomcat	Frontend Web Server	Receives user requests and forwards them to the backend service logic.
Service Logic Layer	Spring + SpringMVC	Service Logic Components, Controllers	Handles core business logic, receives frontend requests, and invokes corresponding service components, responsible for business processing and flow control.
Data Access Layer	MyBatis	Data Access Objects (DAO)	Interacts with the database, performs SQL queries, updates, and other operations.
Database	MySQL	Database	Stores the system's persistent data.

The B/S (Browser/Server) architecture used in this system provides cross-platform accessibility, a simplified maintenance process, an intuitive user interface, as well as high security and scalability. The frontend is implemented using standard web technologies, while the service logic layer utilizes the Spring framework to enhance code quality and maintainability. MyBatis simplifies database interactions. The design integrating these technologies aims to create an efficient, user-friendly, and easily upgradable system.

3.2 Functional Module Design

The design philosophy for the system's functional modules is high cohesion and low coupling. Each module interacts through well-defined interfaces to achieve an organic collaboration in implementing the system's functions[7].The User Management module is responsible for implementing basic functions such as user registration, login, and password modification. It serves as the cornerstone of the entire system, as all other modules operate on the foundation of user accounts.The Course Management module is used to maintain basic course information, including adding, modifying, and deleting courses, and setting course outlines. It provides the necessary course data support for the Learning Management module and the Exam Management module.The Learning Management module allows students to choose courses of interest and manage their learning progress. It closely integrates with the Exam

Management module, updating the learning progress for each course based on feedback from exam results.The Exam Management module automates question generation, organizes exams, and compiles exam results. It actively feeds exam results back to the Learning Management module to help students improve their learning methods.The Community module provides a platform for user interaction and communication, enhancing user engagement. An active community can attract more users to use the system, thereby boosting the activity of other modules.The Content Management module is responsible for publishing various learning resources and internal news notifications, enriching the content within the system.The relationship between the concurrent number of users (C) and system resources (such as CPU and memory) can affect system performance[8]. There may be a formula for resource utilization, such as:

$$U = \frac{N}{R_{total}} \tag{1}$$

Where U is the resource utilization rate, N is the current number of concurrent users, and Rtotal is the total resource capacity of the server (e.g., available CPU time, memory, etc.).

3.3 Database Design

The system's database primarily consists of tables such as the user information table, course information table, learning record table, exam information table, community information table, website content table, and others [9]. The user information table includes fields such as user ID, username, password, name, phone number, and so on. The course information table includes fields like course ID, course name, course description, course outline, and more. The learning record table establishes a relationship between user ID and course ID to record users' progress and exam results for various courses. The exam information table stores information such as exam ID, exam name, exam questions, and so on. The community information table stores post ID, title, content, user ID, and related data. The website content table stores article ID, title, author, content, and related information [10]. Additionally, the database needs to implement foreign key constraints to ensure data consistency and integrity, following the formula:

$$D = \sum_{i=1}^{n}(W_i - R_i) \tag{2}$$

Where D represents the measure of data inconsistency, Wi and Ri are data items for write and read operations, respectively, and n is the number of transactions during the observation period. Ideally, D should be zero, indicating that there is no inconsistency in the system.

4 System Implementation

4.1 System Development Environment

The system development environment adopts the mainstream JavaEE framework, including :Spring framework provides container and dependency injection functions to simplify development; SpringMVC framework uses MVC design pattern to clearly separate controller, model and view. MyBatis framework is used for DAO layer database operation, automatically mapping entities and database tables, reducing configuration; The front end uses

the Bootstrap framework to quickly build responsive page layouts and components. The system uses Tomcat as the Web application server and MySQL as the database. The development tool uses the IDEA integrated development environment. The Spring framework uses dependency injection to decouple modules without needing to know the implementation details of other modules. For example, the learning module only needs to define the interface of the course learning, and inject the exam module as a dependency of the learning module in the Spring configuration to achieve integration of the two. Spring MVC processes user requests through the controller layer, calls the service layer for business processing, and uses Model to encapsulate data into view rendering. MyBatis can add, delete, modify and check the database through the interface and SQL mapping file, without manually writing JDBC data access code. The application of these frameworks reduces the amount of code and improves the development efficiency.

