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EdQuizy: A Development of a Quiz Mobile Application with Anti-Cheating Features

Wan Nurfasihah Najwa Wan Osman[1], Nurul Hidayah Ab Rahman[1]*

[1]Fakulti Sains Komputer dan Teknologi Maklumat,
Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

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Abstract: Recently, the outbreak of Covid-19 has impacted the assessment method in the education system. Teachers used an existing online quiz application to conduct the quiz, but the existing applications are limited with security and anti-cheating support. Therefore, an online quiz mobile application with anti-cheating features, EdQuizy is proposed by adding anti-screenshot and randomized quiz answer option order in student module to minimize students cheating during quiz. It is developed on Android Studio using Java language. Evolutionary prototyping model is applied as a methodology. FLAG_SECURE algorithm is used to implement the anti-screenshot to prevent the window's content from being viewed on non-secure displays. While fisher-Yates shuffle algorithm is applied to randomize the quiz answer option order. The application provides four modules which are registration, year and subject, quiz as well as results module. EdQuizy provides three users; admin to manage users, teacher to manage quizzes, view students' results, and generate grading, and student to answer quizzes and view results. Overall, EdQuizy prevents students from taking screenshots and the answer option order is randomized in the application.

Keywords: Android Applications, Anti-Cheating Features, Online Quiz

1. Introduction

A quiz is a simple test that is provided by educational institutions and some organizations to observe and evaluate the performance of their students and employees. The quiz provides many forms of questions such as fill-in-the-blank, multiple-choice, and true or false.

Recently, Covid-19 outbreak has spread and the education system is one of the sectors that has been impacted by this pandemic. Previously, students learned via a face-to-face approach, however, the teaching and learning process has been radically altered since the pandemic. It causes traditional methods to be replaced by a new normal, which is the online learning approach. Although Malaysia is in the endemic phase effectively on April 1, 2022, the Ministry of Education implements a rotation attendance method where the number of students is reduced to 50% and the remaining 50% are still in

Corresponding author: hidayahar@uthm.edu.my

online learning [1]. Furthermore, most class assessments such as the quiz and final exams are run using an online platform.

Many quiz applications are already available on the internet, but each application provides pros and cons. There is also a limited quiz application that focuses on security and anti-cheating. According to Wiley [2], who surveyed 789 instructors, 93 percent of them believe that the possibilities of a student cheating in an online learning environment are higher than in a traditional learning environment. Students may find numerous ways to cheat on tests. In addition, the quiz application that is offered online does not provide any protection for copying and pasting the quiz questions. Students can search it by pasting it into a web browser or taking a screenshot and uploading the question to discover the answer. They may also pass the question around to other classes and the question can be leaked. Therefore, this project proposed EdQuizy, a mobile quiz application for primary school students with anti-cheating features. The application is proposed to Sekolah Kebangsaan (SK) Fakeh Abdul Samad that is in Kuantan, Pahang as a case study. The objectives of this project are:

i. To design an online quiz mobile application with anti-cheating features and role-based access control for teachers and students in SK Fakeh Abdul Samad.
ii. To develop an online quiz mobile application with anti-cheating features and role-based access control for teachers and students in SK Fakeh Abdul Samad.
iii. To test the application from functionality and users testing.

EdQuizy is developed for android smartphones with anti-cheating features and role-based access control to prevent users (i.e. students) from cheating. The anti-cheating features that are applied in this EdQuizy are anti-screen capture and randomized quiz answer option order. Moreover, three users, which are admin, teachers and students used EdQuizy. Each user has his own set of requirements and only has access to its own sections. The development of EdQuizy is expected to reduce students' cheating as well as help the teacher in assessing the student's academic performance.

The remainder of this paper is organized as follows: Anti-cheating techniques and authorization mechanisms are discussed in Section 2. Besides, a comparison of the existing system between Quizizz, Mercer | Mettl, Google Form and EdQuizy are tabulated in a table. Followed by Section 3 that outlines the Evolutionary Prototyping Model and system architecture is displayed. Section 4 presents the results and discussions of EdQuizy. Finally, Section 5 concludes the EdQuizy project development.

