

## Web-Based Collaborative Question Bank with Adaptive Quiz Generator

Abigail Galvano Alazhar<sup>1</sup>, Nor Bahiah Hj Ahmad<sup>\*2</sup>

Department of Software Engineering, Faculty of Computing, Universiti Teknologi Malaysia,  
81310 Johor Bahru, Johor, Malaysia

<sup>1</sup>galvanoalazhar@outlook.com, <sup>2</sup>bahiah@utm.my

### Abstract

*Teacher-centered learning method can sometimes be seen as a quite passive learning experience for the students. Student may become highly dependent on the learning materials or sample questions that are provided by the teachers. Student also may not be aware of their ability level by working on the given questions. To overcome this problem, Web-Based Collaborative Question Bank with Adaptive Quiz Generator is proposed in this project. This proposed system is intended to solve this problem by providing a collaborative learning platform combined with adaptive learning features for the students. This system allows the students to submit questions along with their answer keys to it, based on the topics they have learned. These submitted questions then will be filtered by the teacher, to ensure the quality of the questions. The collected questions then can be used to generate quizzes for the students. The system also encourages the student to give feedback to the answered questions. The teacher can also monitor the student contribution to the question bank and their progress in answering the quizzes within this system. The proposed system is expected to facilitate knowledge sharing among the students, and also to improve the capabilities of the teacher to understand the students' problem in their study*

**Keywords:** Question bank, Collaborative learning, Adaptive quiz, Web-based

### 1.0 Introduction

Working on sample questions or taking quizzes is one of the ways for the students to revise what they have learned. These sample questions, however, are mostly provided by the teacher / lecturer. Because of this, the students may become discourage to try to create their own question as a practice for themselves or their friends, due to the reliability of the question provided by the teacher / lecturer. This may limit the scope of learning of the students to study only the things prescribed by the teacher. Additionally, the teachers / the lecturers may have limited information on the students' involvement to the subject that they taught, due to this passive behavior of the students (Cheong, 2014).

This paper discussed about the development of a system, which is a collaborative question bank that allows the students to share knowledge to each other by posting question-answer pairs to the question bank (Fong et al., 2004). The question bank then later can be used by the other students to generate quizzes for them. Adaptive learning feature is also incorporated to the generation of the quiz, so that the students have an idea about their

understanding level as they work on the quizzes. The teacher / lecturer later can monitor the performance of their student, by looking at the quality of the posted questions, the involvement and the achievement that students made.

The main objective of the project is to design and develop a web-based collaborative question bank system with adaptive quiz generator using appropriate software engineering principle. The requirements of the proposed system are elicited by analyzing the previous techniques used in creating the question bank and generating quiz based on the question bank. Once the system has been developed, the system was validated and tested on the functionality and the usability of the developed system.

This paper starts with the introduction of the project and followed by the problem background. Further, the following section describes the methodology being adopted in order to implement the project. The results and discussions of the project achievements are presented and finally the paper ends with the conclusion.

## **2.0 Problem Background**

Teacher-centered learning can be seen as the usual learning method that we found in most of the learning institution. The learning materials (such as sample questions) that available are mostly provided by the teacher / lecturer. As a result, most of the students may become too dependent to their teacher / lecturer.

This high dependence on teacher / lecturer may bring some drawbacks for the students. First, the students may become discouraged to look for other learning materials, or posing a question that is beyond what is taught in the class. Second, the provided learning materials, or sample questions, may be tailored specifically for the upcoming examinations, which again could limit their knowledge to the ones that will be tested on the examinations. Third, different lecturers that teaches same subject may give different quality of teaching, and may provide sample questions or learning materials with different quality. The students may have different understanding level because of the exposure to the different quality of lecturers and different quality of learning materials / sample questions. Additionally, by working on the different sample questions given by different lecturers or from different materials, the students may not be able to measure their understanding level relative to the other peers that studied the same subject

One of the ways to overcome the problems mentioned above, is might be by allowing the students to take a larger part in the learning process. Asking question or quizzing to each other is one of the ways for the students to share their knowledge. A system that is based on the questions that is created collaboratively might be needed for the students (Partchev, 2004).

