Design and Implementation of the Heartful Education System Platform Based on PHP

Huang Yuxin* and Rex Bringula

***Abstract*—With the rapid development of Internet technology, the education industry increasingly relies on information technology to improve teaching quality and management efficiency. This article designs and implements a heartful education system based on the PHP programming language to meet the needs of educational managers in student management, teacher management, course management, etc. Through database design and front-end code development, the system provides convenient user login, registration and personal information management functions, and achieves effective management of educational resources through operations such as adding, modifying, deleting, and querying courses. Additionally, this article describes interface design and security considerations. The front-end technology uses HTML5+CSS3+Bootstrap4.0, and the back-end technology uses ThinkPHP6 enterprise-level framework+MySQL database to ensure that the system has a good user experience and data security. After actual testing, the Heartful Education System has certain applicability and value in the education industry. It can help education management departments improve education quality and efficiency while also saving costs (avoiding the high cost of purchasing an LMS platform).**

***Index Terms*—Heartful Education System, PHP, ThinkPHP, BootStrap, HTML5, MySQL**

I. Introduction

Nowadays, with the rapid development of economic globalization, many scientific and technological innovations and educational ideas that developed in the knowledge and economy era enjoy popular support from people [1]. However, the subject of education and study has been developed with the technological development and on-campus recruitment. In comparison with the traditional education mode and methods, modern education has developed as the Internet of PC/mobile terminal and VR changed [2]. In the past 10 years when the Mobile Internet highly progressed, the online education has been gradually introduced into every aspect of our life by the Mobile Internet, big data and cloud platform, the online education platform then emerges at the digital, intelligent and networked environment which is mainly progressed by "Internet+Education" [3]. Through the sound progress of the Internet, the traditional online education platform gradually becomes an open, MOOC-pattern (Massive Open Online Courses) and live-pattern platform which is supported by multiple operation patterns while the technology regurgitate the business, urging the online education platform bring a better study experience for the users in curriculum content, study resources and big data analysis based on basic functions [4, 5].

In fact, given the rapid progress of Mobile Internet, the touchscreen-designed mobile devices are not suitable for the traditional online education platform on PC terminal. The reasons mainly include the following aspects: the lower matching of screens, the worse compatibility of documents, the tinier storage of mobile devices, the users' dissatisfaction of operations. The above reasons bring many inconvenience for the users, and then the boostrap appears and brings a perfect compatibility of PC terminal and mobile terminal. The appearance of the boostrap brings perfect compatibility of the PC terminal and mobile terminal and greatly reduces the development costs for it only requires one-time development and a life-long use [6, 7].

With the outbreak of the COVID-19 pandemic, online teaching and remote work have been adopted worldwide from December 2019 to March 2023. During this time, the online education platform and online conferences have become the primary means of communication. These platforms offer flexibility, contactless interaction, and the ability to study and work anytime and anywhere. They have become essential tools for workers and students. Based on user statistics from Tencent Conference and Tencent Classroom, over the past three years, 400 million users have utilized the platform for learning, and it is estimated that over 3 billion users have engaged in online learning or online meetings daily worldwide. Online education has become a prevailing trend and serves as a valuable supplement to traditional education [8, 9].

There are readily available Answer:Learning Management System (LMS) educational platforms on the market. Quick implementation, technical support, and scalability are some of the advantages of the off-the-shelf LMS. However, commercially available LMS can be expensive . Moreover, open-source LMS may be free but may not address the online needs of schools, and the open-source code does not carry a guarantee or warranty . Additionally, the issue of security and data privacy arises with the use of readily available LMS. One way to solve this problem is to build an in-house LMS. Toward this goal, this study was conceived. We developed an LMS called the "Heartful Education Online Learning Platform" (subsequently referred as system).