2. Related Work

Taking quizzes in a face-to-face or online environment does not prevent students from cheating. During the face-to-face test environment, students cheat by sending signals to their friends, passing their notes, and exchanging their answers in the restroom. Unlike online test environments, students cheat by searching the answer in the web browser and pay subscription fees to get answers from online instructors. According to Backman[3], five students were interviewed to ask about the cheating techniques in the online exam and the common response was that they took the test together with their friends while surfing the internet to obtain the answer online.

Therefore, various features for preventing online exam cheating are offered in various online quiz applications that are available nowadays. These features are applied to establish the authenticity of the online exam conducted by teachers. The features that are provided are anti-screenshot and a randomized answer order option.

2.1 Anti Screenshot Features

Screenshot, also called screen capture or screengrab, is a method of taking a picture to record the elements on the screen by a computer, mobile, or user's tablet [4]. It can be done by using a particular keyboard or button shortcut or using various screenshot applications. The picture will be kept in the form of a graphics file. Screenshot function can be exploited by malicious students during online examinations. Students, for instance, can capture the examination questions and distribute them to their friends to discuss the possible answers during the examination. Therefore, in order to minimize such

risk from happening, anti-screenshot features should be built together in online test applications or systems.

2.2 Randomized Question and Answer Order

Gehringer and Peddycord [5], said mostly, the available exam applications can randomize the sequence of questions and multiple-choice responses, preventing the chance of students cheating during the quiz. All students will get the same question, however, the sequence in which they appear varies from one student to another. Because the sequence is randomized, it is hard for students to copy answers from one another in a given short time.

In Clusky et. al [6] paper, non-proctored online exam control procedures (OECPs) were proposed and generating a random question sequence was included to enhance academic honesty. According to Holden et. al [7], this randomized method is unlikely to eliminate cheating but this may reduce the rates of cheating.

2.3 Comparison of System

Table 1 compares Quizizz [8], Mercer | Mettl [9], Google Form [10] and EdQuizy. Role-based access controls were added for authorization mechanisms in all current systems, as well as on EdQuizy. For the anti-online exam cheating features, anti-screenshot, anti-copy and paste, remote proctoring and randomized question and answer order were examined. Based on the table, only Quizizz does not include features of anti-screenshots. For anti-copy and paste, the feature is not available in Quizizz and EdQuizy. Furthermore, Mercer | Mettl provides online live proctoring in their system, providing AI-based auto proctoring and human-aided assisted live proctoring, but others do not. For randomized question and answer order, all systems provide the features in their system.

Table 1: Comparison between Quizizz, Mercer | Mettl, Google Form and EdQuizy

Features	Quizizz	Mercer | Mettl	Google Form	EdQuizy
Role-based access control	Yes	Yes	Yes	Yes
Anti-Screenshot	No	Yes	Yes	Yes
Anti-Copy and Paste	No	Yes	Yes	No
Remote Proctoring	No	Yes	No	No
Randomized Question and Answer Order	Yes	Yes	Yes	Yes

3. Methodology

Evolutionary Prototyping was chosen to develop EdQuizy. This methodology was selected because users can provide feedback, review the system prototype, and improve before the final system is constructed. As a result, it allows the system to be upgraded and provides enough functionality for the final system.

Figure 1 shows the Evolutionary Prototyping Model. This model started with planning, analyzing, and designing the initial prototype and implementation. The design prototype is refined and repeated until all specified requirements are met based on feedback from the user. Once the prototype is approved by the user, the actual product will be built and tested.