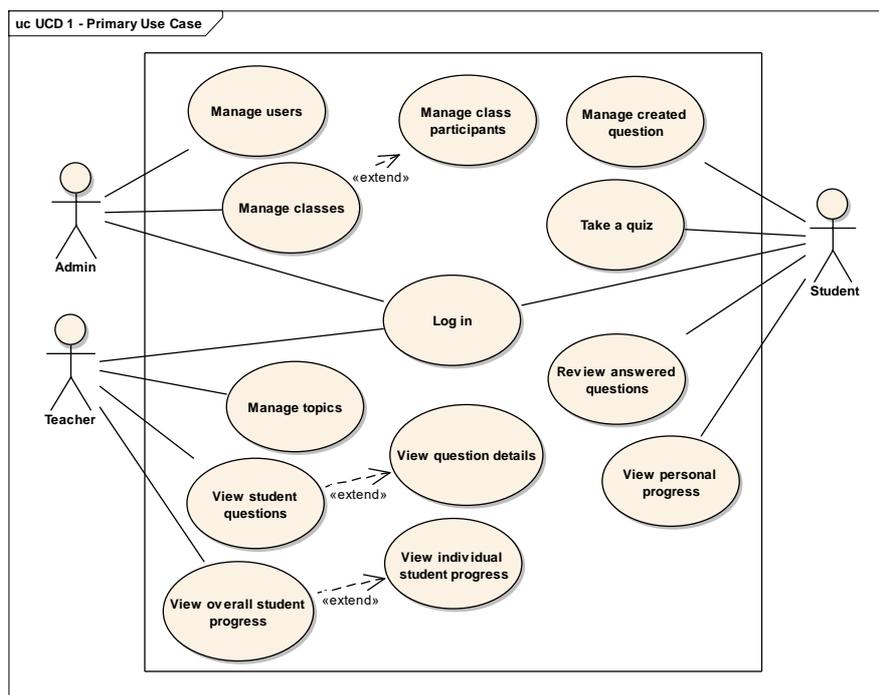
This system should allow the students in providing the learning materials, such as sample questions, to the other students. From this provided learning materials or sample questions, student should also be able to get the idea of their understanding level based on the learning materials or sample questions that they have taken. However, teacher's supervision on the questions, that is made collaboratively and shared among the students in a form a quiz, might be needed as well. This is to make sure that these questions are within the standard that is good enough from the teacher's point of view (Wright et al.,1980).

### 3.0 Methodology

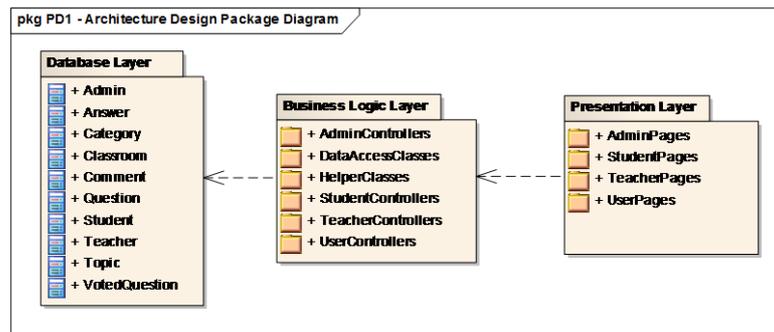
Rational Unified Process (RUP) is one of the software development methodologies. In Rational Unified Process, Unified Modeling Language (UML) plays the important role, as it is mostly dealing with the creation and the maintenance of the model. Rational Unified Process (RUP) is also an iterative process which can be broken into four phases, which are called as: 1) Inception phase, 2) Elaboration phase, 3) Construction phase, 4) Transition phase

In this inception phase, the requirements from the documentation of the quiz feature and the question bank feature in Moodle and the documentation of the other systems, such as PeerWise (collaborative question bank) and PrepU (adaptive quiz), are studied. Item Response Theory, which is the base for the adaptive quiz, is also studied in this phase. BICAL computer program is also studied to implement the calibration of the student understanding level and question difficulty.

