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THE CONSTRUCTION AND DESIGN OF E-LEARNING PLATFORM FOR DATABASE COURSE

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ABSTRACT

With the rapid development of computer technology and the improvement of performance of mobile devices, e-learning based on the Internet and smart mobile devices becomes an important direction of educational development. This paper proposed the system design idea, general framework and functions realization of e-learning platform for database course. The platform broke through the traditional teaching mode, limited by time, place, laboratory equipment and teacher conditions, and allow students to independent learning, independent experiments and automatic experimental evaluation. The e-learning platform will help improve the teaching quality of database course, and ultimately achieve the purpose of mobile learning.

Keywords: *Database Course, E-learning, Remote Self-Experiment, Automatic Revaluation, Mobile Learning, SOA*

1. INTRODUCTION

With the enlargement of college enrollment, college education in China has been converted from the traditional elite education to mass education. But now many colleges and universities still adhere to traditional research training education model [1]. E-learning is seen as a future application worldwide as it promotes life-long learning by enabling learners to learn anytime, anywhere and at the learner's pace. E-learning classrooms have no meaning of traditional classrooms instead of various networked-computer platforms. All the activities are transacted by the universal network, usually the Internet. E-learning has become one of most important means for the future education, especially for universities. E-learning has become one of most concerned paths for people to acquire their expected knowledge. More and more universities have been invested a huge amount of resources to implement their e-learning platform or environment. It is very important to design an efficient e-learning platform for teaching, learning, research, and administration.

Mobile technology has the potential to expand and enhance interaction in the classroom, enable more real-world field (outdoor) activities, improve learning environments and engage students in new and exciting ways. Mobile e-learning is an exciting new trend in learning technologies that has resulted from advances in ubiquitous and mobile computing. Recent advances in mobile and ubiquitous computing and wireless communications and networking have paved the way for a new learning paradigm called mobile learning (or m-learning). Mobile learning is e-learning delivered through mobile computing devices, which represents the next stage of computer-aided, multi-media based learning. Therefore, mobile learning is transforming the way of traditional education.

Database technology is one of the most widely used technologies in computer science and technology. It is widely used in computer-aided design, artificial intelligence, e-commerce, administration and science and has become an important basis. Therefore, the database is an important course for computer science and other related professional major programs in universities.

Therefore, based on our teaching and implementation experience and previous work [2], we build the e-learning (m-learning) platform for database course. It breaks through the traditional teaching mode limited by the time, place, laboratory equipment and teaching conditions. Since the platform can not only let student autonomous learning, but also realize independent experiment and automatic appraisal, it can improve teaching quality of database course.

This paper is organized as follows. Section 2 presents the related works. The design ideas of

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platform are described in section 3. The system design is introduced in section4. The system implementation and results are discussed in section 5. Finally, conclusion is drawn in section 6.

2. RELATED WORK

Yu-Feng Tsai et al. [3] established an e-learning system with a robot arm and integrated many open source software such as Moodle, DDD and MSPGCC, utilized it as a remote learning platform for C programming language allowing students not only to exercise C programs, but also to control the robot arm and see how it works. The paper [4] proposed a software reconfigurable e-learning platform for power electronics courses, which consists of a reconfigurable power electronics test-bed, a Web-based distance laboratory, and a user interactive e-learning platform. Chung C. Chang and Kou-Chan Hsiao [5] used web service components developed with Microsoft .NET and XML technologies to construct a teaching platform with standard specifications, allowing system developers to rapidly construct an e-learning system based on SOA and web services. The research in literature [6] was to study the Hakka teachers' using of e-learning flat-top with distance education at Miaoli in Taiwan.

The paper [7] explored the extension of e-learning into wireless/handheld (W/H) computing devices with the help of a mobile learning (m-learning) framework, and provided the requirements to develop m-learning applications that can be used to complement classroom or distance learning. To provide device-independence mobile learning services, a context-aware mobile learning approach was proposed in literature [8].

