Questions-Bank System to Enhance E-Learning in School Education

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***Abstract*—The assessment process in an educational system is an important and essential part of its success to assure the correct way of knowledge transmission and to ensure that students are working correctly and succeed to acquire the needed knowledge. This paper describes the analysis, design, and implementation of the Questions-Bank system, that allows the students of primary, preparatory, and secondary schools to take web-based quizzes and exams, to download course reviews, and previous exams. "Questions-Bank", means that each question has a weight and area of knowledge deals with it. The system facilitates generation of automatic, balanced, and different exam sheets, that containing different types of questions, covering the entire curriculum, and displaying gradually from easiness to difficulty. The exam sheet produced by the system, takes into account the different levels of the students from excellent, good, to fair, and avoids any mistakes of language and non-clear terminologies. The system allows the schools to create a Questions-Bank database, that stores the previous exams, the model answers, the reviews, and useful exercises for each course. Our system is used successfully in distance learning as well as in self-training. We have tested the system with different type of courses taught in Qatari schools, ranged from primary to secondary levels. The feedbacks of both teachers and students were highly promising.**

***Index Terms*—E-Learning, educational systems, web-based evaluation systems, interactive applications.**

I. INTRODUCTION

Introducing Internet at schools has encouraged the development of new tools and systems within the scope of education and training. As a result, a new era of learning and training approaches has emerged, where new educational models have been developed, students could learn independently at any time or location, simply by connecting to the Net along with the appropriate systems and tools. Teachers, at the same time, could teach through “on-line” setting and could schedule lessons and exams without the classical physical constraints. This electronic learning approach, also known as e-learning, has opened new horizons in teaching for both teachers and students [1-4].

The assessment process in an educational system is an important and primordial part of its success to assure the correct way of knowledge transmission and to ensure that students are working correctly and succeed to acquire the needed knowledge. Many assessment methods can be used: conducting some experiments, realizing different mini-projects, making quizzes and exams. The evaluation mechanism help students to discover whether they have gained the required knowledge as expected, and provide appropriate and timely feedback to teachers to adjust their lectures, exercises and exams [5-7].

In this, paper we introduce the web-based "Questions-Bank" system, which can be used with any school courses and may save hours in exams and quizzes preparation and correction, as well as may save resources like, photocopying and distributing the exams papers, locations of these exams, teachers and assistants, etc. The proposed system has the following functionalities and features:

- ***Knowledge evaluation*:** Students can evaluate their understanding levels, and teachers can track the activities of their students and can guide them to reach the pre-determined objectives of the courses
- ***Exams generation*:** Teachers can store many types of questions like multiple choices, true/false, and fill in the blanks. The system uses an intelligent algorithm to generate balanced exam sheet, that containing different types of questions, covering the entire curriculum, and displaying gradually from easiness to difficulty.
- ***Exam grading*:** quizzes and exams can be marked automatically by the system. Thus, students can get instantly their marks in a given quiz immediately after submitting their responses and see also the corrected answers.
- ***Communication*:** The system has a communication tool that allows students and teachers to interact together and discuss their activities.
- ***Course management*:** The system is highly flexible and doesn’t necessitate any programming skills from its potential users. Thus, teachers can add, delete and update their course materials at any moment through the web.
- ***Questions-Bank database*:** The system allows the schools to create a Questions-Bank database that stores the previous exams, the model answers, the reviews, and useful exercises for each course.

The paper is organized as follows: in section two we give a brief overview about the Questions-Bank system while in section three we present the system analysis and design. In section four we describe the system implementation and in section five we evaluate the system. The paper is finally concluded by our future works, in section six.

II. SYSTEM OVERVIEW

The system interface (Arabic/English) is entirely web-based, and doesn't necessitate any technical skills from the potential users. The system is divided into three applications, called *administrator*, *teacher*, and *student* application. As shown in Figure 1, the system is appropriate for on-campus teaching, with access to the Internet, or off-campus teaching using the local network.

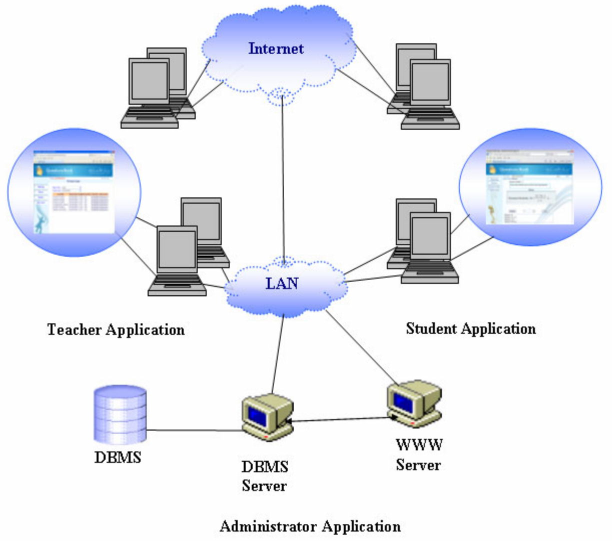


Figure 1. System overview

- *The administrator application*: This application provides the school administrator with simple tools to manage the information of the Questions-Bank system. The following are some features provided by the *administrator* application:
  - Activate/Inactivate the system.
  - Import and Export the Questions-Bank database
  - Send automatic email immediately containing the new password whenever the user changes his/her password.
  - Administer the basic information of the system:
    - Levels data,
    - Subjects (or courses) data,
    - Classes data,
    - Teachers data, and
    - Students' data.
- *The teacher application*: This application provides the teachers with various tools to construct the system services. The following are some features provided by the *teacher* application:
  - Change account password
  - Manage (add, update, delete and display) all the system services (reviews, exam questions, quizzes, previous exams, and model answers)
- *The student application*: This application provides the students with interactive tools to use the services of the system. The following are some features provided by the *student* application:
  - Change account password
  - Download assignments, revision documents, previous exams, and other files that are uploaded by the teachers.
  - Take web-based quizzes, exams, assignments, interactive tutorials, and reviews.

III. SYSTEM ANALYSIS AND DESIGN

A. *Adopted Software Development Process*

Software development process represents the structure imposed on the development of a software product, which includes software life cycle and software process. There are several models for such processes, each describing an approach to a variety of tasks or activities that takes place during the process. The process involves translating user needs into software requirements, transforming the software requirements into design, implementing the design in code, testing the code, and sometimes installing and checking out the software for operational activities. Note that, these activities may overlap or be performed iteratively [8].

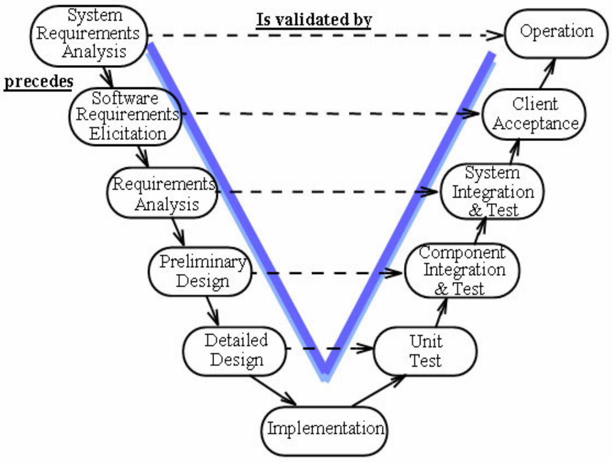


Figure 2. The V-model - software development process

B. *Life Cycle Model*

Numerous models have been proposed to handle the problems of defining activities and associating them together. Our adopted software development process is the V-model, as shown in Figure 2, which can be presumed to be the extension of the Waterfall model [9]. Instead of moving down in a linear way, the process steps are bent upwards after the implementation phase, to form the typical V shape. In the development of the Questions-Bank system, the V-model was followed by:

1. Specifying the system requirements using different gathering approaches.
2. The requirements were analyzed and classified into functional and nonfunctional requirements, and use cases and domain model were constructed.
3. The system design was started by determining the database tables, appropriate interfaces, *class diagram*: to show a static view of used classes, and *interaction diagrams*: to show the collaborations among the objects of the system to complete an action.
4. The implementation phase was launched by implementing the functionalities of the system.

