Student Centered Knowledge Level Analysis for eLearning for SQL

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Abstract. There are many different designs for eLearning on the Internet. The static webpage design can only provide fixed learning materials. The dynamic webpage design can change the page data depending on the students' input. The intelligent webpage design records students 'learning results for their knowledge level analysis and provides sequence and format to test the students for practicing and training accordingly. A student centered model enables the system to provide customized course contents and study guidance to individual student. The web-based application helps students of all levels with different educational background to achieve their learning goals effectively. This paper provides an eLearning system with intelligent dynamic web pages customized to each student's effective learning style in SQL (Structural Query Language) as a practical relational database language in the syllabus of an undergraduate Database Systems course.

1 Introduction

The eLearning mode has an increasing impact on learning and teaching in recent years, and it is clear that the role of eLearning in all walks of education will continue to grow[1]. The Internet is a worldwide collection of computer networks, cooperating with each other to exchange data using a common software standard[2]. Putting information on the Web is quite inexpensive compared with traditional publishing of putting information before a potential audience of millions[3]. Internet-based eLearning system has become part of the mainstream education. It supplements the traditional way of paper-based education. The architecture of the student centered model is divided into three levels: beginner, advance and expert learners. The system applies graduated questions to analyze students and to identify the student's knowledge level to provide suitable learning course contents for them. The system presents video and audio learning material for the students who adopt to eLearning.

SQL allows users to pose complex questions of a database. It provides a means of creating databases[4]. The SQL standard has been developed by workgroup[5] WG3 of TC97/SC21 of the ISO. The SQL itself is a non-procedural language which can be easily issued by an end user without a procedure to implement the command. A relational database stores data in tables (relations), whereas a database is a collection of

tables. A table consists of records and each record has a fixed number of "fields" of a given data type.

The main objective is to build a resource that helps students who will use a relational database by SQL to find the resources and learning materials that they are looking for. Figure 1 is the architecture of the eLearning system which is student centered with intelligence web pages design to record students' learning ability and behaviors. The ODBC (Open Database Connectivity) interface allows applications to access data by use of SQL. It requests a connection with a data source, sends SQL to data source, and reports users back to a user. The application consists of a variety of features external to ODBC interface, including email, spreadsheet capabilities, online transaction processing and report generation. This webpage has membership system to keep the records of the students learning result[6].

How does one make the eLearning with good quality? The important criteria for evaluating quality in eLearning are in order of priority:

- It functions technically without problems across all users
- It has clearly explicit pedagogical design principles appropriate to students type, needs and context
- It has a high level of interactivity

For each of these criteria, only a minority of respondents of a survey on eLearning system response in their experience that the quality had been "excellent" or "very good"[7].
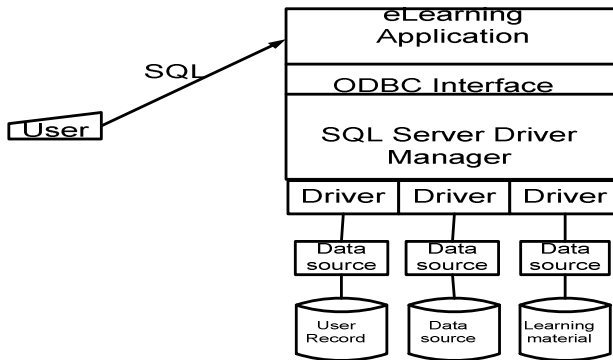

Fig. 1. Architecture of Student center intelligent eLearning system for SQL

2   Related Work

ChL.com[8]provides the Internet based eLearning tool for students study the SQL language. The system comes with text presentation and graphical interface which is a simple graphical tool for controlling the pages. FluffyCat.com[9] provides the Internet based eLearning tool for students to look for SQL language reference and examples. SQLzoo.net[10] provides the web based learning tool for students to study the SQL language. It gives live SQL worksheet for students to practice SQL commands in

different platforms. Course2.com[11] provides the Internet based eLearning tool for students to study the SQL language. The graphic interface and pages linkage functions facilitate the students searching for SQL statements. wbi.cityu.edu.hk/webct[12] provides Internet based eLearning tool for students to download the learning materials and makes online quiz. Oracle 9i: SQL [13] provides the learning question and formal answer for students to practice the Oracle 9i SQL examination.