There are some achievements of research on e-learning platform for database course. The paper [9] presented a Web-based educational system, ADVICE, that helps students to bridge the gap between database management system (DBMS) theory and practice. The proposed system allows easy exercise management and continual progress monitoring. Wenjuan Wang [10] introduced a distance experimental system in database course based on JSP, Office Visio and SQL server technologies, solving the problem of how to assign role and authority in real distance experiments of the SQL Server database.

3. DESIGN IDEAS OF PLATFORM

At present, there are two courses in database teaching schedule. One is the principle of database system and its application, which involves basic concepts, theory, principle, basic design technology, design method and design process. It had been formed starting from database concepts, data model, schema architecture, system composition, relation operation, normalization theory, database protection, SQL, ER model, model transformation from ER model to relational model, normalized design method, design of storage mode and physical structure etc. The experimental teaching content is mainly that asking students using SQL statements to complete various kinds of basic database operations like insert, delete, update, select and so on. Another is database course design, which is a comprehensive and designing experimental content on the basis of basic experiment. Students are required to collect related material according to the needs of database system related to a real life closely, write all kinds of database documents, finish the design of database using visual tools, such as Powerdesigner and ERWin, and then use programming language to realize a relatively complete database system. The aim of the two courses is to enable students to apply their learned knowledge to use, maintain, analyze, and design and develop database applications on the base of understanding basic concepts, theory and method.

Because database system course is a very practical course, it needs a lot of computer practice to deepen the understanding and mastering of database theory knowledge. There are two kinds of ways of how to organize the experimental teaching process. One is to let students independently finish their experiments in completely free status. Another is that students finish their experiments under the full guidance of instructor. Existing problem of the first kind of circumstance is that students are often hard to finish the experiments because lack of teacher's guidance, and teachers also unable to monitor the students' progress effectively. The second way is mainly influenced by laboratory space and time. At present only 8 to 12 hours of experiment within 60 hours of teaching plan is not enough for training students' practical ability. Although students can install database system software in their own computer to accomplish some simple experiment, it is often not effective because lack of teachers' guidance and personal autonomy. Hence it is very necessary to build an autonomous experiment platform to help students complete basic courses experiment of database.

There are two traditional ways to check experiment including checking student's

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experimental report, and teacher is on-site inspection in the laboratory. If the first way is used, teachers will find many identical experimental reports. Therefore the evaluation based on the experimental report is unfair. The second method is mainly dependent on manual inspection of teacher for each student. The teachers' workload is large and it is not efficient. Our purpose of automatic evaluation platform for database experiment is to reduce the workload of teacher evaluation, improve teaching efficiency and realize fair and objective evaluation of the students ' experiment.

With the enhancing of performance and universal of smart mobile device, it is necessary for the database course to provide a mobile learning platform transplanted from e-learning platform based on Web.

4. SYSTEM DESIGN

4.1. Platform Architecture

The architecture, presented in Figure 1, integrates the ideas from mobile learning and e-learning into application requirements. There are several good reasons for choosing a Web architecture based on SOA for our platform. First, the Web is accessible almost from anywhere via an arbitrary browser. Second, the platform is easy to use and uses a simple interface to support different types of devices with different capabilities, like the display size. Third, the advantages of using a SOA are:

- Modularity: as the services are dynamically coupled at runtime.
- Interoperability: due to standardization of the service interfaces.
- Extensibility: due to the relative ease with which new services can be incorporated.

4.2. Functional Framework

Based on the above mentioned design ideas, the whole e-learning platform for database course consists of four modules: 1) the basic teaching management platform. 2) database independent experimental platform. 3) automatic experimental evaluation platform. 4) mobile learning platform. Beside, each module includes numbers of modules which compost of an organic whole basing on its functions. Its top-down and hierarchical structure is shown as in Figure 2.