Each of the previously mentioned phases is associated to a certain phase of testing to verify and to validate that the work is accurately executed, if problems are found during the verification or validation phases, then a re-execution of left side of the V is performed to make fixes and improvements.

C. Methods and Techniques to Analyze the Problem

- *Scenarios*: A *scenario* is an informal description of actions done by a specific user in order to make a use of the system. It can be considered as an instance of a use case. It is expressed as a story of how a user can access the system.
- *Use-cases*: A *use-case* describes the interaction between the users of the system and the system itself through a sequence of simple steps that show how the system responds to a request from a certain user. It is mainly used to capture the functional requirements of the system. Use cases must be written in a language that is understandable by clients. They must describe the events from the point of view of the users.
- *Initial UML Interaction Diagrams*: An interaction diagram demonstrates a certain aspect of a system by modeling its behavior. It is used to visualize the collaboration among several objects to complete a certain task.
- *Initial Static Class Diagram*: An initial class diagram (also called the domain model) consists of class and object diagrams. It is a static model that furnishes a visual representation of the real-world concepts that are visible to the user not of software components. Elements of a domain model are *classes* and the *relationships* between them. It is widely used as a source of inspiration for designing software objects.

D. System Analysis

The *analysis phase* is the chief phase in which the system requirements are identified in more details. The goal of this phase in the system development is to refine the system goals into defined functions and operation of the intended application. System requirements are documented in a complementary set of artifacts: flow charts, use case diagrams, system sequence diagrams and so on. Each artifact provides a different perspective of the system under design and contains distinct requirements. The combination of these perspectives establishes the tasks that are to be accomplished by the system.

1) Available Information Gathering Technique:

It's difficult to build a solution if we don't know the requirements. The "elicitation" step is where the requirements are first gathered from the client. Many techniques are available for gathering requirements. Each has a value in certain circumstances, and in many cases, we need multiple techniques to gain a complete picture from a diverse set of clients and stakeholders. Here is a look at some of the approaches that could be taken.

- *Interviews*: The most common technique for gathering requirements is to sit down with the clients and ask them what they need. Our discussion would help us plan out ahead of time, based on the type of requirements that we are looking for.
  - Gather facts, opinions and speculations.
  - Ask about specific details.
  - Ask for other sources of information.
  - Ask about the stakeholders' vision for the future.
  - Ask if they have alternative ideas.
  - Ask them to draw diagrams.
- *Prototyping*: Prototyping is a relatively modern technique for gathering requirements. In this approach, we gather preliminary requirements that we use to build an initial version of the solution. We show this to the client, who then gives us additional requirements. We change the application and cycle around with the client again. This repetitive process continues until the product meets the critical mass of business needs or for an agreed number of iterations.
- *Use Case*: Use cases are basically stories that describe how discrete processes work. The stories include people (users) and describe how the solution works from a user perspective. Use cases may be easier for the users to articulate, although the use cases may need to be distilled later into the more specific detailed requirements. At this stage, client requirements are gathered. This is done on the basis of information provided by the client in the form of documents. Requirements could be classified in two types: *Functional* and *Non-Functional* requirements.

2) System Specification

- *Functional requirements*: Describe the interactions between the system and its environment independent of its implementation. The environment includes the end user and any other external system with which the system interacts.

The Questions-Bank system should allow different types of users to interact with the system according to given privileges. There are three main users, as shown in Figure 3: school *administrator*, *teacher*, and *student*. It provides various services for each one:

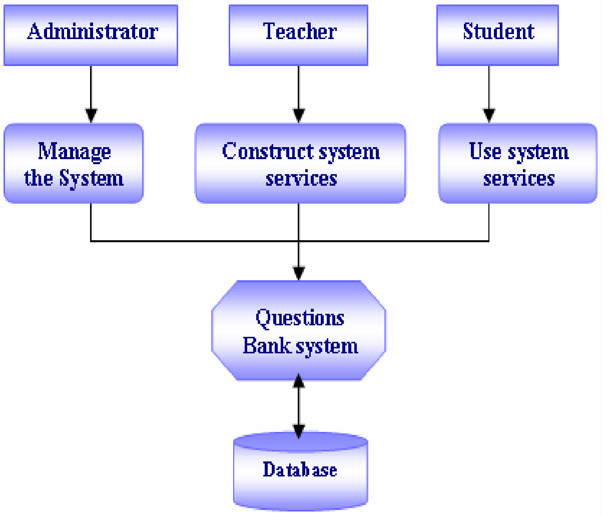


Figure 3. The three main users of the system

a. Questions-Bank system allows the *school administrator* to:

- Login (as administrator).
- Chang account password
- Get new password instead of the lost one.
- Activate/Inactivate the system.

- Renew data (Import the data from the Excel file to the SQL server database, delete data from specific table)
- Send an email immediately containing the new password whenever the user changes his/her password.
- Manage (add, update, delete and display) the basic information of the system:
  - Levels data,
  - Subjects (or courses) data,
  - Classes data,
  - Teachers data, and
  - Students' data.

b. Questions-Bank system allows the *teacher* to:

- Login (as teacher).
- Change account password
- Manage (add, update, delete and display) all the system services:
  - Reviews,
  - Exam questions
  - Quizzes, and
  - Previous Exams (with their model answers)

c. Questions-Bank system allows the *student* to:

- Login (as student).
- Change account password
- Get new password instead of the lost one.
- Download assignments, revision documents, previous exams, and other files that are uploaded by the teachers.
- Take web-based quizzes, exams, assignments, and interactive tutorials.

▪ *Non-functional requirements*: Describe aspects of the system that are not directly related to the functional behavior of the system. Non-functional requirements include a broad variety of the requirements such as implementation requirements, interface requirements, operation requirements and others.

- *Usability*: The system must provide a coherent user interface that is consistent with the organization interface. The system must be obvious, allowing the user to navigate the system easily.
- *Reliability*: The system must perform and maintain its functions in routine circumstances
- *Supportability*: The system must be easily modified or extended by more functions.
- *Performance*: Performance requirements are concerned with quantifiable attributes of the system, such as response time, throughput availability and accuracy.
- *Security*: The system must prevent unauthorized users to access the system. Authorized users must be provided with user ids and passwords. In order to achieve high level of security, the password must be encrypted.

3) Hardware and Software Resource

We have used some software during our system development such as: Windows XP professional, Windows Server O/S, Microsoft office Excel, Microsoft Word, SQL Server database system, MS Visual Studio.Net, and Photo Shop.

4) System Models

▪ *Scenario*: A scenario is a specific sequence of actions and interactions. It is one particular story of using a system, or one path through the use case. In our system, we have developed a simple scenario that illustrated the basic actions in the system.

▪ *UML use case*: UML use-cases, as shown in Figure 4, were used in the analysis, in which the functional requirements are extracted and described along with a scenario of the flow of events. Universal Modeling Language (UML) is an industry standard language for specifying, constructing, visualizing, documenting artifacts of a software system.

E. System Design

The design goal of our system is to resolve some of the issues, specifically; it is to be made easily accessible and customizable. Students will not be afraid to use our system. The system will be designed as a web application requiring only a web browser administer and use. Hence, no additional software needs to be downloaded.