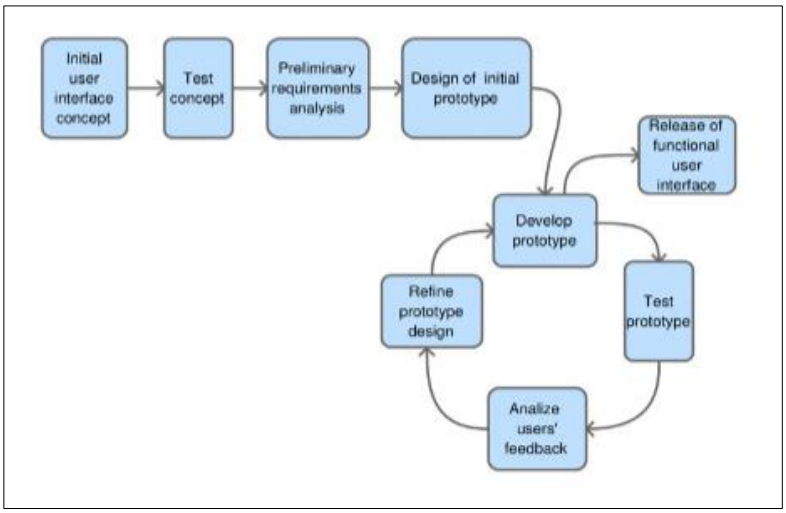

Figure 1: Evolutionary Prototyping Model [8]

3.1 Planning phase

Finding a supervisor, discussing the chosen project titles, and identifying problems and objectives to develop the system were all part of the planning process. To gather more information about the system and user requirements, one of the teachers from SK Fakeh Abdul Samad, was interviewed during this planning phase. Furthermore, data was gathered throughout this phase to guarantee that all project needs were determined before moving on to the following step.

3.2 Analysis phase

In the analysis phase, the issue was analyzed, and a solution was devised. This phase focused on requirements gathering and identified functional and non-functional requirements that should be included in the system. Object-oriented designs are used to describe the behavior and explain the structure of the system into smaller modules. Object-oriented techniques employ the unified modeling language (UML) to design the system via visualization, diagram, and processes. UML consists of a use case, class diagram, sequence diagram and activity diagram.

A use case is the main system requirement that specifies the end users' activities, roles, and behavior in the EdQuizy. Three target users are shown in detail in Figure 2, Figure 3 and Figure 4 which are student, teacher and admin respectively.

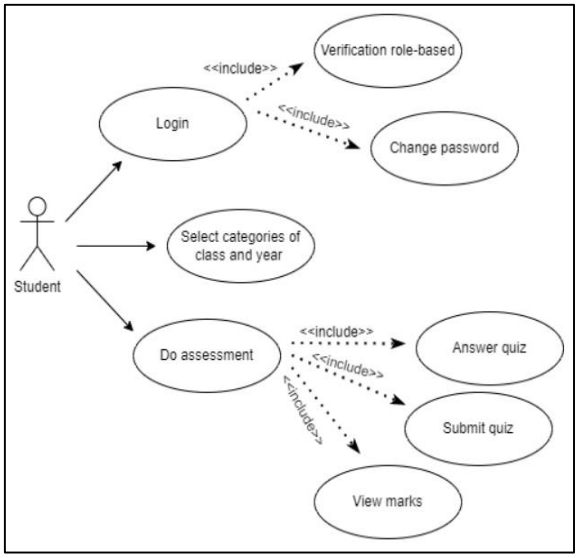

Figure 2: Use Case Diagram for Student

Figure 2 shows the use case diagram for students in the EdQuizy. Students need to login into the application when using it. Students are also able to change their passwords in the application. After that, before they want to answer quizzes, students need to select the categories of their current class and year. After answering the quiz, students are allowed to submit their answers and view their marks.