The mission of the system is to deliver every lesson with care. We aspire to have teachers ignite students' interest in learning through care and passion, encouraging them to apply what they have learned. The essence of the platform lies in meticulously ensuring the quality of the courses[10]. All courses that enter the platform must undergo a review process, and if they do not meet the criteria, they are rejected, ensuring that only the best courses make it onto the platform. The elements of "care and passion" are reflected in how teachers

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continuously pay attention to students' learning status, such as providing class reminders (using the clock-in function), answering questions related to assignments, and tracking their progress. The system records students' learning activities on the platform, including study hours, courses taken, attendance, certificates earned, etc., and provides visualized analysis reports for students to review. Given this goal, the study specifically aims to

1) Analyze the management of the online education platforms that is active in the current market, and make a demand analysis based on our own technological level.
2) Based on the actual demands of the current online education platforms who requires a thorough subdivision of the users, analyze the functional demands of the PC terminal and mobile terminal, and explain the system demands, framework and database design, etc.
3) Based on the selection of the system development technology stack, develop an online education platform that is developed by the lightweight framework ThinkPHP6 technology to fulfill all demands of our clients under a strict and standard process for enterprise software development.
4) Run the system testing of the platform based on the actual demands of the multiport users of the platform.

II. Related Technologies

Traditional LMS platforms such as Moodle, Blackboard, Canvas, and Saki have been widely used in teaching. They all offer good stability, flexibility, and openness. However, users in education and research have pointed out that LMS faces a problem: it is relatively closed and unable to quickly integrate external platform tools and services, leading to poor flexibility and an inability to achieve personalized teaching. Since their inception in 2012, MOOCs have gained significant attention and rapid development. While MOOC platforms showcase innovation in course videos, homework mechanisms, and forum interactions, they still lack behind traditional LMS teaching platforms in terms of learning management tools and system support tools, even after years of development.

Canvas, recommended by many universities in response to the epidemic, including Stanford University, Harvard University, University of Washington, Princeton University, and University of Wisconsin-Madison, is an online teaching platform/tool. It is a learning management system owned by the American company Instructure, founded in 2008. Canvas is an open-source platform with a cloud system architecture, support for multi-type tool integration, powerful data analysis, and mobile user support. Like most e-learning platforms, Canvas provides a basic set of features, including coursework, tests, and learning evaluations.

Blackboard is a widely used platform developed by the company to support millions of users in the field of online learning. It is utilized in higher education, basic education, and corporate and government training across North and South America, Europe, and Asia. The Blackboard teaching platform is divided into three parts: the teaching management platform, portal community platform, and resource management platform. The teaching management platform allows teachers to effectively manage courses, publish teaching content, assign homework, and customize evaluation programs for students.

The difference between the two learning platforms is that Canvas focuses more on learning management, while Blackboard focuses more on course management. The heartful education platform is designed to explore and overcome these limitations by combining learning management and curriculum management. For example, it aims to achieve personalized design, strengthen data analysis, and enable intelligent teaching. The platform also emphasizes education quality and service quality, promoting the deep integration of education information to become an essential channel for communication between teachers and students.

80% of the world's websites are developed in PHP. (PHP: Hypertext Preprocessor) is a scripting language executed on the server side, especially for web development and can be embedded in HTML. PHP syntax learns from C, absorbs the features of Java and Perl to develop its own special syntax, and continuously improves itself according to their strengths. PHP supports both object-oriented and process-oriented development and is very flexible in its use. PHP supports both object-oriented and process-oriented development, which makes it very flexible to use. Therefore, it is most suitable to use PHP+ThinkPHP to develop an education platform.

III. System Analysis and Design

The design and realization of an online education platform requires a huge and systematic work which on early phase is based on an extensive investigation and demonstration to get feasibility and demands analysis of the system's realization and the overall functionla structure diagram. For different users, the functional modules that is realized needs to be divided reasonably while correlative, in order to make the system capable of solving the practical problems that appear during the education process. And guided by the design philosophy of scientific system, we can build a full-featured, reasonably-designed online education platform with friendly interfaces.