When compared with others, our eLearning system includes text, video and audio presentation, example demonstration, live database practice, test and quiz material, different level learning, Feedback to staff, subject partitioning, bookmarks, reports, student membership registration and frequent answer question. The webpage is intelligent to meet students' need.

3   Intelligent Web Pages Design for eLearning of SQL

The eLearning system in this project can be divided into four modules including Knowledge Level Analysis module, Beginner Learning module, Advance Learning module and Expert Learning module. The system will analyze the knowledge level of the students according to their academic qualification and professional experience, and then divide them into three knowledge levels of Beginner Learner, Advance Learner and Expert Learner. For beginners, the student does not have any post secondary school qualifications nor any professional experience. For advance learner, the student has either university qualification or professional experience. For expert learner, the student has both university qualification and professional experience. The functional specifications of the eLearning system can be shown in Figure 2.
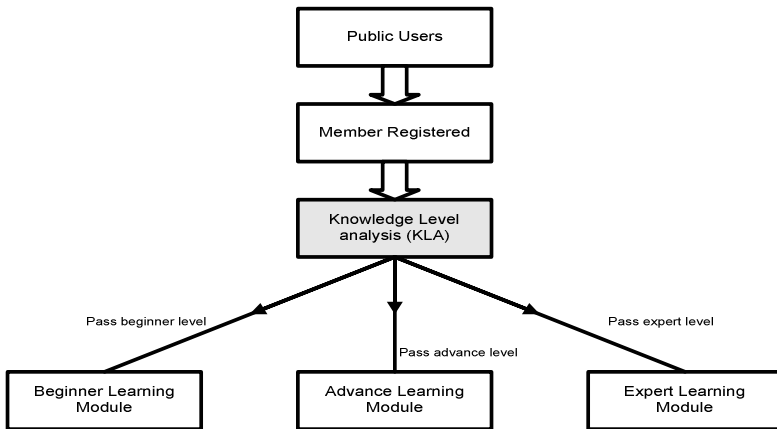

Fig. 2. New members registration for eLearning

Knowledge Level Analysis Module. An aptitude analysis test is given to the students for testing their knowledge level in using SQL. The test includes three levels of questions, Beginner, Advance and Expert. Each Question Module has randomly loaded the question from three question pools.

The system requests the students to answer the entire question in the test which takes about 30 questions. All tests are multiple choices

- Beginner Question Module (Total: 10 questions).The question pools are covered
  - SQL Standard / History basic concept (3 – 4 questions)
  - Data Manipulation Language (DML) Level 1 (3 – 4 questions)
  - Data Definition Language (DDL) Level 1 (3 – 4 questions)
- Advance Question Module (Total: 10 questions). The question pools are covered
  - SQL Common Element basic concept (3 – 4 questions)
  - Data Manipulation Language (DML) Level 2 (3 – 4 questions)
  - Data Definition Language (DDL) Level 2 (3 – 4 questions)
- Expert Question Module (Total: 10 questions). The question pools are covered
  - SQL Module Language basic concept (3 – 4 questions)
  - Data Manipulation Language (DML) Level 3 (3 – 4 questions)
  - Data Definition Language (DDL) Level 3 (3 – 4 questions)

The student needs to pass the minimum requirement in score of KLA test:

- In Beginner level module, the student's correct rate score must be greater than 80%
- In Advance level module, the student's correct rate score must be greater than 70%
- In Expert level module, the student's correct rate score must be greater than 60%

If the student fulfills the Beginner Level minimum requirement, the student will be assigned the Advance level learning module. The registered student must have answered all questions in Knowledge Level Analysis(KLA) system. The system will display total number of points in this test and assign the level of learning module to the student.