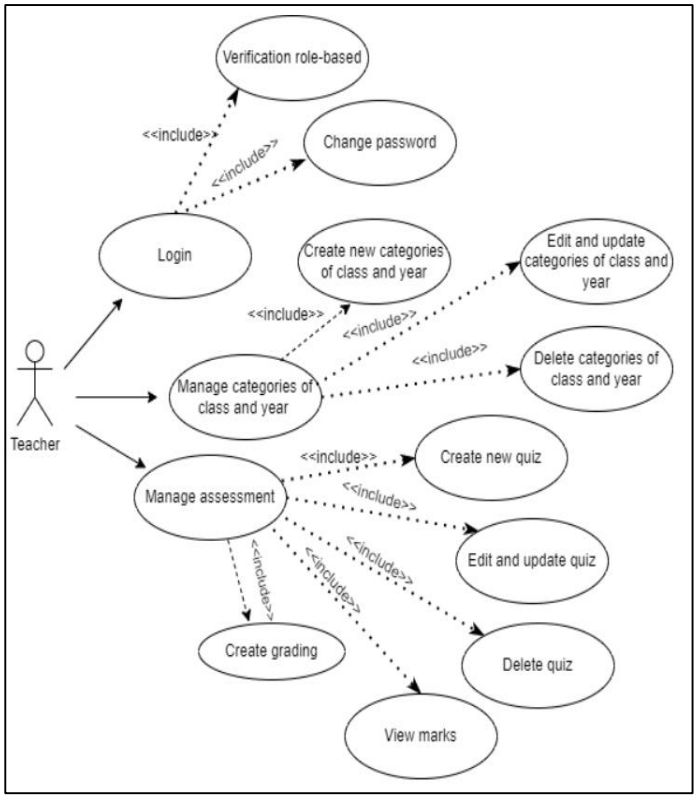

Figure 3: Use Case Diagram for Teacher

Figure 3 demonstrates the use case diagram for teachers. Teachers need to login and are allowed to change passwords in the application. Teachers are also able to manage categories of class and year to create the quiz based on their current year and class of teaching. Subsequently, teachers are responsible for managing quizzes by creating, editing, updating and deleting quizzes. Furthermore, teachers are allowed to create grading for the quizzes' questions and view marks of their students.

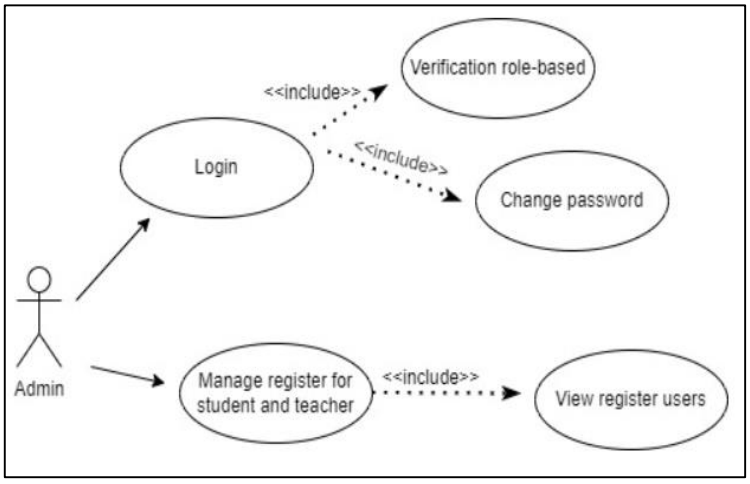

Figure 4: Use Case Diagram for Admin

The use case diagram for admin is shown in Figure 4. Admin required to login into the system. Admin also can change passwords in the application. Admin is also in charge of managing the registration of students and teachers in the application. Security requirements are identified in this phase. Threat modeling is an approach to identify any potential security risks and weaknesses. The abuse case is employed to identify the possible security threats and harmful behavior for EdQuizy by the potential threat actors.