In the elaboration phase, the requirements are translated as the UML diagrams. The use case diagram and the actors are identified, which includes the admin, teacher and student. The use case diagram can be seen in Figure 1. Use case specifications, sequence diagrams, and activity diagrams are also created as the part of the Software Requirement Specification (SRS). Additionally, the software architecture for the system and the database design are also created to make the Software Design Document (SDD). The software architecture of the system can be seen in Figure 2.



**Figure 1** The use case diagram of the system



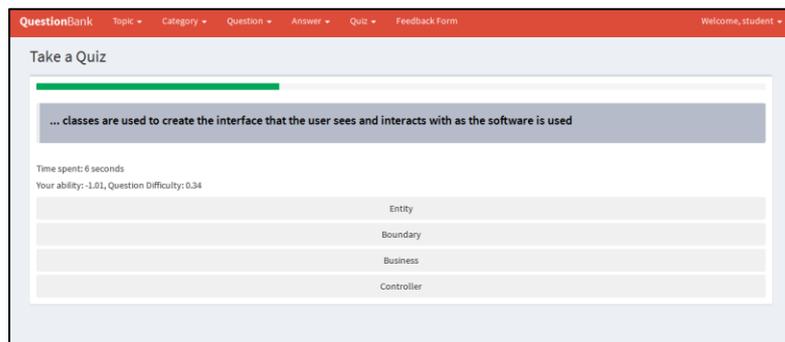
**Figure 2** The architecture of the system

In the construction phase, the design created in the previous phase got converted into the source code. The construction phase will be done for each of the identified actors, which are the admin, teacher, and student. In the transition phase, integration testing between all of the function in the system is done. User acceptance testing is also performed by distributing questionnaire to the student that tried this system.

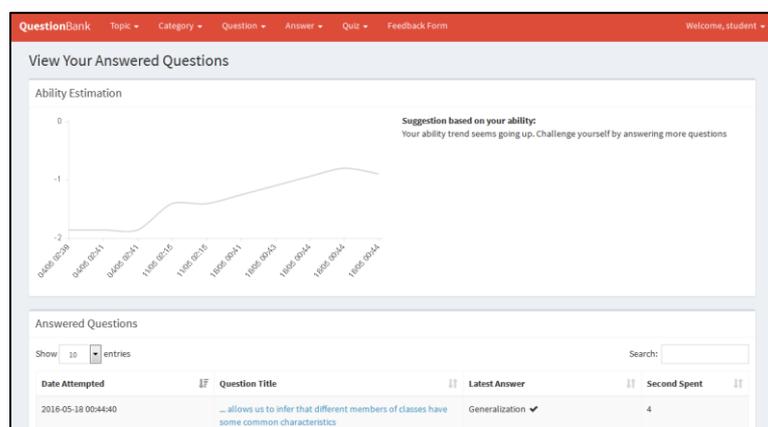
#### 4.0 Result

The system is developed using Javascript to handle the presentation layer of for the teacher and student, Java for the business logic layer and the data access objects, and MySQL handles the database. The presentation layer is developed using a Javascript framework called Backbone.js, which is one of the Javascript framework that can be used in creating a single page application. This implementation of a single page application is chosen so that it has the feeling of an application rather a traditional web page. The business logic layer is developed using a Java web application framework called Spring MVC. Additionally, to handle the data access, a Java object-relational mapping called Hibernate is used. The example of the developed web application can be seen in Figure 3, Figure 4 and Figure 5. Figure 3 shows the interface for the user to add new question in the database. Figure 4 shows the screen shot of the interface for the user to take the quiz, while Figure 5 shows the analysis of the questions being answered.