Beginner Level Module. The student learns to understand the basic concept of SQL statement and how to apply the statement into the database. The materials include the followings:

- The structure of the database
- The basic concept of SQL and database schema
- The contents of the tables
- The data type, literal, name and predicate in Table
- Query expression
- Table Expression
- Value Expression
- The definition of DDL, DML and Module statement
- The definition of independent DML statements
- How to use the "SELECT" statement in Database
- How to use the "SELECT FROM" statement in Database
- How to use the "SELECT BETWEEN" statement in Database
- How to use the "SELECT GROUP BY" statement in Database
- How to use the "SELECT IN/NOT IN" statement in Database
- How to use the "SELECT JOINS" statement in Database

- How to use the "SELECT LIKE" statement in Database
- How to use the "SELECT ORDER BY" statement in Database

Advance Learner Module. The students learn how to use the "Create" command to create table and other advance feature in SQL, and also the special statement to make the mathematic calculation. The materials include the following:

- How to use the "CREATE SCHEMA" statement
- How to use the "CREATE TABLE" statement
- How to use the "CREATE VIEW" statement
- How to use the "DECLARE" statement
- How to use the "OPEN" statement
- How to use the "FETCH" statement
- How to use the "CLOSE" statement
- How to use the "INSERT" statement
- How to use the "UPDATE" statement
- How to use the "DELETE" statement
- How to use the function statement in Database
- How to use the "AVG( )" statement in Database
- How to use the "COUNT( )" statement in Database
- How to use the "MAX( )" statement in Database
- How to use the "MIN( )" statement in Database
- How to use the "SUM( )" statement in Database

Expert Level Module. The student learns all the features and special functions in SQL. The materials include the followings:

- How to use the "GRANT" statement
- How to use the "DELETE" statement
- How to use the "UPDATE" statement
- How to use the "COMMIT" statement
- How to use the "ROLLBACK" statement
- How to use the "MODULE" statement
- How to use the "PROCEDURE" statement

4   Prototype of the Application Oriented eLearning System

The system in this project is implemented with a three tier client-server architecture. The client has the presentation interfaces that are implemented as HTML page on the student's computer side, which is embedded with the java script and run in the Internet Explorer web browser. The ASP application programs for performing the screen layer is for the users to login the system. The student model can update and adaptation resides in the middle layer server. The server-side application components communicate directly with the backend database storing information of learning materials and student model.

- **Client Tier (Student Side – Entity Class).** The client tier is a web browser running in the student computer. The browser functions as the user interface of the tutoring module and are responsible for handling adaptive presentation of course materials and providing adaptive navigation support. The user interface in ASP application program generates the HTML frame that is divided into three parts. The main page is dynamically page, which is changed by the student login. If the student login, the main page will be shown of the member functions and student information.
- **Middle Tier (Server Side – Control Class).** The middle tier resides in server side used to handle the student model initialization. It is responsible for receiving the student request and data. The middle tier consists of the S ASP (Active Service Page) Dynamic server page language.
- **Database Tier (Database Management System Side – Control Class).** The database management system stores the student personal information, lecture material, question for testing, student testing result, student knowledge level, administrators and teaching staffs records. It also resides on the server side and is composed of a back-end database server. By using the Microsoft ODBC Driver and program with ASP languages and SQL statements. Internet based eLearning for SQL is partitioned into 4 main modules, including the Interface Module, Database Control Module. This section describes the design to be used in detail of the design in the problem solving in this project as shown in Figure 3.
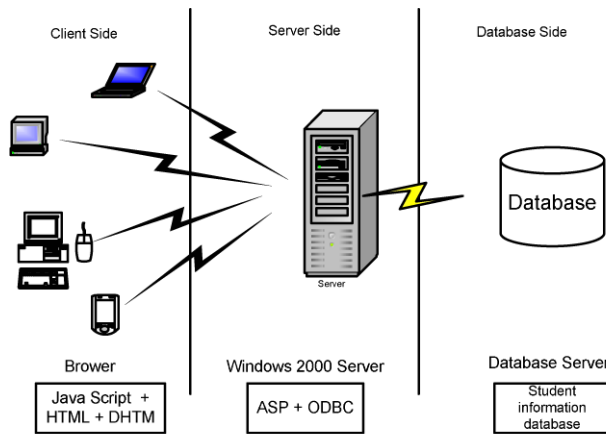

Fig. 3. The three tier architecture of the Internet Based eLearning for SQL

This section describes the detail functions of this project provided by the Internet webpage application. The whole project is divided to three main sections: Non-Member Section, Member Section and Administrator Section.

The Non-member section is provided with the Information Searching, Email to Web Master, Introduction of eLearning system, main topic catalog and hot topic

preview section. By default, the learning material is divided to three sections, SELECT, FUNCTIONS and ADD/REMOVE which have high frequencies usage.