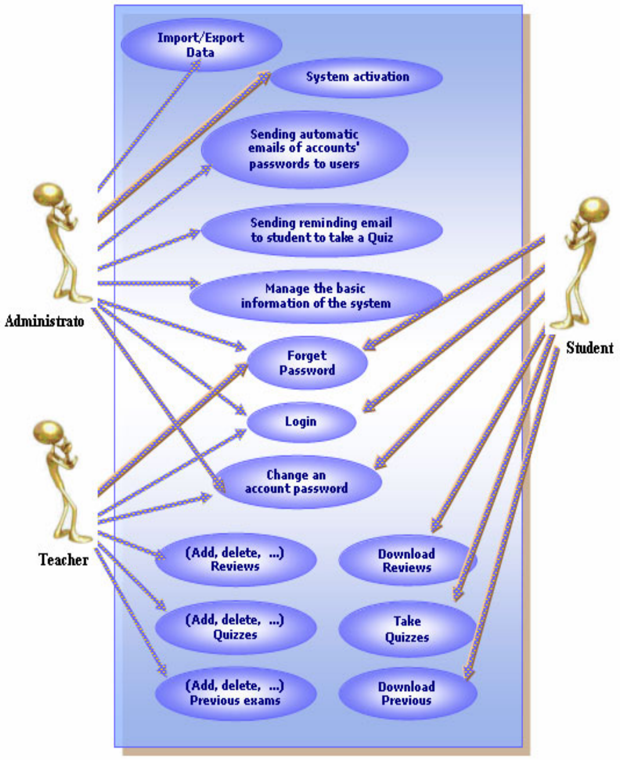

Import/Export Data
System activation
Sending automatic emails of accounts' passwords to users
Sending reminding email to student to take a Quiz
Manage the basic information of the system
Administrato
Forget Password
Login
Change an account password
Student
Teacher
(Add, delete, ...) Reviews
Download Reviews
(Add, delete, ...) Quizzes
Take Quizzes
(Add, delete, ...) Previous exams
Download Previous

Figure 4. UML use case diagram

1) Design Methodology and Patterns

A *methodology* is a collection of methods for solving a class of problems. It specifies which method should be used and the manner in which it is utilized. *Software development methodologies* decompose the process into activities. They provide methods for several activities as shown in Figure 5.

Design pattern is a general re-usable solution to a commonly occurring problem in software design. A design pattern is not a finished design that can be transformed directly into code. It is a description or a template for solving a problem that is common among different situations. It typically shows relationships and interactions between classes or objects.

2) Database design

Database is an important component in our system. Microsoft SQL Server database is the database management system used for the system. The implementation of the database has been developed and modified many times to be applicable with the system requirement.

The DBMS stores the subjects in each school level, the reviews, the previous examinations, the exams questions, the quizzes, the student grades, and the basic information of the administrator, teacher, and student. We have chosen the entity-relationship model to represent the database design [10]. Figure 6, shows the basic entity-relationship diagram, and Figure 7, represents the corresponding relational database schema, that contains the main tables used for creating the Questions-Bank database.

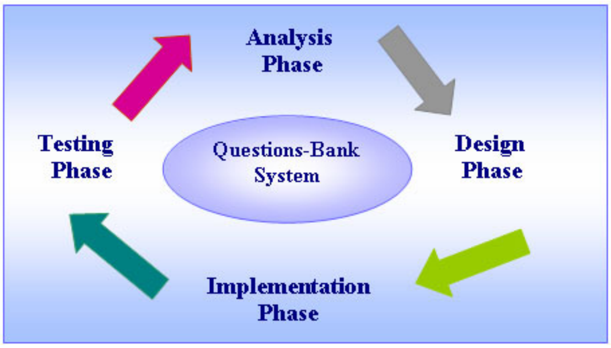


Figure 5. Software development methodologies

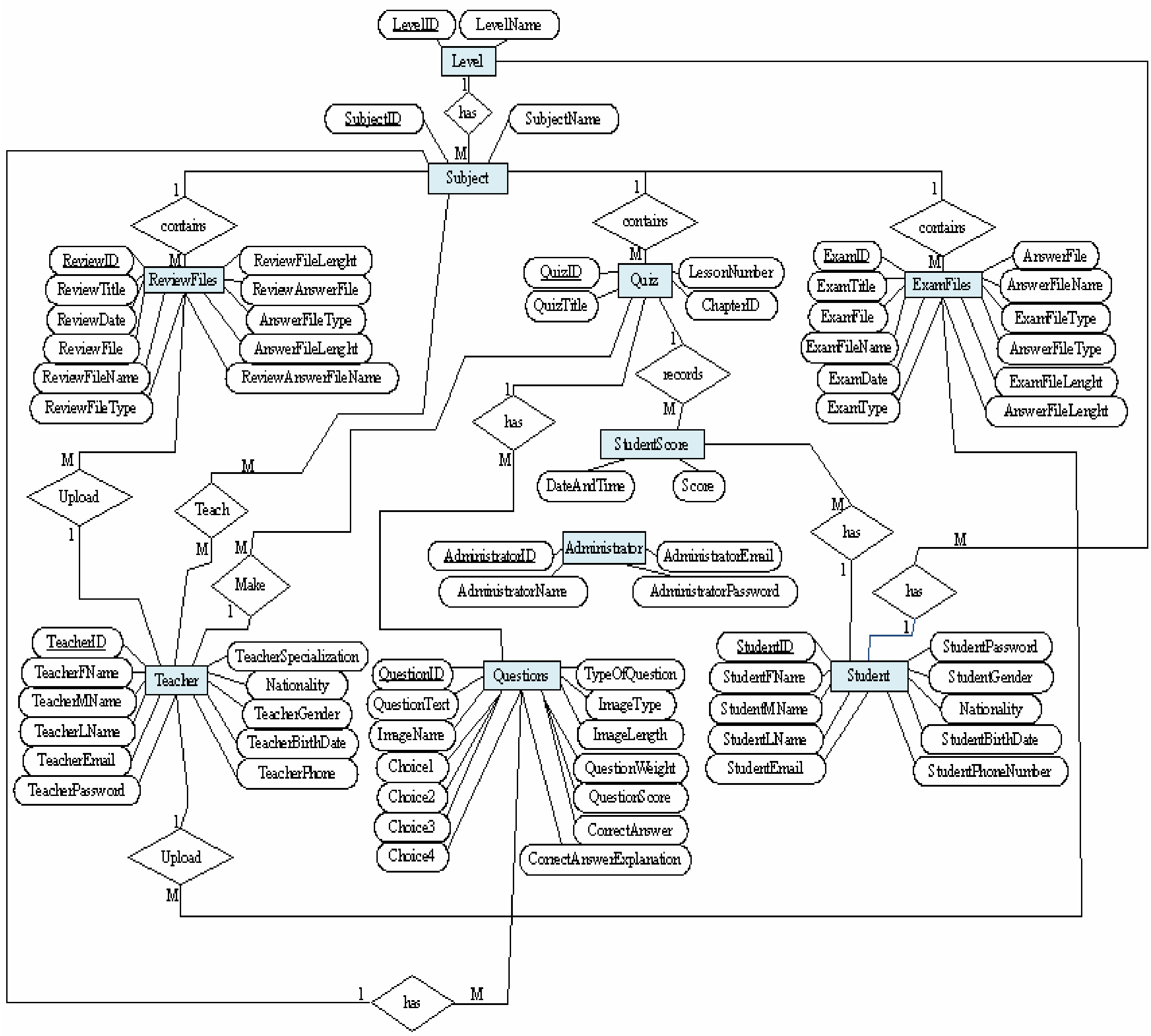


Figure 6. The basic entity relationship diagram (ERD)