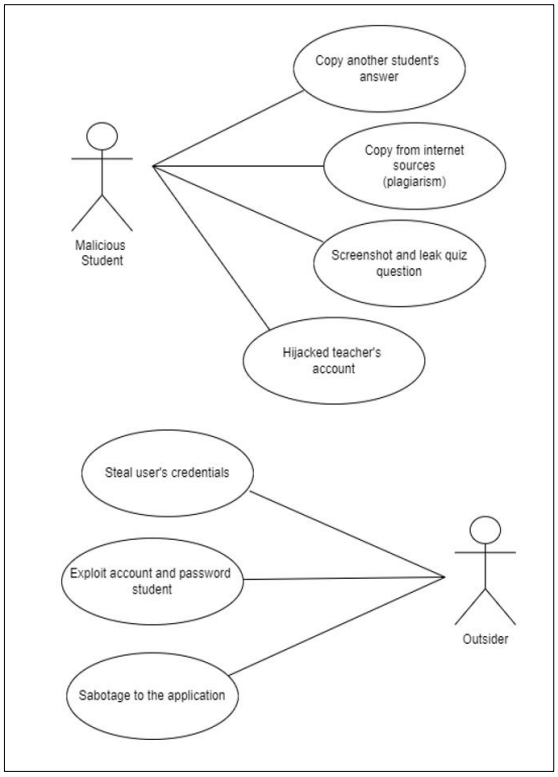

Figure 5: Abuse Case for EdQuizy

As indicated in Figure 5, two potential threat actors have been identified which are: - (1) malicious students and (2) outsiders. First, four possible malicious acts are determined for the malicious students. The malicious students may copy another student's answer by asking and having communication with their friends to get the answer. Next, malicious students may plagiarize it by copying the answer from an online source to acquire the right answer while taking the quiz. The malicious student may also take a screenshot and distribute it to other students who have not yet taken the quiz. Additionally, the malicious students can hijack the teacher's account to do any illegal activities and take over the teacher's account.

An outsider is the second potential threat actor. Outsiders may steal users' credentials to get users' sensitive information to gain something. Furthermore, an outsider can also exploit the accounts and passwords of students. Students that use an easy password will be exposed to this attack. Lastly, students may hire an outsider that can sabotage the application because of the proposed system's anti-cheating features, which may prohibit them from cheating during the quiz by telling the attackers to make an available copy and paste in the menu bar.