A. System Feasibility Analysis

Feasibility analysis is conducted to determine whether it is worthwhile to invest sufficient resources, including manpower, materials, and finances, to solve a particular problem. In the case of the system, we analyzed its feasibility from four aspects: user groups and markets, technical feasibility, economic viability, and operational feasibility.

1) User groups and markets: The main user groups are enterprises, individuals and schools. Enterprises, individuals and schools regard education and training as an important task to improve their ability. For example, enterprises hold regular internal training. Individuals will invest a lot of spare time in online learning. Schools will also hold regular teacher training. With the extensive development of information infrastructure, online education has become an integral part of everyone's learning.

2) Technical feasibility: The system is developed using the Xampp + Bootstrap + ThinkPHP enterprise-class framework, which is a mature and robust development mode that has proven itself in the market. The platform adopts a B/S (browser/server) three-layer network structure, placing the system's functional focus on the server. This approach reduces the workload on client browsers and ensures strong openness, inheritance, and scalability. System upgrades and maintenance are facilitated by only updating the server side. B/S architectures have a significant market share, making the realization of the System technically feasible [11, 12].
3) Economic viability: Economic viability can be assessed from two perspectives. Firstly, the development cost of the system is reasonable. The development environment, server software, ThinkPHP framework, PHP language, and MySQL database software used are all open source, resulting in low development costs. Secondly, the economic benefits that arise after the system is implemented are substantial. As previously discussed, the platform brings convenience and reliability to enterprises, individuals, and schools, which have a far-reaching impact exceeding mere market-based economic benefits. Considering these aspects, the development and implementation of the platform system are economically feasible.
4) Operational feasibility: The Xampp + Bootstrap + ThinkPHP enterprise-class framework and B/S architecture employed in the system development require clients to access the web server through a browser and connect to the background database via middleware. The user-friendly interface makes operations straightforward, with developers only needing proficiency in language development and database operations. Therefore, the design and implementation of this platform are operationally feasible.

To sum up, the system has a promising market prospect. It has a large user group including enterprises, individuals and schools and its user group is stable and ever-increasing. On the technology and operation, the author has a rich experience of software development and is quite proficient in the technologies needed and development tools. Therefore, the development of the system is feasible when we take the user group, market prospect, economy cost, technology and operation into consideration.

B. Analysis of System Function Requirements

Through the above demonstration and the users overall demands analysis of the heartful education platform, we can divide the overall functional demands of the system into the following five function module: user administration module, curriculum administration module, exam administration module, clock-in administration module and certificate administration module. Each function module has subfunctions and requires specific module realization and permission setting according to different users. The overall function modules of attentive education platform is shown as the following picture.

The User Management module is responsible for managing user information, including adding user information, managing student and lecturer information, and clearing cache files. It provides functions such as user rights management with three levels (administrator, student, lecturer), allowing for adding, deleting, modifying, and viewing user information with pagination and fuzzy query capabilities. Users can be added individually or in batches, providing a convenient one-click function for adding student information. The module also displays specific student and lecturer information, including names, profile pictures, introductions, and pagination. Additionally, it includes a function to delete cached files uploaded by users in batches to free up server storage space.

The Course Management module handles all aspects of course information, including adding courses, course purchase summaries, course reviews, and trending topics. The module allows for fuzzy queries on courses, categories and instructors, as well as the ability to categorize and add sections to course information. Users can add courses by providing details such as course name, number, category, details, cover image, instructor, price, access time and tags. Course addition can be done individually or in batches using templates as reference. The module also facilitates the display of course purchase information with the ability to add, delete, modify and check purchase information to ensure easy administration. Course Comments allows students to rate and give feedback on courses, allows messages to be sent, and provides functions to add, delete, modify and paginate. Hot Topics feature facilitates business cross-promotion and displays friendly links on the page.

The Test Management module is for both students and teachers. On the student side, users can access purchased courses for testing. Upon completion of the test, the test results (which will show: pass/fail status with corresponding certificates) will be released immediately. On the instructor's side, instructors can decide whether or not to issue test papers for their online courses or online training programs. If test papers are to be issued, the system provides an Excel template file and the ability to set up test times. The instructor can enter the test questions into an Excel sheet, upload it to the system, and display the paper information on the student side for online testing.