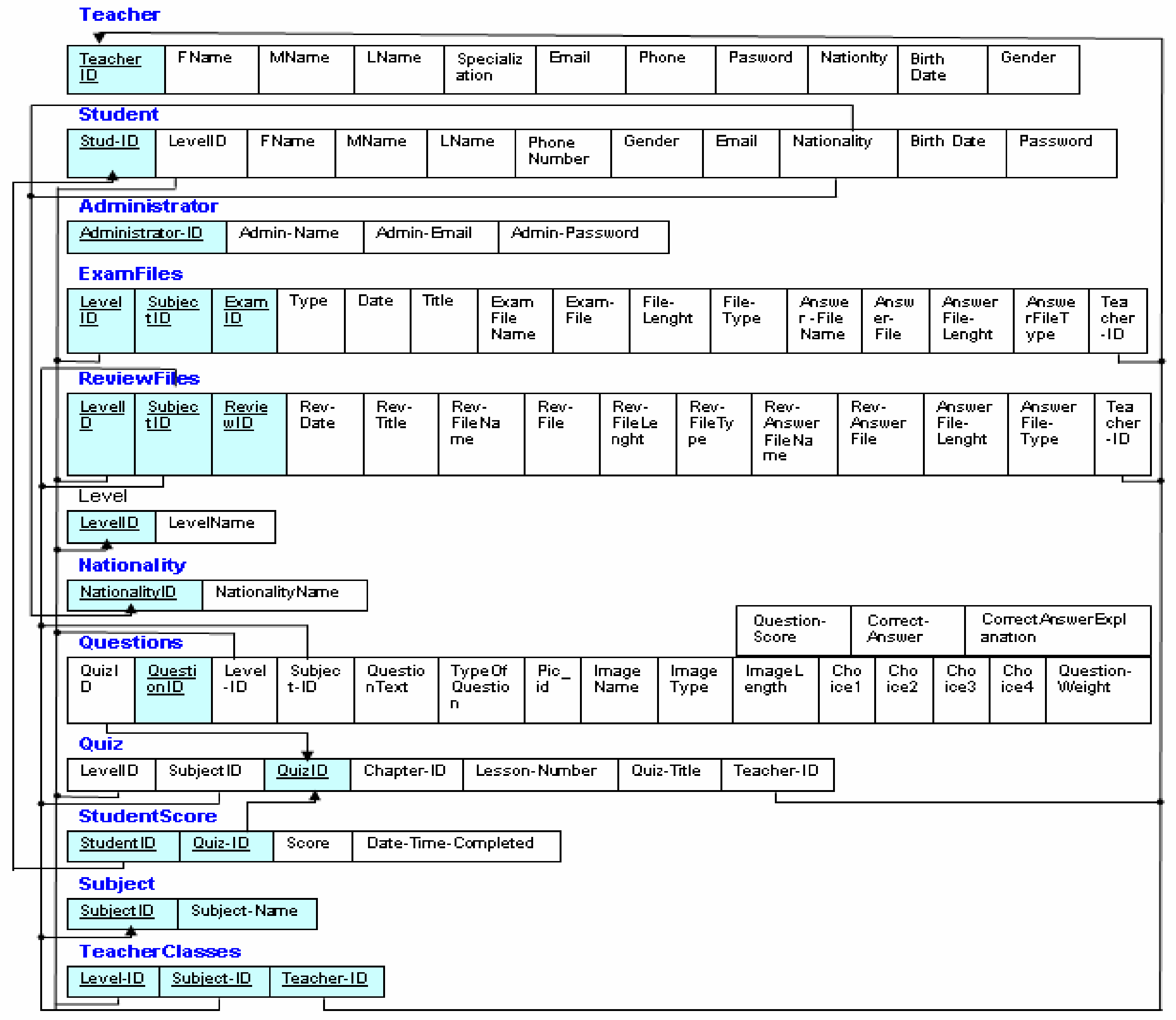

Teacher
Teacher ID | FName | MName | LName | Specialization | Email | Phone | Pasword | Nationlty | Birth Date | Gender
Student
Stud-ID | LevelID | FName | MName | LName | Phone Number | Gender | Email | Nationality | Birth Date | Password
Administrator
Administrator-ID | Admin-Name | Admin-Email | Admin-Password
ExamFiles
Level ID | SubjectID | Exam ID | Type | Date | Title | Exam File Name | Exam-File | File-Lenght | File-Type | Answer-File Name | Answer-File | Answer File-Lenght | AnswerFileType | Teacher-ID
ReviewFiles
LevelID | SubjectID | ReviewID | Rev-Date | Rev-Title | Rev-FileName | Rev-File | Rev-FileLenght | Rev-FileType | Rev-Answer FileName | Rev-Answer File | Answer File-Lenght | Answer File-Type | Teacher-ID
Level
LevelID | LevelName
Nationality
NationalityID | NationalityName
Questions
QuizID | QuestionID | Level-ID | Subject-ID | QuestionText | TypeOfQuestion | Pic_id | Image Name | Image Type | ImageLength | Choice1 | Choice2 | Choice3 | Choice4 | Question-Weight | Question-Score | Correct-Answer | CorrectAnswerExplanation
Quiz
LevelID | SubjectID | QuizID | Chapter-ID | Lesson-Number | Quiz-Title | Teacher-ID
StudentScore
StudentID | Quiz-ID | Score | Date-Time-Completed
Subject
SubjectID | Subject-Name
TeacherClasses
Level-ID | Subject-ID | Teacher-ID

Figure 7. Relational database schema

3) *Application Logic Design*

Application logic design will deal with three main parts of the application design:

- *First part*: the architectural design of the system which is concerned with the tiers of the system.
- *Second part*: the upper level design is further introduced as an identification of the distinct subsystems and their functionalities.
- *Third part*: the detailed design is discussed with the class diagram and sequence diagrams.

4) *System Architecture*

The web-based "Questions-Bank" system consists of three components as shown in Figure 1: The *client*, the *server*, and the *database management system* (DBMS). The client side application is developed by web-based programming languages such as XHTML, ASP.NET, Macromedia Flash and Java script. The server application is developed by Microsoft Visual Studio (ASP.NET, C#.NET, and VB.NET) and acted as a gateway between the database and the clients.

The school information, user's information, course materials, questions, quizzes, exams, model answers, reviews, and tutorial are stored and managed using Microsoft SQL Server database. The database and the server applications will run on Microsoft Windows Server.

5) *Quiz Generation Algorithm*

The DBMS of the "Questions-Bank" system includes an innovative and intelligent algorithm for managing the *difficulty* of the quiz questions [2]. The algorithm uses the difficulty attribute set by the user as input parameter. The teachers set the *difficulty levels* of their questions at creation phase using a numbering system. The value assigned to a specific question identifies how difficult (or easy) it would be for a student to reply correctly to the question. Our algorithm can generate automatically different quizzes with different levels of difficulties. Obviously, teachers are not always as accurate as would be desirable in estimating the difficulty of a question (as they don't know the exact level of the students using the system) our algorithm can update the difficulty and the easiness of the questions based on the responses given by the students. The algorithm has the ability to detect the difficulty/easiness of a question based on students reply and adjust the difficulty value accordingly. As a result, some of the feedbacks of the students in a given course are used to adjust the level of the questions. The following are the methods of our algorithm:

- `Get_Difficulty()`: This method determines the difficulty of a specific question.
- `Calc_Margn()`: This method calculates the lower and the upper bounds of error percentage in the students' responses.
- `Calc_Error()`: This method calculates the percentage of wrong responses to a question, as a ratio between errors and a constant value named `Max_Num_Access`. The involved variables are reset after each difficulty evaluation.
- `Mark_Ques()`: This method activates a Boolean field in the register of a question if the difficulty level reaches the thresholds.

Four difficulty degrees have been considered rangy from level one to level four. If a question has a value higher than four, it could be too difficult or it could be ambiguous. Similarly, if a question has a value of 0, the question could be too easy, or too obvious, and nearly all the students can answer it correctly. The questions that are out of bounds are marked, so they cannot be used for any quiz, and the teachers must update them. Table 1 shows the upper and lower bounds for determining the difficulty of the questions.

TABLE I. QUESTIONS LEVELS

Difficulty	Lower bound (%)	Upper Bound (%)
1	10	30
2	30	50
3	50	70
4	70	90

Algorithm: ManageQuestion(Difficulty)

```
1. Access random question from the "questions"
   database table.
2. Check the Max_Num_Access of the question
      Get_Difficulty(); Calc_Margn();
      Calc_Error();
3. Recalculate_Difficulty();
4. if (Error < LowerBound) then
      Difficulty--;
   else if  (Error > UpperBound) then
      Difficulty++;
5. if  Difficulty is out-of-bounds then
      Mark_Ques();
```

IV. SYSTEM IMPLEMENTATION

The web-based "Questions-Bank" system takes the advantage of the latest development technologies in its implementation. It is an ASP.NET web application to be used on the Internet and was written using Microsoft's Visual Studio .NET development environment in the C# programming language. Code that executes on the server to process event handlers for events such as button clicks is written in C#. Microsoft's SQL Server 2008 is used for database operations, including the storage and retrieval of login information. Successfully logging into the system, users are taken to an action page that dynamically presents options to them based on their privileges.