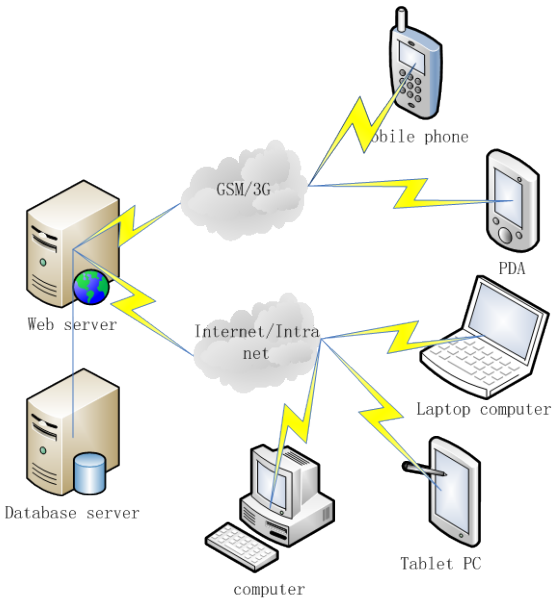

Figure 1: Platform Architecture

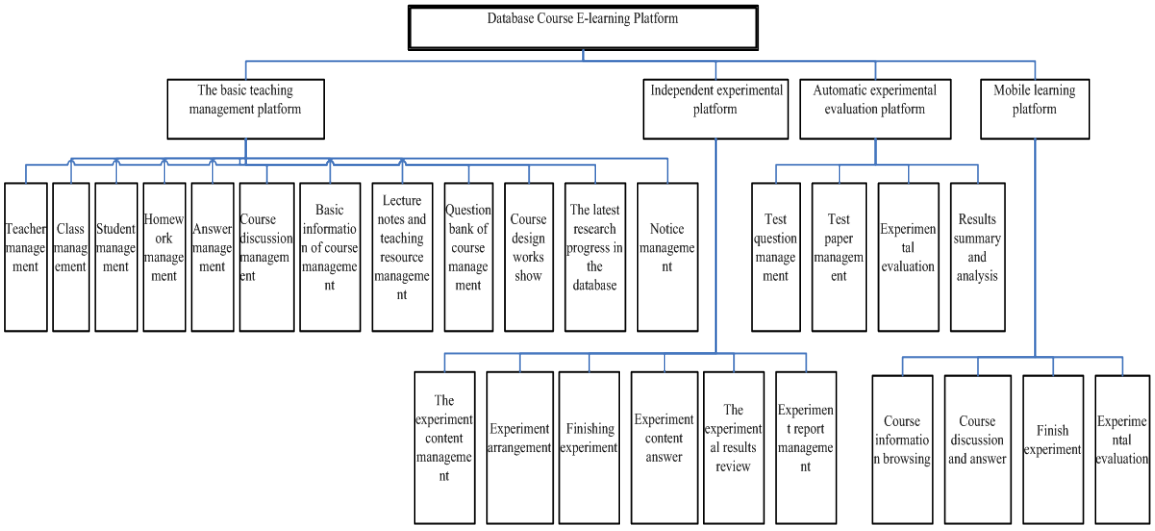

Figure 2: Functional Framework

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4.3. Basic Teaching Management Platform

The basic teaching management platform is mainly designed for course information display, communication each other and basic parameter configuration of system, which mainly includes: 1) teacher management. 2) class and student management. 3) homework management including homework assignments and submits. 4) question and answer management. 5) course discussion between teacher and student through BBS way. Student and teacher can exchange their ideas and experiences on the message board. 6) introduction of course basic information and course syllabus. 7) teacher's lecture PPT and teaching resource management. 8) test paper house ware management. 9) show about some good database course design. 10) all kinds of notices and experimental information announcement. 11) the latest research progress of database technology. 12) parameter configuration. 13) system data backup. 14) related links.

4.4. Independent Experimental Platform

Mastering standard operation language SQL of relational database is the most basic and most important content for learning database. After doing SQL experiments, students can master the grammar and function of data definition, data control and data manipulation. These experiments include: 1) the operation of database and table. The operations about database include creation, addition, separation etc. The operations about table include create, modify, insert data etc. 2) the query of table include conditions query, sub-query, sort query, group query, aggregate functions query. 3) the creation of view and store procedure. For these above experiments, we design remote independent experiment platform based on Web. The basic process is described as follows:

1) Teachers add the experiments. Each teacher add experiments for his teaching class according to the teaching plan after landing system, including experimental requirements, specific content, correct answer and common error analysis etc. Each teacher can browser other experiments submitted by other teachers in the same teaching group.