The fourth module is Punch Card Management. It focuses on the assessment of students' attendance information. Students can clock in online, and it also provides a convenient way for teachers to check students' attendance and monitor their learning progress. Finally, the certificate management module is responsible for issuing course certificates to students who have successfully passed the exam. The certificate includes information such as certificate number, issuing organization, student name, course of study, assessment details and date. This facilitates easy access to the certificate at a later date.

C. Analysis of System Service Flowcharts

The system business process diagram illustrates the major operations performed by system users, including administrators, teachers, and student users. Each level of user has specific tasks and workflows in the system. The system administrator has the highest privileges and can access the system through the back-end operator interface (Fig. 1). After

entering the correct account and password, the administrator can successfully log in to the main interface. In the main interface, the administrator can perform various operations according to the available functional modules. Since the system follows the principle of front-end and back-end separation, only the administrator has access to the backend. The administrator is responsible for managing user data, including teacher and student profiles, video uploads and homepage content updates, as well as course-related functions such as course creation, addition, deletion, querying, commenting and purchasing summaries. With Q&A management, teachers can edit Q&A content and students can view and interact with them. Administrators have the right to view and analyze data related to punch card management and certificate management. Each tutor, business and school has a dedicated account that belongs to a secondary administrator.

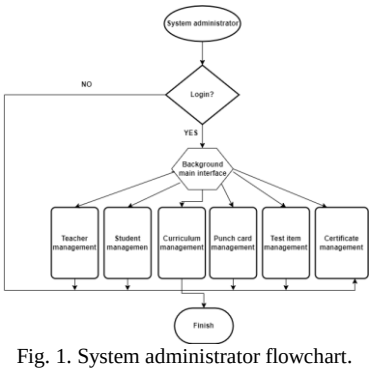

Fig. 1. System administrator flowchart.

Teacher users constitute the primary user group responsible for releasing course announcements and course resources within the system (Fig. 2). After selecting the teacher user identity in the front-end login interface of the system and entering the corresponding account and password for verification, teachers successfully log in to the main interface and perform user operations based on the settings of the functional modules. At this user level, teachers can modify personal information, edit, publish, and classify course announcements, create content directories, and upload, edit, and update course resources. They can also create test questions, upload, edit, view, and delete test bank resources, and automatically correct and display results after submission. Furthermore, teachers have privileges for course reviews, punch card management, and certificate management, allowing them to view, edit, download, and delete relevant information.

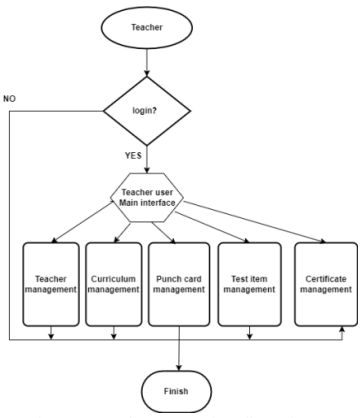

Fig. 2. Teacher's service flowchart.

Student users constitute the primary group for browsing resource information and engaging in course learning on the platform (Fig. 3). After logging into the system platform interface, selecting the corresponding role identity, and entering the matching account and password for verification, they can successfully access the main interface of the student function and perform relevant operations based on the function module. Students can maintain personal profiles, edit, publish, and classify information in public notices. The course content is categorized into paid courses and free courses, allowing students to purchase their preferred courses and engage in studying, taking examinations, and obtaining certificates. Additionally, students can provide feedback by scoring the courses and offering suggestions for improvement.