A. Database implementation

The database is designed to have the following main tables: `Level`, `Subject`, `ReviewFile`, `Quiz`, `ExamFiles`, `Questions`, `StudentScore`, `Student`, `Teacher`, and `Administrator`.

During the development of the system, data for the testing of different functionalities was needed to be imported into the database tables. The tables in the database are filled using two different ways .The first way is to fill the tables by importing the data from an MS Excel sheet that contains the basic data from the school's database. The second way is done during the run time of the system.

B. System requirements implementation

To prove the functionality of the "Questions-Bank" system, we have implemented several web-based applications as components of the system. The Questions-Bank system is divided into three sub-systems, as shown in Figure 8: the *administrator*, the *teacher,* and the *student* sub-system.

i. ***The administrator sub-system*****:** This sub-system provides the school administrator with web-based services to manage the information of the Questions-Bank system. The following are some services provided by the administrator sub-system:

a. Login: Before users are granted access to the "Questions-Bank" system, they must successfully login to the system. The user's accounts are associated with different levels of privileges. *Username* and *password* is the most common authentication method, used to access the system, as shown in Figure 9. Login information is verified by comparing the entered `username` and `password` with the stored ones in the database. The authentication program on the Web server opens a database connection and retrieves the user record.

If the user input data matches a database record, the user is granted to access the system services. Otherwise, an "*invalid login*" message is displayed, and the login page is displayed again.

b. System management: The *administrator sub-system* provides the school administrator with web-based services to add (update, or delete) the basic data needed for the other two sub-systems, such as: levels data, subjects data in each level, school data, classes data, teachers data, and students data, as shown in Figure 10.

c. **Change password:** The "Questions-Bank" system provides the user to change his/her account password:

- The user login into the system from the user *login page*.
- The user clicks on the link "`Change Password`", and then he/she will be directed to the suitable page.
- The user enters his/her `old password`, `new password` and re-enters the `new password` again, then he presses the "`Change`" button.
- A validation is applied on the input data to ensure that they are filled with required information.
- The user's `old password` is deleted and the new one is inserted using an update query.

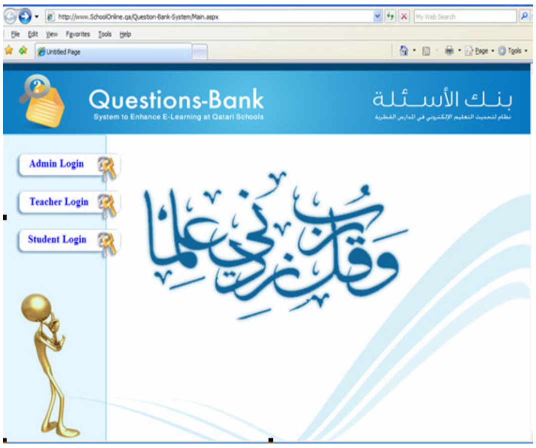
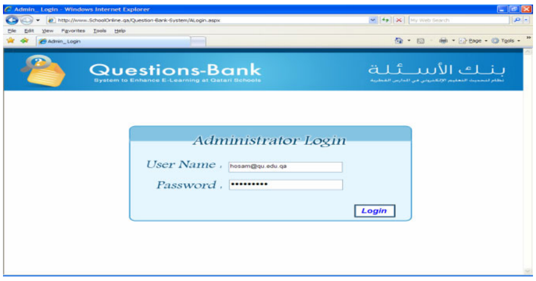

http://www.SchoolOnline.qa/Question-Bank-System/Main.aspx
Questions-Bank
System to Enhance E-Learning at Qatari Schools
بنك الأسئلة
Admin Login
Teacher Login
Student Login
وقل رب زدني علما

Figure 8. The Questions-Bank sub-systems

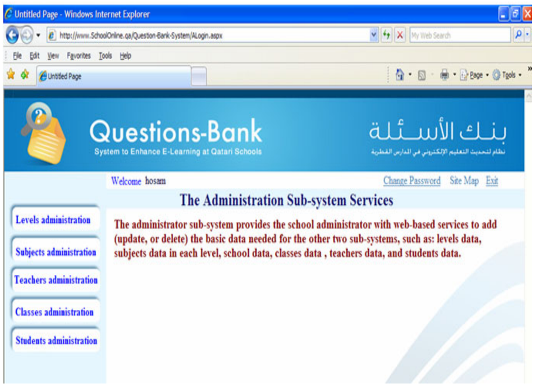

Admin_ Login - Windows Internet Explorer
http://www.SchoolOnline.qa/Question-Bank-System/ALogin.aspx
Questions-Bank
System to Enhance E-Learning at Qatari Schools
بنك الأسئلة
Login

Administrator Login

User Name : hosam@qu.edu.qa

Password : ••••••••••

Figure 9. *Administrator* login

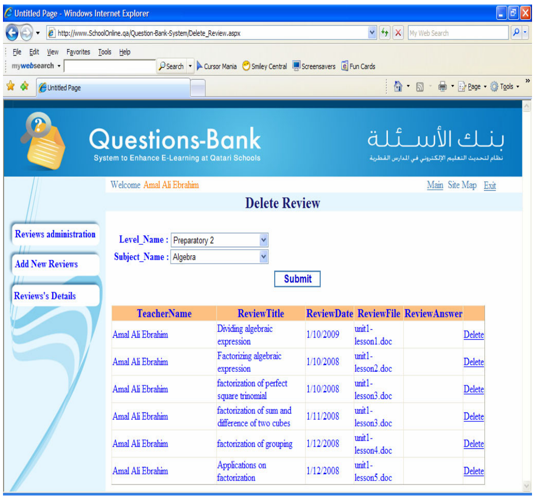

Untitled Page - Windows Internet Explorer
http://www.SchoolOnline.qa/Question-Bank-System/ALogin.aspx
Questions-Bank
System to Enhance E-Learning at Qatari Schools
بنك الأسئلة
نظام لتحديث التعليم الإلكتروني في المدارس القطرية
Change Password
Site Map
Exit
Levels administration
Subjects administration
Teachers administration
Classes administration
Students administration

Welcome hosam

The Administration Sub-system Services

The administrator sub-system provides the school administrator with web-based services to add (update, or delete) the basic data needed for the other two sub-systems, such as: levels data, subjects data in each level, school data, classes data , teachers data, and students data.

Figure 10. Administrator sub-system


Untitled Page - Windows Internet Explorer
http://www.SchoolOnline.qa/Question-Bank-System/Delete_Review.aspx
Questions-Bank
System to Enhance E-Learning at Qatari Schools
بنك الأسئلة
نظام لتحديث التعليم الإلكتروني في المدارس القطرية
Main
Site Map
Exit
Reviews administration
Add New Reviews
Reviews's Details
Submit

Welcome Amal Ali Ebrahim

Delete Review

Level_Name : Preparatory 2

Subject_Name : Algebra

TeacherName	ReviewTitle	ReviewDate	ReviewFile	ReviewAnswer	
Amal Ali Ebrahim	Dividing algebraic expression	1/10/2009	unit1-lesson1.doc		Delete
Amal Ali Ebrahim	Factorizing algebraic expression	1/10/2008	unit1-lesson2.doc		Delete
Amal Ali Ebrahim	factorization of perfect square trinomial	1/10/2008	unit1-lesson3.doc		Delete
Amal Ali Ebrahim	factorization of sum and difference of two cubes	1/11/2008	unit1-lesson3.doc		Delete
Amal Ali Ebrahim	factorization of grouping	1/12/2008	unit1-lesson4.doc		Delete
Amal Ali Ebrahim	Applications on factorization	1/12/2008	unit1-lesson5.doc		Delete

Figure 11. Review administration (delete)

ii ***The teacher sub-system***: This sub-system provides the teacher with web-based tools to manage the information of the Questions-Bank system. In addition to the `login`, and `change password`, the following services are available in the teacher sub-system:

a. **Reviews administration:** Teacher can use this service to upload (add) the MS Word, PP presentation, video, etc. files that contain the reviews for each subject. Also teacher can delete specific review(s) from the database and can display the stored reviews, as shown in Figures (11).