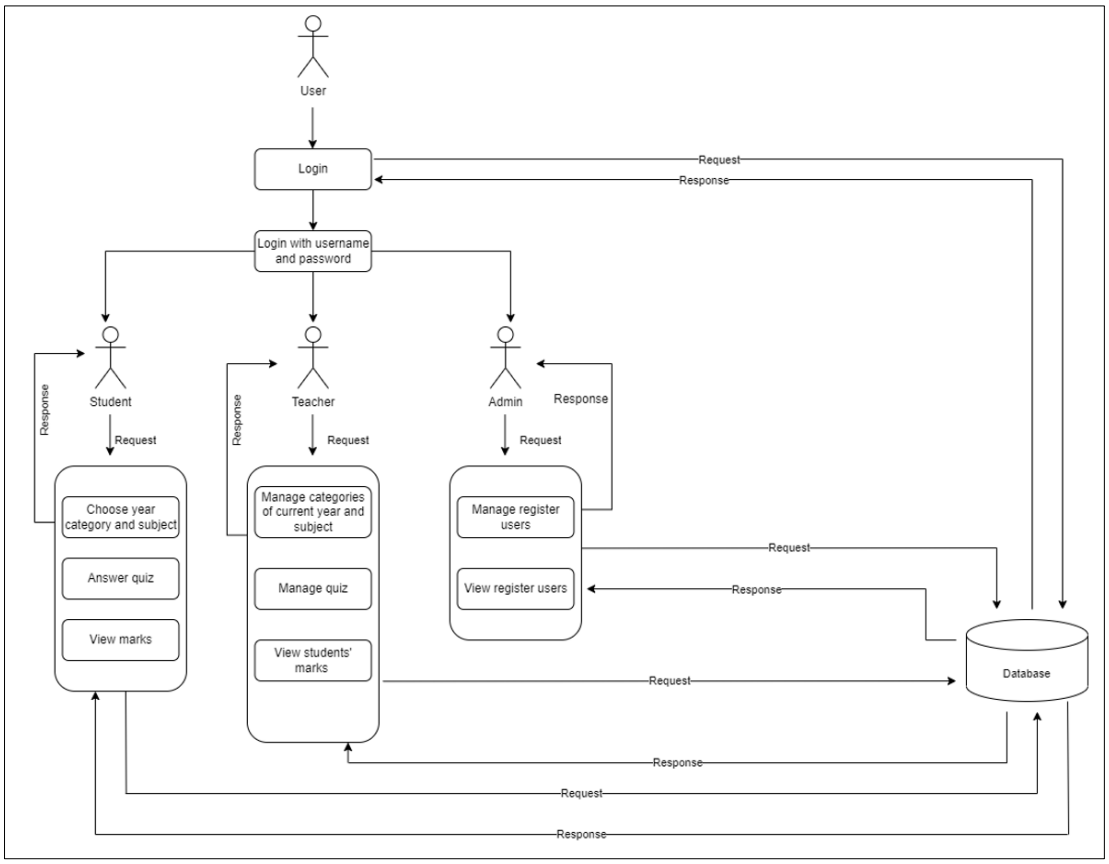

Figure 6: System Architecture for EdQuizy

Figure 6 presents EdQuizy's system architecture that consists of three users which are student, teacher and admin. Users must log in to the application using their username and password. The system will display the interface based on the users' roles after verifying their roles in the database. Students can request to choose categories of their current year and subjects, answer quizzes and view marks. Besides that, for teachers, teachers can request to manage categories of their current teaching class and year, manage quizzes and view students' marks. Admin is in control of registering users in the application. Admin can request to manage registered users and view registered user information. The tasks of the user will respond to the user.

3.3 Design phase

The design phase includes software development tasks such as designing and constructing a user interface, database, and modules for EdQuizy. A data dictionary is used to identify the data that should be inserted into the database. Moreover, the user interface was designed in accordance with modules that were available such as the registration module, class category module, quiz module, result module and log activity module. The design principle that is applied during the development includes layout, aesthetics, and consistency.

Figure 7: Interface design for the main page

In Figure 7, users are required to select their user role before being redirected to the login page to insert their username and password.

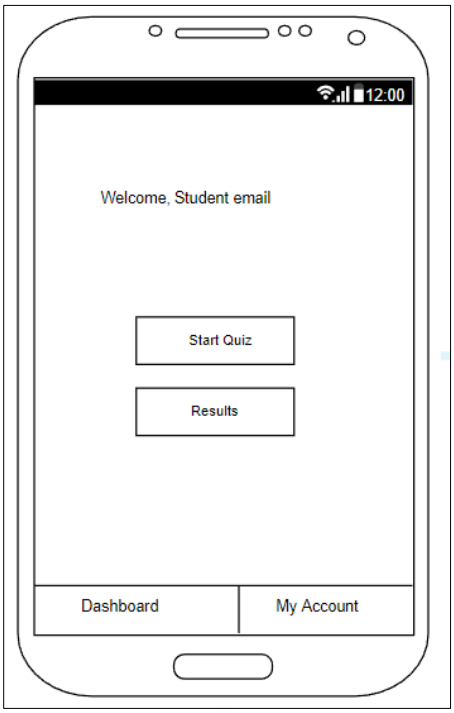

Figure 8: Interface design for student's homepage

Figure 8 shows the interface design for the student's homepage. On the page, the menus for the start quiz, and results are displayed. There is also a bottom navigation bar menu for users to select the dashboard to see the main menu and select my account to manage user profile.

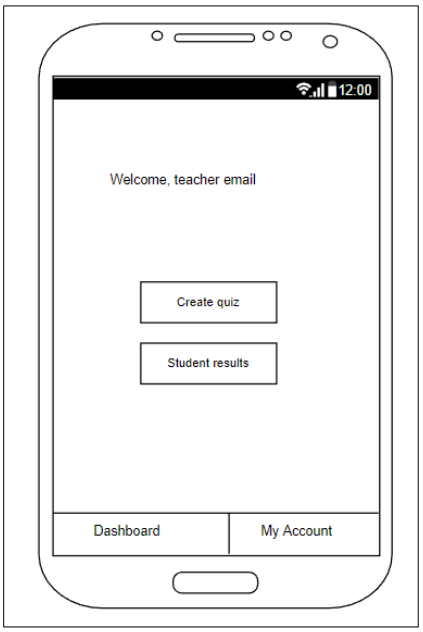

Figure 9: Interface design for teacher's homepage

The interface design for the teacher's homepage is shown in Figure 9. The menus for creating quizzes and student results are presented on the page. The user can also click the dashboard to see the main menu and my account to manage their user profile from the bottom navigation bar menu.

Figure 10: Interface design for admin's homepage

Figure 10 displays the interface design for the admin's homepage. Admin is responsible for managing users and viewing registered users. The menus for adding new users and viewing registered user registration log are presented on the page.