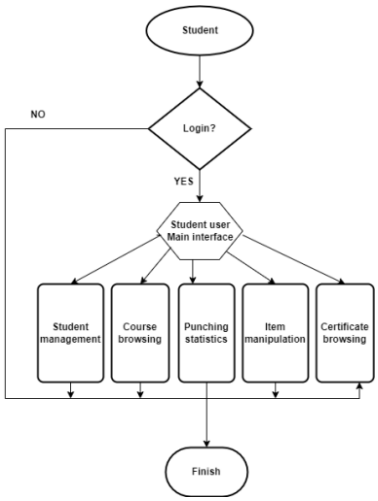

Fig. 3. Student's service flowchart.

D. System Architecture Design

The overall design of the system facilitates the developers to evaluate the cardio-parenting platform from the overall aspect of the system. The technical framework structure diagram of the system helps the developers to understand the relationship between the multiple levels of the system as well as the interaction between the application functional modules and the functional modules of other levels.

The system adopts B/S (Browser/Server) grid structure, i.e., browser and server network system design. The main application of the client side is the website browser to realize the unification of client-side development and management, while the main functions of the system are realized on the server side. On the basis of simplifying the user side, the B/S structure puts the focus on the development and maintenance of the website side, which makes the maintenance of the system more targeted. Compared with the traditional C/S (Client/Server) network model (i.e., client and server side), the B/S structure also has the advantages of separating the user-side program from the display function, running the application program on the web server, concentrating all the layers in one group, reducing the pressure on the client side, and realizing the system access by using the browser on the client side, overcoming the imbalance of the tasks of the two sides of the C/S structure and the shortcomings of the C/S structure.

Based on the B/S network structure model, the system is

subdivided into a three-layer framework structure including user application layer, program layer and database layer, and its working process is as follows: inputting query information on the user's front-end page, the program layer receives the data and searches the database, and then passes the qualified information records to the database layer, and finally, the program layer references the information records from the database, and the user layer references the data given by the application layer record and display it on the front-end page.

The B/S three-tier framework structure can also be described as three relatively independent functional units: the representation tier, the functional tier (i.e., the web server with application extensions), and the data tier (database server) (Fig. 4).

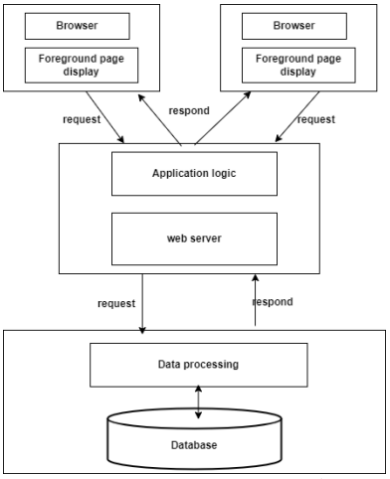

Fig. 4. The B/S three-layer architecture of the system.

E. System Modules Design

Based on the overall structure and functional requirements of the system, we have designed program flowcharts and operation flowcharts to illustrate the implementation of the system functions. These flowcharts depict the sequence of actions and operations within the platform system function modules, providing a visual representation of how the system functions are executed.

The system login module encompasses three distinct operations: system administrator login, teacher user login, and student user login. When users attempt to log in, they are prompted to enter a valid username and password. The system retrieves data from the administrator table, teacher table, and student table in the database. It then determines the role type of the user based on the entered credentials. After successful verification, the user is directed to the corresponding welcome interface associated with their specific role, granting them appropriate permissions to perform specific tasks aligned with their role.

In the course management module, teachers initiate the process by submitting a new course request to the administrator and filling out the appropriate request form. Once approved by the system administrator, the teacher can create course catalogs and perform tasks such as uploading, modifying and deleting course resources in each catalog. Course videos are mainly recorded videos rather than live videos to ensure the quality of the course.

In the teacher user's main interface, they can access all course announcements, teacher information, and the course content catalog. They have the rights to view, edit, add, and delete course content they have set up. They can also perform batch uploads and engage in course interactions such as scoring and providing suggestions.