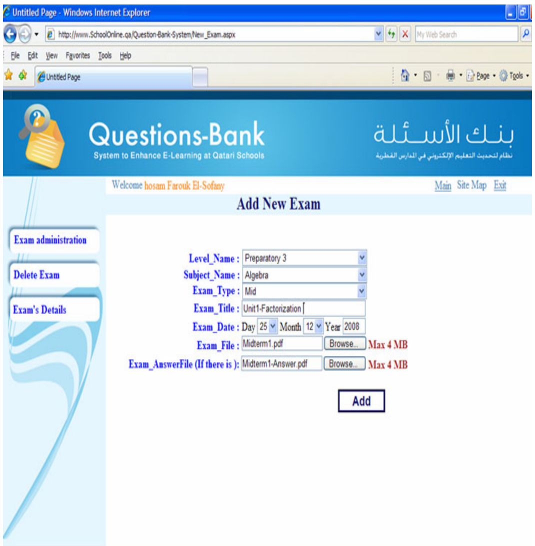
The teacher can store the following data for each review: `level name`, `subject name`, `review title`, `review date`, `review file`, and the `review answer file` (if exist).

b. **Previous exams administration:** Teacher can use this services to upload (add) the previous exams and their model answers for each subject, as shown in Figure 12. Also teacher can delete specific exam(s) from the database and can display the stored exams.

The teacher can store the following data for each previous exam: `level name`, `subject name`, `exam type` (midterm, final), `exam title`, `exam date`, `exam file`, and the `exam answer file` (if exist).

c. **Exam administration:** Teachers can use this online tool to add, update, and delete questions and answers for their exams and quizzes. The questions are inserted into the database dynamically, so new questions can be added during the configuration of a exam or quiz, as shown in Figure 13.

The teacher can store the following data for each exam/quiz: `level name`, `subject name`, `chapter number`, `lesson number`, `quiz title`, `quiz type` (multiple choices, true or false, fill in the blank), `question text`, `question image file`, `choice1`, `choice2`, `choice3`, `choice4`, `correct answer`, `question weight`, `question score`, and `question explanation`.


Untitled Page - Windows Internet Explorer
http://www.SchoolOnline.qa/Question-Bank-System/New_Exam.aspx
Questions-Bank
System to Enhance E-Learning at Qatari Schools
بنك الأسئلة
نظام لتحديث التعليم الإلكتروني في المدارس القطرية
Main
Site Map
Exit
Exam administration
Delete Exam
Exam's Details
Browse...
Add

Welcome hosam Farouk El-Sofany

Add New Exam

Level_Name : Preparatory 3

Subject_Name : Algebra

Exam_Type : Mid

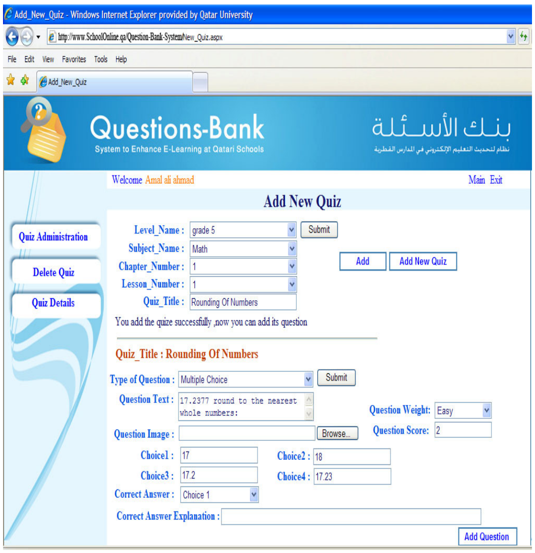
Exam_Title : Unit1-Factorization

Exam_Date : Day 25 Month 12 Year 2008

Exam_File : Midterm1.pdf Max 4 MB

Exam_AnswerFile (If there is): Midterm1-Answer.pdf Max 4 MB

Figure 12. Previous exams administration (upload)



Add_New_Quiz - Windows Internet Explorer provided by Qatar University

http://www.SchoolOnline.qa/Question-Bank-System/New_Quiz.aspx

Welcome Amal ali ahmad

Add New Quiz

Level_Name : grade 5

Subject_Name : Math

Chapter_Number : 1

Lesson_Number : 1

Quiz_Title : Rounding Of Numbers

You add the quize successfully ,now you can add its question

Quiz_Title : Rounding Of Numbers

Type of Question : Multiple Choice

Question Text : 17.2377 round to the nearest whole numbers:

Question Weight: Easy

Question Image :

Question Score: 2

Choice1 : 17

Choice2 : 18

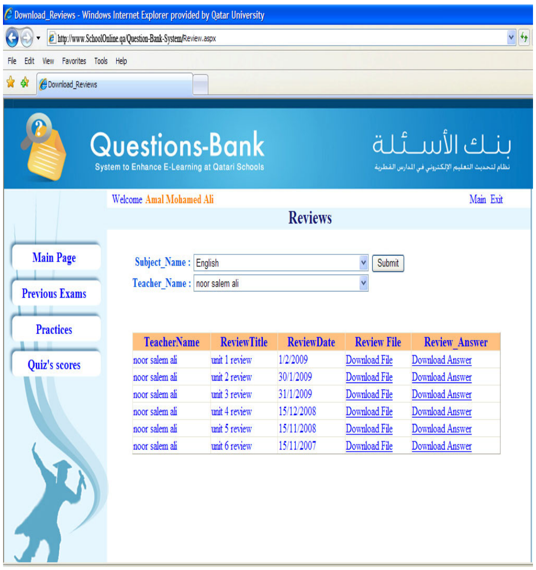
Choice3 : 17.2

Choice4 : 17.23

Correct Answer : Choice 1

Correct Answer Explanation :

Figure 13. Quiz administration (add new quiz)



Download_Reviews - Windows Internet Explorer provided by Qatar University

http://www.SchoolOnline.qa/Question-Bank-System/Review.aspx

Welcome Amal Mohamed Ali

Reviews

Subject_Name : English

Teacher_Name : noor salem ali

TeacherName	ReviewTitle	ReviewDate	Review File	Review_Answer
noor salem ali	unit 1 review	1/2/2009	Download File	Download Answer
noor salem ali	unit 2 review	30/1/2009	Download File	Download Answer
noor salem ali	unit 3 review	31/1/2009	Download File	Download Answer
noor salem ali	unit 4 review	15/12/2008	Download File	Download Answer
noor salem ali	unit 5 review	15/11/2008	Download File	Download Answer
noor salem ali	unit 6 review	15/11/2007	Download File	Download Answer

File Edit View Favorites Tools Help
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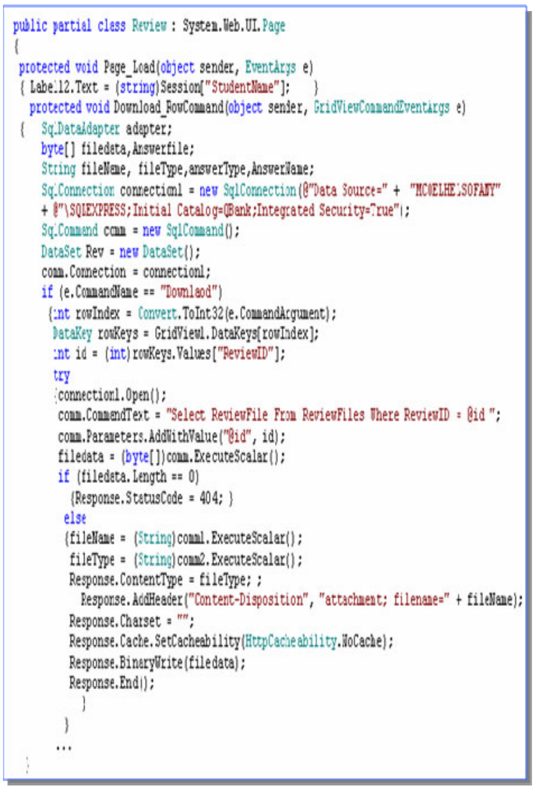
Main Exit
Main Page
Previous Exams
Practices
Quiz's scores
Submit

Figure 14. Download reviews

d. **Print students scores:** Teacher can use this tool to print the grade reports for the students who took the web-based quizzes (exams) proposed by the system, as shown in Figure 18.