**Figure 3** Implemented function to Add New Question



**Figure 4** Implemented function to Take a Quiz



**Figure 5** Implemented function to View Answered Questions

Additionally, User Acceptance Testing also has been done to test the overall usability and the functionality of the system. ( Nurul and Khairuddin, 2008). The subject of this User Acceptance Testing comprises of 12 students that have tested the system. The results of the User Acceptance Testing are displayed in Table 1. From Table 1, it is observed that overall the user is satisfied with the usability of the system.

**Table 1** User Acceptance Testing results (using Likert scale whereby: 1 – strongly disagree, 5 – strongly agree)

| <b>Factor</b>                          | <b>Mean</b> | <b>Standard Deviation</b> |
|--|-------------|---------------------------|
| Familiarity with the topics            | 4           | 1.04                      |
| Problem understanding label            | 2.5         | 1.31                      |
| Problem in navigation                  | 2.75        | 0.62                      |
| Easy to post new question              | 3.16        | 0.83                      |
| Easy to take a quiz                    | 2.91        | 1.08                      |
| Ability to monitor understanding level | 3.91        | 0.79                      |
| Ability to review back questions       | 3.25        | 1.05                      |
| Ability to give feedback to questions  | 3.41        | 0.9                       |
| Ability to view answer statistics      | 4.08        | 0.9                       |
| Overall satisfaction                   | 3.33        | 0.98                      |

## **5.0 Discussion**

From the results of the User Acceptance Testing, overall students that have tested the system feel average to satisfied feeling. Most of the students find no problem in understanding the labels and navigating throughout the system, as well as to post a new question to the system. However, there is a mixed reaction of the features that enable the students to take a quiz based on their preferences. This problem is observed during the testing session as well. It is assumed that this problem happened due to performance issue of the system, which may relate to the traffic issue or code issue.

It is also observed that the students feel mostly satisfied with the features that are available in the system, such as monitoring the ability level when taking adaptive quiz, reviewing the answered questions, giving peer assessment through comments and votes, and viewing their statistics on the topics and categories based on their achievements.

As for the objectives, all three objectives of the project have been achieved. The functions on the related systems (Moodle, PeerWise and PrepU) that are related to quiz creation and question bank have been studied. Additionally, the calculation and the algorithms related to Item Response Theory also have been studied. The requirements also have been identified based on all these information. To build this system, layered architecture has been decided as the architecture design of this project that comprises of: Presentation layer, Business logic layer and Data layer. The system also been developed using Java and Javascript web technologies. User Acceptance Testing also has been done to the students, which is the main user of the system.

## 6.0 Conclusion

The system has been successfully developed and has performed its functions according to the requirements, despite of having some weaknesses. One of the weaknesses in system is, the questions submitted by the students still need to be supervised and filtered by the teacher. This is may not be an efficient process, especially if the teacher is very busy. An artificial intelligence technique might be implemented to overcome this weakness. The questions submitted by the students might be clustered to the appropriate topic and category based on their characteristics using the developed artificial intelligence. The artificial intelligence may also be implemented in removing the question as well as the comments to the questions that might not be appropriate.

Additional suggestion is that the improvement should allow the students to posted different kinds of questions, and not just multiple choice questions. The students should also be allowed to attach related media, such as animations, audio or video to the questions as well as to the possible answers to add more interactivity to the system.

Overall the system can give great benefit to the students and teachers. This system may help the students to collaborate with other students easily by expose the student with different kinds of questions posted by the other students. This system may also help the students to identify in their knowledge level of certain subject as they work on the quizzes. On the other hand, this system may help the teachers to encourage a more student-centered learning in their classes. The teachers will be able to understand the capabilities of each of their students based on the quality of the questions that they contribute and their performance in answering the questions.

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