From the main learner interface, users at this level can browse the instructor's personal information, course content descriptions, course announcements, and catalogs of specific project assignments. They can gather information about the instructor and the course. Once they start the course, they have the right to browse the course materials (no download feature is available). They can also submit assignments and quizzes for each project and task in the course. Course exams are given at the end of the course.

The test item management module consists of two components: the teacher end and the student end. Once students purchase a course, they will automatically receive homework assignments or test questions. Teachers can create questions based on their recorded courses. Test questions can be uploaded using an Excel template, which enables automatic generation of test papers. Teachers can preview, edit, and delete the test questions as needed.

In the punch card management module, teacher users can record course settings and monitor students' learning progress by punching in relevant information. On the other hand, student users can clock in based on the study time set for the course, thereby tracking and recording their personal progress.

In the certificate management module, the teacher initiates the course assessment, and students can obtain the corresponding certificate upon successfully passing the assessment. The certificate information includes the student's name, certificate picture, certificate content, certificate number, issuing unit, and issuing time. Students can view and download their certificates from the platform.

F. Database Design

For a system, one of the crucial steps is to design the database tables. Considering the requirements and analysis of the system, along with a comparative analysis of the mainstream relational databases MySQL and Oracle in the current market, we have chosen to use MySQL due to its open-source nature, lower cost, and ease of operation. This choice allows developers to design and maintain the database tables more efficiently within the system.

The E-R diagram represents the relationships between entities, describing the real-world entities, their specific attributes, and the relationships among them (Fig. 5). It serves as a graphical representation of the relational conceptual model. The E-R diagram uses shapes such as rectangles, circles, diamonds, and connection lines. The rectangle represents an entity, the circle represents the specific attributes of an entity, and the diamond represents the relationship between entities. The main types of relationships include "subordinating," "managing," and "using," among others.

Based on the demand analysis and the division of function modules in the system, we have provided the database table design results for the main function modules of the system. The learning platform consists of 12 tables, which are as

follows: user table, lecturer details table, student details table, course information table, course chapter table, course purchase table, course review table, hot topic table, test questions for students, test questions for teachers, punch card information table, and certificate management table.

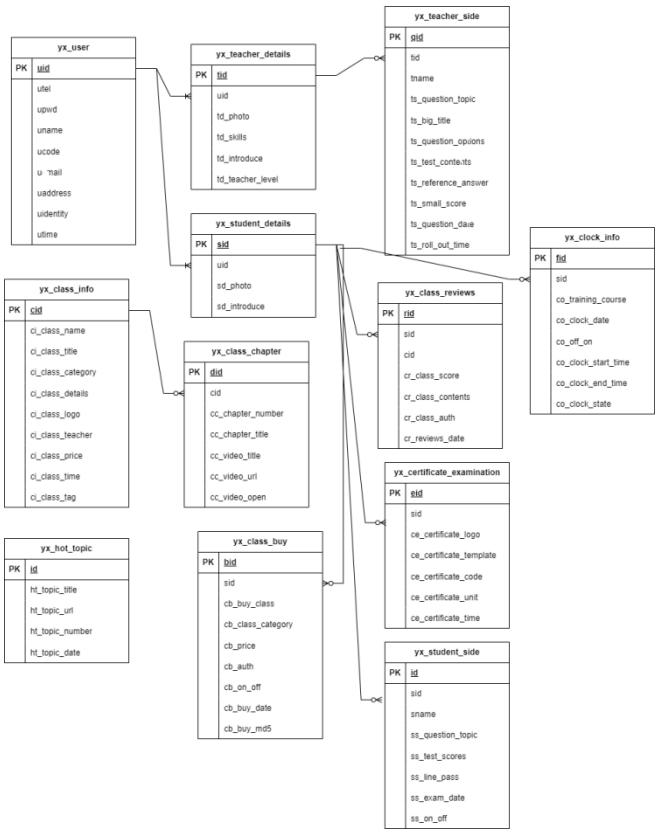

Fig. 5. Database design.