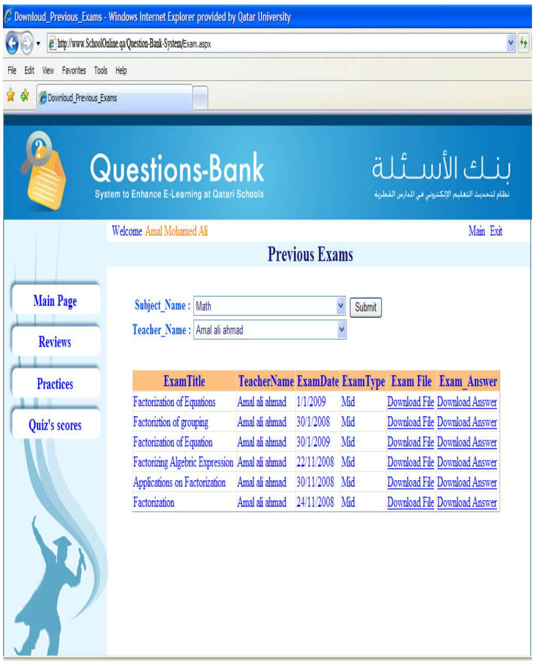
iii ***The student sub-system***: This sub-system allows the student to download reviews, to download the previous exams and their model answers, and to take selected quizzes. In addition to the `login`, and `change password`, the following services are available in the student sub-system:

a. **Download reviews:** Student can use this service to download the reviews files for his/her subjects, as shown in Figures 14. The student select the `subject name`, and the `teacher name` (as input) from the available list of values, the system search for the required query, and displays all the stored reviews from the database, Figure 15, shows the implementation of the "*Review-algorism*", that used for this service.



```
public partial class Review : System.Web.UI.Page
{
 protected void Page_Load(object sender, EventArgs e)
 { Label12.Text = (string)Session["StudentName"];    }
   protected void Download_RowCommand(object sender, GridViewCommandEventArgs e)
 {   SqlDataAdapter adapter;
     byte[] filedata,Answerfile;
     String fileName, fileType,answerType,AnswerName;
     SqlConnection connection1 = new SqlConnection(@"Data Source=" + "MC0ELHE1SOFANY"
     + @"\SQLEXPRESS;Initial Catalog=QBank;Integrated Security=True");
     SqlCommand comm = new SqlCommand();
     DataSet Rev = new DataSet();
     comm.Connection = connection1;
     if (e.CommandName == "Downlaod")
      {int rowIndex = Convert.ToInt32(e.CommandArgument);
       DataKey rowKeys = GridView1.DataKeys[rowIndex];
       int id = (int)rowKeys.Values["ReviewID"];
       try
       {connection1.Open();
        comm.CommendText = "Select ReviewFile From ReviewFiles Where ReviewID = @id ";
        comm.Parameters.AddWithValue("@id", id);
        filedata = (byte[])comm.ExecuteScalar();
        if (filedata.Length == 0)
          {Response.StatusCode = 404; }
         else
         {fileName = (String)comm1.ExecuteScalar();
          fileType = (String)comm2.ExecuteScalar();
          Response.ContentType = fileType; ;
            Response.AddHeader("Content-Disposition", "attachment; filename=" + fileName);
          Response.Charset = "";
          Response.Cache.SetCacheability(HttpCacheability.NoCache);
          Response.BinaryWrite(filedata);
          Response.End();
            }
         }
       ...
 }
```

Figure 15. The implementation of the "*Review-algorism*"



Downloud_Previous_Exams - Windows Internet Explorer provided by Qatar University

http://www.SchoolOnline.qa/Question-Bank-System/Exam.aspx

Welcome Amal Mohamed Ali

Previous Exams

Subject_Name : Math

Teacher_Name : Amal ali ahmad

ExamTitle	TeacherName	ExamDate	ExamType	Exam File	Exam_Answer
Factorization of Equations	Amal ali ahmad	1/1/2009	Mid	Download File	Download Answer
Factoriztion of grouping	Amal ali ahmad	30/1/2008	Mid	Download File	Download Answer
Factorization of Equation	Amal ali ahmad	30/1/2009	Mid	Download File	Download Answer
Factorizing Algebric Expression	Amal ali ahmad	22/11/2008	Mid	Download File	Download Answer
Applications on Factorization	Amal ali ahmad	30/11/2008	Mid	Download File	Download Answer
Factorization	Amal ali ahmad	24/11/2008	Mid	Download File	Download Answer

File Edit View Favorites Tools Help
Downloud_Previous_Exams
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نظام لتحديث التعليم الإلكتروني في المدارس القطرية
Main Exit
Main Page
Reviews
Practices
Quiz's scores
Submit

Figure 16. Download previous exams

b. **Download previous exams:** Student can use this service to download previous exams and their model answers for his/her subjects, as shown in Figure 16. The student select the `subject name`, and the `teacher name` (as input) from the available list of values, the system search for the required query, and displays all the stored exams from the database.

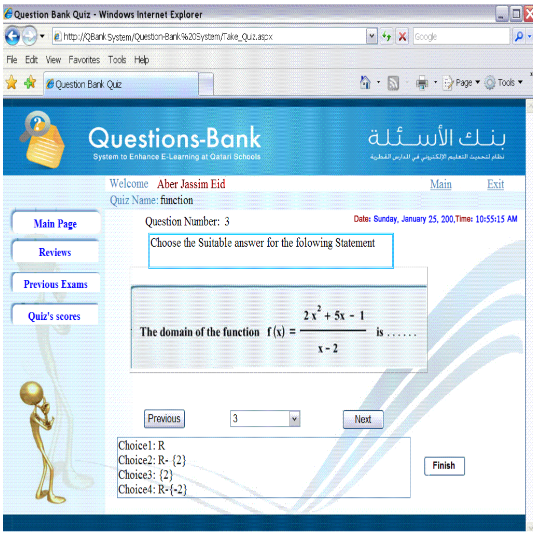
c. **On-Line Quiz:** After a student login into the system from the *student login* page, he/she can select the quiz, where the questions will be selected *randomly* by our algorithm from the database. Our system covers many types of questions as mentioned before, such as: multiple choices, True/False, and fill in the blank. The quiz will be over either whenever the student finishes it and select the "Finish" button, or whenever a pre-allocated time will be over. The system will calculate the number of correct answers and display the result. Finally, the student score will be saved in the corresponding database for possible tracking, as shown in Figures 17 and 18.

The quiz is displayed based on question-by-question methodology. A navigator is included so the student can go *backward* and *forward* over the questions in single steps. When the last question is reached, the student can go back to the *previous* one, and if the first question is reached, the student can go forward to the *next* questions. When the student finishes the quiz, a record will be created in the `StudentScore` table, and stored in the database. Teachers can consult this table to track the activities of their students.

V. SYSTEM EVALUATION

To obtain some feedback about the "Questions-Bank" system, we have prepared a questionnaire and distribute it to the potential students registered in the system. Sixty students have been randomly selected to use as a testing pool. A group of 30 students have used the hard paper quiz (and review) and another similar group has used our web-based system. Table 2 shows that both groups obtained approximately similar results. Students had to obtain a grade of 60% to pass the quiz. After taking the quiz, all the students had to fill in a questionnaire with general and specific questions related to the method of testing. The most significant questions reflecting student opinion are set out in Table 3, with the relevant group responses.

The results of question 2 indicate that, independently of the method used, a vast majority of students want to know their grade as soon as possible as well as the correct answers. The results of question 5 indicate that, a large percentage of students who did not use the computer-based system felt that their marks would have been worse if a computer had been used. Similarly, question 4 shows that a percentage of student using computers felt that they might have done better using traditional methods.