2) Students finish the experiments. Students do not need to install SQL Server database software on his own computer. After landing system through web browser, they can see experimental requirement published by teacher. Students submit the SQL statement using query analyzer based on Web, called WebSQL similar to query analyzer of SQL Server. System will return the corresponding results (right result or error information) to student after receiving the SQL statement and carrying out database operations. Students can also browser experimental result analysis and common mistakes analysis done by teacher during the experimental process. At the same time, students can also ask some question about experiment to teacher. Finally, student submits his total SQL statements as last experimental result.

3) Teachers monitor experimental process. The system records students landing system time, leaving system time and what experiments have been done. Thus teachers can timely grasp and inspect students' experimental achievement, answer students' questions and make experiment guidance.

4.5. Automatic Experimental Evaluation Platform

Because there are often many correct and different efficiency SQL statements for one SQL query request in database system, automatic experimental evaluation platform is designed based on the result of SQL statement. As long as the results of student's SQL statement are consistent with the expected results, no matter how SQL execution efficiency is, we think that students have mastered the points of basic knowledge. The process is described as follows:

1) Test questions management of experiments. Teachers submit test questions of experiment including title, content, its knowledge, category, complexity, score and correct SQL statements etc.

2) Grouping test paper. Before the experimental evaluation, teachers need to group a test paper for his teaching class according to the teaching requirements after landing system. After selecting some experimental test items from test question storehouse and modifying appropriate score, a test paper is finished for experimental evaluation.

3) Doing experimental evaluation. After logining system, Students submit the SQL statement of test paper using query analyzer (WebSQL) of platform. After receiving the SQL statement, platform carry out database operations, and compare its results with correct SQL statements. If two result dataset are the same (mainly from row and column), we argue that the SQL statement submitted by students is correct. When all tests are finished, the students can get his score at once. The process is illustrated in figure 3.

4) Summarizing the score. The system records start time, end time, and final score distribution.

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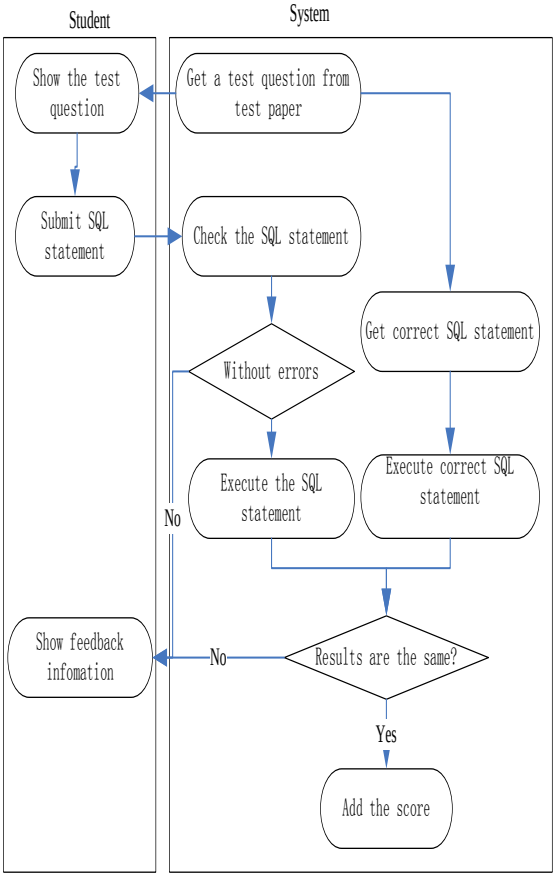

Figure 3: Process of Experimental Evaluation

4.6. Mobile Learning Platform

Mobile learning platform transplanted from e-learning platform based on Web include: 1) Course information browsing, which mainly realizes the browsing of course information, notice, and experiment content. 2) Course discussion and answer questions based on intelligent mobile devices. 3) Doing experiments using intelligent mobile devices. 4) Experimental evaluation.

5. SYSTEM IMPLEMENTATION AND RESULTS

System is designed and coded using multilayer architecture technology based on C#.net Nhibernate technology [11], as shown in figure 4.