This section of the paper focuses on introducing the core technologies required for designing and implementing the system. As an enterprise-class application, the online education and learning platform utilizes the widely adopted ThinkPHP framework in the backend. In the frontend, the bootstrap plugin is employed to present data and content in a user-friendly interface and style. The system utilizes the MySQL database, suitable for small and medium-sized relational databases. To facilitate server-client interaction, the system incorporates the common REST API interface and employs the JSON standard data format. For deployment, the Apache+Linux distributed scheme is used to run the system on a cloud server (local operation involves Xampp integrated server deployment).

IV. System Implementation

From the functional demands and frame design of the heartful education platform we can get a brief introduction that the platform mainly includes five parts which are user administration, curriculum administration, exam administration, clocking-in administration and certificate administration. The following is a thorough description of the five parts.

The user management module is primarily responsible for managing three user permissions: administrator, lecturer, and student settings. Upon entering the login interface and providing the account and password, users with different permissions will be directed to different main interfaces with varying function permissions. The following screenshots illustrate this process.

The administrator holds the highest authority among the three user types and currently only supports back-end login. Through the back-end management, the administrator can update the front-end interface and assign secondary administrators to teachers for easier management. The main interface of the administrator primarily includes user management, course management, test question management, punch card management, and certificate management, encompassing a significant amount of information.

The login interface is the same for teachers and students, and the authentication process goes to different interfaces with different functions according to the selected role permissions (Fig. 6 and Fig. 7).

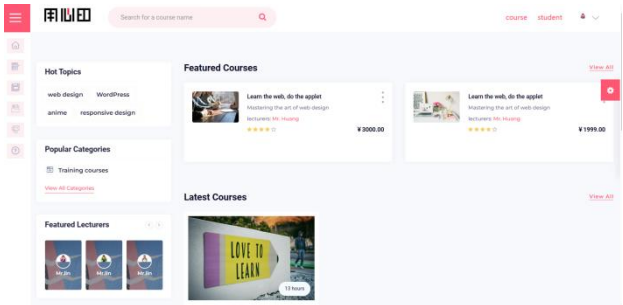

Fig. 6. Student main interface.

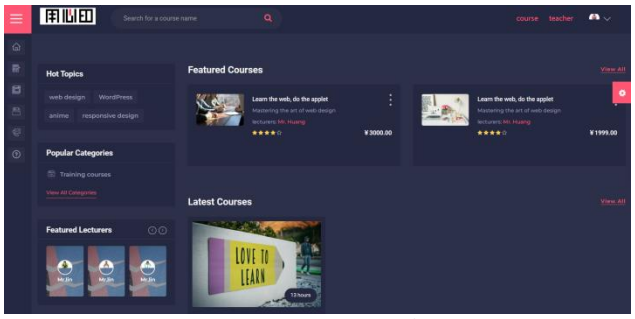

Fig. 7. Teacher main interface.

The course management module is primarily focused on implementing various functions related to course management, such as course information preview, course addition, course comments, course purchase summary, course playback, and more (Fig. 8).

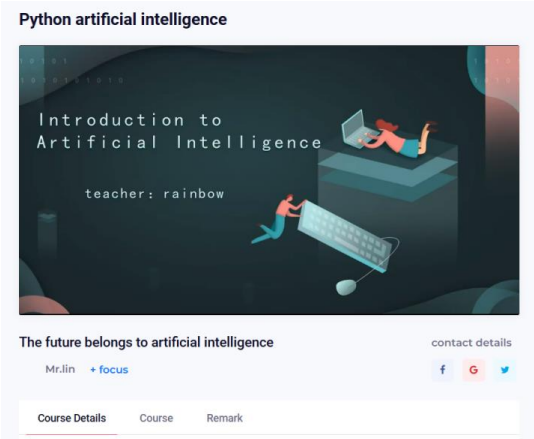

Fig. 8. Course details and playback.

The test question management module is mainly divided into two parts: the student side and the teacher side. On the student side, users can preview and participate in the test; on the teacher side, users can edit test questions, all test questions will be automatically corrected, and test results will be generated (Fig. 9).