Question Bank Quiz - Windows Internet Explorer
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Google
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Question Bank Quiz
Page ▾ Tools ▾
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Main
Exit
Main Page
Reviews
Previous Exams
Quiz's scores
Previous
Next
Finish

Welcome Aber Jassim Eid

Quiz Name: function

Question Number: 3

Date: Sunday, January 25, 200,Time: 10:55:15 AM

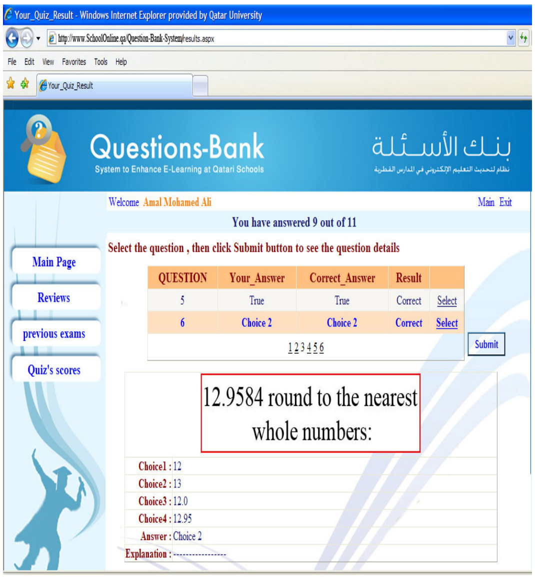
Choose the Suitable answer for the folowing Statement

The domain of the function $f(x) = \frac{2x^2 + 5x - 1}{x - 2}$ is . . . . . .

3

Choice1: R
Choice2: R- {2}
Choice3: {2}
Choice4: R-{-2}

Figure 17. Student quiz


Your_Quiz_Result - Windows Internet Explorer provided by Qatar University
http://www.SchoolOnline.qa/Question-Bank-System/results.aspx
File Edit View Favorites Tools Help
Your_Quiz_Result
Questions-Bank
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Main Exit
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Reviews
previous exams
Quiz's scores
Submit

Welcome Amal Mohamed Ali

You have answered 9 out of 11

Select the question , then click Submit button to see the question details

QUESTION	Your_Answer	Correct_Answer	Result	
5	True	True	Correct	Select
6	Choice 2	Choice 2	Correct	Select

1 2 3 4 5 6

12.9584 round to the nearest whole numbers:

Choice1 : 12
Choice2 : 13
Choice3 : 12.0
Choice4 : 12.95
Answer : Choice 2
Explanation : ----------------

Figure 18. Student quiz' scores

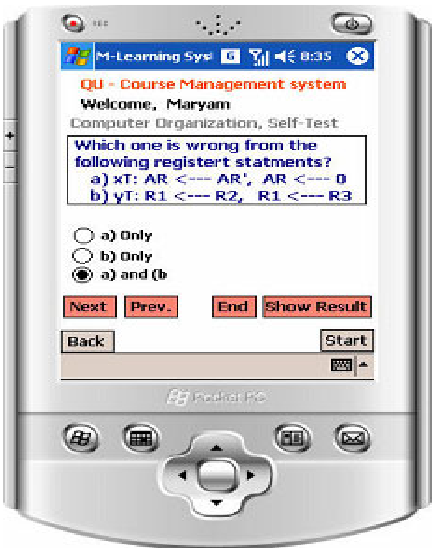
Finally, the majority of the students trust more a computer-based evaluation system than classical methods. Some students did comment on the absence of printed copies of their answers and the fact that they could not compare their answers with the correct results after the quiz.

TABLE II.
QUIZ RESULTS OF THE TWO GROUPS OF STUDENTS

Student Groups	Passed	Percentage
A – paper quiz & review	22	% 73.33
B- computer quiz & review	25	% 83.33

TABLE III.
RESULTS OF THE QUESTIONNAIRES OF BOTH GROUPS

	Group A (%)	Group B (%)
1. Do you trust the on-line evaluation system?		
Yes	65	90
No	35	10
2. When do you prefer to be told your quiz score?		
At the end	80	95
Later	20	5
3. How would you describe the process of entering answers in the computer?		
Easy	-	75
Acceptable	-	22
Difficult	-	3
Very difficult	-	-
4. How do you feel your result would have been, if the quiz had been on paper as the traditional way?		
Worse	-	25
Same	-	40
Better	-	5
Do not know	-	30
5. How do you feel your result would have been, if the quiz had been by the on-line system (i.e., computer-based)?		
Worse	40	-
Same	30	-
Better	20	-
Do not know	10	-



QU - Course Management system

Welcome, Maryam

Computer Organization, Self-Test

Which one is wrong from the following registert statments?
a) xT: AR <--- AR', AR <--- 0
b) yT: R1 <--- R2, R1 <--- R3

○ a) Only
○ b) Only
● a) and (b

Figure 19. The Mobile Questions-Bank system (MQB)

VI. CONCLUSION AND FUTURE WORKS

This paper describes the analysis, design, and implementation of the Questions-Bank system, that allows the students to take web-based quizzes and exams, to download course reviews, and previous exams. The system facilitates generation of automatic, balanced, and different exam sheets, that containing different types of questions, covering the entire curriculum, and displaying gradually from easiness to difficulty. The system allows the schools to create a Questions-Bank database that stores the exams questions, the previous exams, the model answers, the reviews, and useful exercises for each course.

Today, Mobile learning (M-learning) can use a collection of tools that tutors and developers can combine to deliver their teaching resources, such as:

- SMS (text messaging) for skills test and for collecting feedback.
- Java-based quizzes.
- Learning modules use on PDAs.
- Collection of pictures and video using camera-phone.

We intend to improve our research work, that introduced in [11], by implementing the prototype "*Mobile Questions-Bank" system* (MQB), that provides the students to take wireless quizzes, wireless reviews, and wireless exams, as shown in Figures 19.

In order to develop the MQB system, three mobile technologies will be evaluated to use:

1. **SMS (Short Messaging Service):** The questions could be sent to students via SMS messages, after which the students could reply with the answers via SMS messages. This approach is susceptible to delays because delivery times of SMS messages may vary greatly. When responding to a stream of questions, there is possibility of the SMS messages being duplicated or delivered out of sequence, causing errors in scoring.
2. **WAP (Wireless Application Protocol)**: The questions could be displayed in the student's mobile phone as a very simple Internet web page based on the WAP format. The student could then select the response using the mobile phones navigation keys. The questions and answers would be transmitted using GPRS (General Packet Radio Service) or 3G (3rd. Generation) mobile data networks. However WAP generally offers an unfriendly user interface that may be confusing to students. When the mobile data transmission breaks due to network issues, it is not possible to recover from the error and show the student a helpful message.
3. **J2ME (Java 2 Micro Edition) and XML** (eXtensible Markup Language**)**: The student could download and install a small J2ME application that would interact with the server over the GPRS and 3G mobile data networks, fetching XML questions file and transmitting responses as XML answer file to the server. Unlike WAP, J2ME applications have full control over the mobile phone screen to ensure that the application looks and operates the same on any mobile phone. J2ME applications also have full control over the data transmission and can retransmit the data in case of error

The system environment will be divided into two major blocks. The first one is the *client side application*, which developed by J2ME/JAVA with parser to read and write XML files. The second block is the *server application,* which developed by ASP.NET, C#.net, and XML database. Using this architecture will offer a great promise to combat the following defects related to the use of mobile devices:

- **Screen size limitation**: J2ME applications have full control over the mobile phone screen to ensure that the application looks and operates the same on any mobile phone.
- **Narrow network bandwidth**: The student can connect to the network to browse and download the XML questions file, this file contains the quiz itself, so that, the student can disconnection with the server, and can connected back when he/she want to send the XML answers file.
- **Small memory capacity and low computing power:** In order to combat this defect, we will develop the J2ME program and the transmitted XML file suitable to support wide ranges from mobile phones.

ACKNOWLEDGMENT

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