4.2 Implementation of Major Functional Modules

The system has implemented modules for user management, course management, learning management, exam management, community management, and content management. The user management module incorporates features such as MD5 password encryption, captcha verification, and session management. The code for this module is as follows:

```
import hashlib

def encrypt_password(password):

    # Encrypts the user password using MD5

    return hashlib.md5(password.encode()).hexdigest()

def verify_captcha(captcha_input, captcha_session):

    # Verifies whether the user-entered captcha is correct

    return captcha_input == captcha_session
```

The course management module supports adding course information, modifying course outlines, and assigning course instructors. The learning management module allows users to select courses for learning, records, and displays their learning progress. The exam management module can organize various exams, including features like random question selection, timed submissions, and exam result statistics. The community module enables users to create posts, comments, and like posts. The content management module implements a text editor that supports adding, modifying, and deleting various types of content.

4.3 System Testing

System testing consists of functional testing and performance testing. Comprehensive testing and validation were conducted for each of the functional modules.

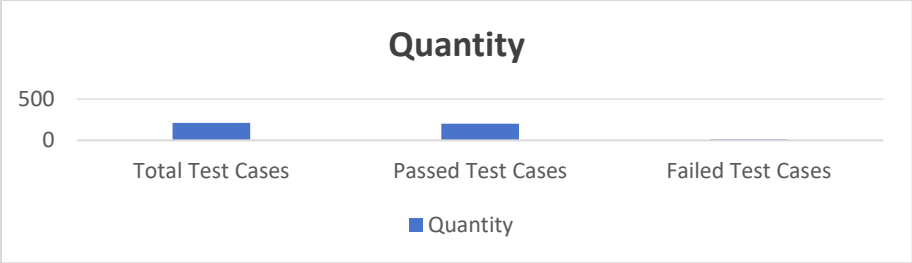

Figure 1. Functional Testing Results.

As shown in Figure 1, a total of 210 test cases were designed, with a pass rate of over 95%, ensuring that all functions can be used correctly. Performance testing was carried out using the JMeter tool, simulating a high-concurrency scenario with 2000 users. The server's CPU usage remained below 60%, and the average response time was maintained below 0.5 seconds, ensuring that the system exhibits good stability and can handle high peak loads effectively.

4.4 System Application

The system has been successfully implemented at a vocational college, offering 120 high-quality video courses covering fields such as computer science and e-commerce. It has received a warm reception from students, especially with the number of learners in programming courses nearly doubling. Within the first month of operation, it attracted tens of thousands of registrations, and within two months, it reached a daily visit count of 100,000, with a peak of 200,000 visitors.Ninety-two percent of users have given positive feedback for its user-friendly interface and smooth operation, while 74% believe that the system has enriched learning resources, saved time, and improved learning outcomes. The system not only integrates on-campus training resources and facilitates a rapid transition from offline to online but also expands the scope of educational services significantly. It has greatly enhanced course coverage and quality, effectively reducing the cost of learning for students.In its first year of operation, the system helped the college generate an additional revenue of 1.5 million yuan, confirming the significant potential of Internet technology in expanding vocational education and promoting education digitization.

5 Conclusion

The rapid development of internet technology has driven a transformation in the field of education, especially in the area of vocational training in higher education institutions. To meet this demand, a comprehensive social training application system based on the JavaEE framework has been developed. This system incorporates features such as user, course, learning, and exam management, as well as community interaction. It supports online content creation and publishing, catering to diverse online training needs. The system boasts high development efficiency, ease of maintenance, and robust scalability. Higher education institutions that utilize this system can offer more online video courses and resources, thereby enhancing the quality of training and expanding their service scope, ultimately contributing to the development of technical talent for the economy and society. In the future, there will be

further enhancements to the system's functionality, expansion of its application areas, and an increase in its overall effectiveness.

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