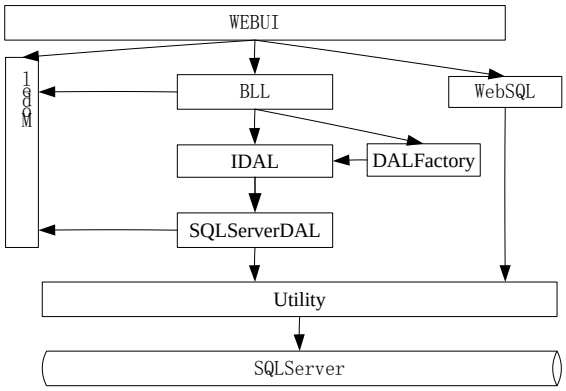

Figure 4: Multilayer Architecture Based on C#.net Nhibernate

Multilayer architecture can be divided into eight modules: 1) WebUI-page presentation layer. 2) BLL-business logic layer. 3) IDAL-data interface definition layer. 4) SQLServerDAL- data access layer. 5) DALFactory-the abstract factory of data layer. 6) Model- entity object layer; 7) Utility-public methods of data operate layer and data access. 8) WebSQL- data query layer.

(1) WebUI are the pages used to interact with users, accept the data submitted by user, construct object class of Model, call the methods of BLL, and then returns the results to user.

(2) BLL does business logic processing. BLL transmits data from DAL to WebUI page if the data is effective. Data from WebUI page also need to be validated before transmitting to DAL to prevent directly transmitting invalid and wrong value into DAL. BLL does not directly interact with data layer, but access database through IDAL interface and DAL.

(3) IDAL defines the methods interface that need to realize in DAL, such as insert, delete, update, select operation of entity object. The purpose of this layer is that there is a rigid convention for the method of DAL, prohibiting arbitrarily code the method of DAL. Each business entity is corresponding to one IDAL interface class. Methods defined in IDAL are inherited by SQLServerDAL.

(4) SQLServerDAL realizes the methods of IDAL, such as insert, delete, update, select etc, and calls the public method of NHibernate in Utility layer for accessing SQLServer database.

(5) DALFactory only does one thing that is to decide returning which specific DAL from BLL according to the parameters of configuration file.

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(6) Model includes entity classes and its mapping files (.hbm) of NHibernate. Basically, one database table is corresponding to an entity class and a mapping file. We design 23 entity tables including teacher table, class table, student table, experiment table, experiment arrangement table, test question table, test paper table, student papers table etc.

(7) Utility encapsulates the underlying operations of NHibernate, creating session factories and calling save, update methods of session.

(8) WebSQL is a data query layer. WebSQL realize database access by constructing SQL statements directly. Although HQL language of Nhibernate can realize data query, grammar rules of HQL are still different from standard SQL, and object list but dataset are return after processing by Nhibernate. At the same time, we also often need to implement multi-table query, and only need some particular columns but all columns in query results. With all factors considered, we directly use WebSQL to realize independent experiment and automatic evaluation of experiment, and use Nhibernate to realize insert, delete, update, select methods of other parts of platform.

During the database structure realization, in order to prevent from destroying the entire platform when students do some operations, such as database delete and modify etc, a master database is established to store entire necessary database table of platform itself and a personal database is built for each student, created when building student information and deleted when deleting student information. All database operations of each student are done on his personal database.

6. CONCLUSION

Experiments are an important part of teaching activities. In order to mobilize students' learning initiative and active participation, improve the experimental teaching, and reduce the evaluation workload of the experiment, this paper presents a remote e-learning and mobile learning platform to assist in teaching of database course. The platform makes students study at anytime and anywhere and makes teachers monitor experiment activities outside the classroom. At the same time, the platform can also provides automatic experimental evaluation. As an important supplement to traditional teaching, the platform will play an important role in promoting the database course teaching. In addition, the platform is still at the research stage of an experimental prototype. Many learning functions are under tests online only between a few laboratory computers. In the future, we will expand the scale of the learning platform, and aim at the research related to network traffic reduction of the whole system.

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