Fig. 9. Test paper interface.

V. System Testing and Results

The major work of the system test is done during the development process or after the debugging and development of the system. The aim of the system test is to measure the smooth level of the system's operation and whether the software is qualified for putting into service by automation or manual testing. For the purpose of the functional test and performance test of the attentive education platform, the tests will be done in a black box and while box method.

The server is used for the local system software deployment which is set for testing the interaction function module with the PC terminal. The database server is used for running the MySQL adopted to support the system, which is mainly for the authentication of the function modules of the PC terminal's main website and the back end's administration website, and it is available to test on the mobile phone by sending the address to the mobile phone.

After conducting detailed testing of each function point in the functional modules of both ends of the system, by enumerating specific test cases and analyzing the test results, the software system did not exhibit any serious fatal defects. Both ends of the platform function normally, allowing for proper communication between the client and the server, without any deployment faults.

Overall, based on the result data from the system tests, all the sub-functional modules of the current system have successfully met the basic requirements outlined in the requirement analysis. Furthermore, they can fulfill the business function requirements for users learning courses on PC and mobile terminals, as well as administrators managing courses. However, during the testing process, several issues were identified. First, the system currently lacks permission design, which resulted in the absence of illegal input interception. The second issue is that the Aliyun virtual machine server utilized by the system may experience occasional picture storage loss, leading to instability. Lastly, some frequent operations on mobile terminals may experience delay in synchronizing learning record results. These issues should be addressed and resolved to further enhance the system's performance and user experience.

VI. Conclusion

This article first introduces the significance of the research on the Heartful Education Platform, and puts forward the advantages of the Heartful Education Platform in PC and mobile business deployment under the background of the mobile Internet era. Users can obtain better learning services, so that more users can improve their professional knowledge, professional skills and comprehensive quality through online education, so that they can win in the fast-paced society. At the same time, operators will also gain a lot of profits through paid online education courses, and these profits will allow operators to invest more manpower and material resources to improve the course resources of online education platforms, thereby forming a better online education ecosystem.

Secondly, the main development techniques used in the system development process are introduced. The system is developed using enterprise-level technology, using the latest lightweight framework ThinkPHP, relational database MySQL for data storage, and Bootstrap for responsive layout.

To sum up, according to the development process of the education platform and the purpose, significance and background of the software development project process, this paper introduces in detail the focus on the education platform in accordance with the definition of software engineering, software requirements and design, and system implementation and testing. design and implementation process. The heartful education platform basically meets the needs of the market, saves the cost of purchasing the LMS platform, and realizes independent research and development (it can independently develop functions according to the needs of users).

VII. Outlook

From the current version 1.0 of the system, the learning website on the PC side and the mobile side has basically met the learning requirements of users, and the background administrator can manage and maintain the course information and website data. On the PC side and the mobile side, users can log in. Learn and comment on the corresponding courses, and teachers can also answer questions about the courses. During the internal use period, it can basically meet the needs of most users. However, this system is ultimately developed on a commercial profit software system platform. At the same time, the system is independently developed by myself. It is inevitable that the codes will be written in different ways, which is not conducive to others' modification. Therefore, there are still many places in the system that need to be further improved and optimized, and the system should be further upgraded according to user feedback and changes in actual operational requirements during commercial operations.

1) The friendless of different user groups' client side

websites' interfaces need to be improved for it is not designed by professional art designers.

2) The system is deployed on both local and Ali cloud virtual server so there is inevitable differences on both terminals.
3) In the clocking-in and certificate administration modules, parts of the functions have not completed yet.
4) The system has limited data analysis content for back-end administrators, and at the same time does not set functions such as role management permissions. Therefore, in the later system function upgrades, role management permission functions need to be added to allow teacher users to have more functional permissions. , providing overall system performance.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Huang Yuxin performed the code implementation; Rex Bringula performed the testing; and Huang Yuxin and Rex Bringula co-authored the paper. All authors had approved the final version.

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