The Administrator or teaching staffs can modify the default topic and add the new topic into the eLearning System database. Moreover, the knowledge level definition is setup by the administrator or teaching staffs. In the lecture section user interface for retrieving SQL statement is the same as the SQL2.com. The students may click on the required topics on the categories displayed on the right hand side frame page. The contents within the categories windows supports are highlighted.

Non Member Student Without Registration Section. This module is interacted with the non member students to understand the learning material and provides a best environment and layout for student. It accepts the students to input the SQL statement to run and output the real world output result on the screen for student's reference. The system interfaces are generated by an ASP application program. All lecture note and testing questions are loaded from database. This provides the upload area for teaching staffs to update the lecture notes into the Webpage as shown in Figure 4.

Fig. 4. The Index webpage of non-member student eLearning for SQL system

The Main Page of the non member student eLearning System is divided to four parts: login section, and course topic section, searching engine and lecture notes section.

The login section is used for students and teaching staffs to specify user ID and password. Moreover, the non-register students can show the introduction information

of the course without login to member section. The Search section is used for all users to search any information from the database. The students can input the topic of the course and course description. This section displays the number of visitors online in this system.

The course topic section is used for user (non-registered student) to select what topic is interesting to preview. The students can view the brief and full description of the course topics. On the preview section, the students can click into detail description. On the top of the section, the "Contact us" button, the students may click on this button to send the email to the teaching staff to get more information about this system.

The lecture section is in the right hand side frames of a main frame. In order to provide a preview the brief description on the lecture, the system provides the current Topic (SELECT). The users interface for users to select what lecture to view the detail description. The students may click on the "Let's GO" and the detail information of this lecture will be displayed on the screen.

Member Student with Registration Section. This section is for who want to register the membership in the system. In the Member area, it is provided with six functions on the left hand frame.

- **Lecture** – It provides the formal lecture notes, example, video/audio and SQL trial test box. It is used to give some example of the SQL statement for students self study. The students also may click the play video button to view more detail voice lecture in the video. Otherwise, the students should put the SQL statement in the Test Box to find out the corresponding output result.
- **Self-Testing** – It provides the self-testing for students who want to practice at the testing environment. This section does not have time limit, deadline date for submision and testing result recording. Therefore the students can redo the testing many times after each login. Furthermore, the students will know the correct answers after the self-testing is completed.
- **Quiz / Quiz Result** - It provides the quiz for teaching staff to know the quality of the students learning. It is only assigned by the teaching staffs. The students are not allowed to execute the quiz function. For example, the quiz will be provided at the end of each month and the deadline date is one week lead time. The correct answer doesn't feedback after the finished quiz. The students may click the "Quiz Result" to view the quiz result and correct answers after the deadline date.
- **Update Info** - It provides the section for students to update the personal information.
- **Withdraw** – It provides the function for students to withdraw the membership from the system. After the students confirm the membership withdraws, all records of these students will be removed from the database.
- **Logout** – It provides the action for students to logout from the system. Moreover, the system will logout the students if there is no action after 30 minutes.

Fig. 5. Lecture material (SQL examples) for registered student

The system provides the Lecture notes for students self study. The lecture notes are divided into 3 levels, beginner, advance, and expert student, which are assigned by system depending on the students first knowledge level analysis testing. If the students finish the Knowledge Level Analysis testing, the system will display what level students have and assign the suitable lecture material for this student. Normally, the lecture notes include four parts, detail descriptions, detail example, video/audio demonstration and real time SQL statement test box. in Figure 5.

The video/audio demo plays the video of teaching staffs explain the lecture notes with voice and pointer point similar to the lecture in the classroom. It also provides different cases example for students to try testing on the test box in Figure 6.

Here the user interface allows the students to input the MS SQL format SQL statement in test box. After students input the SQL statement and click the "See the Result" button, the result will be displayed on the screen. Therefore the students can try the different cases which are not included in the current example.

The quiz section's questions and answers are designed by administrators or teaching staff that is hard coded in the database. The quiz section has the deadline date. The students must finish quiz before the deadline date. After the deadline date, the system will be posted with the correct answers and the mark of the quiz. Furthermore, the screen is displayed of how many questions are finished. It reminds the students to complete all question in every login. Therefore the students do not need to finish all questions in one time as shown in Figure 8.

Fig. 6. Lecture material (video demo) for registered student

Fig. 7. Lecture material (SQL executable box) for registered student)

Please beware of the 30 minutes idle timeout after logon!
Today is Sunday March 21, 2004
Member : **1**　We are very happy to see you again.

Are you Ready to start ? Please click here `0:10` [Start]

You have [____] seconds left

Testing Question for SELECT

[Next ►] 1

Question	Answered
1	●
2	●
3	●
4	●
5	●

Table 1

● Not Finish yet
● Finihed !

Question 1
LastName FirstName Address City

Sno	Fname	Lname	Address	Tel_No	Position	Sex	Dob	Salary	Nin	Bno
SL21	John	White	19 Taylor St, Cranford, London	0171-884-5112	Manager	M	1-Oct-45	30000.00	WK442011B	B5
SG37	Ann	Beech	81 George St, Glasgow PA1 2JR	0141-840-3345	Snr Asst	F	10-Nov-60	12000.00	WK432514C	B3
SG14	David	Ford	63 Ashby St, Partick, Glasgow GII	0141-339-2177	Deputy	M	24-Mar-58	18000.00	WL220658D	B3
SA9	Mary	Howe	2 Elm Pl, Aberdeen AB2 3SU		Assistant	F	19-Feb-70	9000.00	WM532187D	B7
SG5	Susan	Brand	5 Gt Western Rd, Glasgow G12	0141-334-2001	Manager	F	3-Jun-40	24000.00	WK588932E	B3
SL41	Julie	Lee	28 Malvern St, London NW2	0181-554-3541	Assistant	F	13-Jun-65	9000.00	WA290573K	B5

◯ List all staff with a salary greater than $10,000?

Please select the correct answer

◯ SELECT sno, fname, lname, position, salary FROM staff WHERE salary > 10000

◯ SELECT sno, fname, lname, position, salary FROM staff FROM salary > 10000

◯ SELECT sno, fname, lname, position, salary FROM staff WHERE salary LARGER 10000

◯ SELECT sno, fname, lname, position, salary FROM staff FROM salary LARGER 10000

[Submit]

[Next ►]

Fig. 8. Self-testing user interface

5　Conclusion

The contribution of this paper is to propose using intelligent web pages approach to design an eLearning system to evaluate and record students' knowledge level and provide interactive learning material to students according to their abilities to learn. The approach has been proved to be feasible and interesting to most students.

References

1. Montgomery, S.M., Groat, L.N.,"Student learning styles and their implications for teaching", 2000.
2. Jay Cross, information architect of Internet Time Group, "eLearning", Training & Development, November 1999.

3. Murray, T., Shen, T., Piemonte, J., and Condit, C., "Adaptivity in the metalinks Hyper-book authoring framwork.", 2000.
4. Mitovic, A., "Porting SQL-Tutor to the web". In: Proceedings of International Workshop on Adaptive and Intelligent Web-based Educational Systems, Held in Conjunction with ITS 2000 19th June, 2000 Montreal, Canada.
5. The SQL standard, A complete reference, Rick F. van der Lans
6. Khan, B. H. (ed.), "Web Based Instruction". Englewood Cliffs, New Jersey: Educational Technology Publications, 1997.
7. Jane Massy, "Quality and eLearning Summary report, European eLearning Consultant and Analyst in April 2002.
8. SQL tutorial CHL, CHL - Information System and Information Technology courses center http://www.cs.unibo.it/~ciaccia/COURSES/RESOURCES/SQLTutorial/sqlcont.htm
9. Fluffy Cat.com - SQL Reference and Example Site. Larry Truett and www.FluffyCat.com, Larry Truett, http://www.fluffycat.com/sql/
10. A Gentle Introduction to SQL. By Andrew Cumming of the School of Computing of Napier University, Edinburgh, UK, http://sqlzoo.net/
11. SQL Course 2.com Advanced Online SQL Training, http://sqlcourse2.com/sql_interpreter.html
12. ELearning tools in City University of Hong Kong, http://wbi.cityu.edu.hk/webct/homearea/homearea
13. Oracle 9i: SQL with an Introduction to PL / SQL, Lannes L. Morris-Mu.