3.4 Implementation phase

EdQuizy is formed during the implementation phase. This is the phase where the system was set up and deployed, implemented into source code via coding, used the add flag algorithm to implement the screen capture capabilities provided in the Android API, and unified all the modules. EdQuizy is an Android application developed in Java. The data is stored in the Firebase database. This phase will also add security and anti-cheating features.

Figure 11, 12, Figure 13 shows the interfaces of Main Page, Admin Login Page, and New User Registration respectively that are developed for EdQuizy using Android Studio.

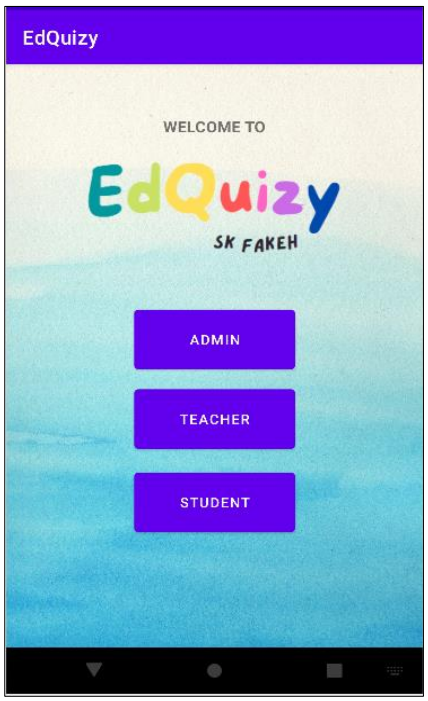

Figure 11: Main Page for EdQuizy

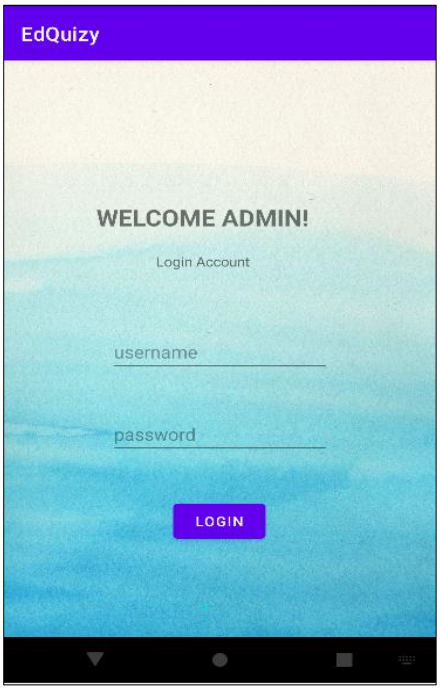

Figure 12: Login Page for Admin

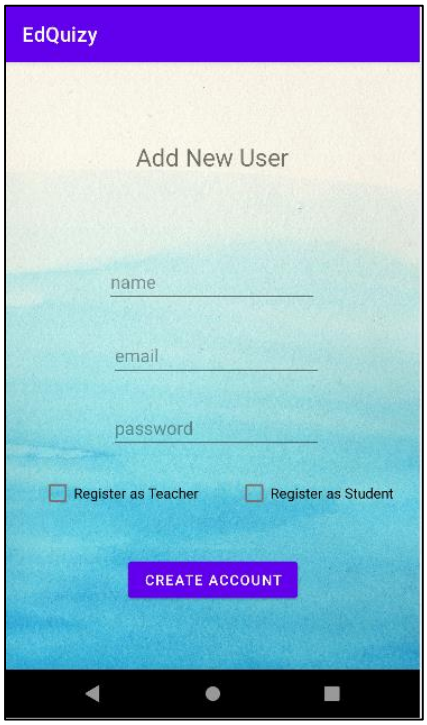

Figure 13: Register New User Page in Admin Menu Page

3.5 Testing phase

This phase is another important phase since the system is fully tested before being delivered to the end-user. Throughout this phase, all system flaws were determined, including bug fixes and security. If there are any changes or improvements that need to be made, they must be made right away until the user is satisfied. The involved testings are user testing, application testing, and testing on the anti-cheating scenario.

4. Results and Discussion

This section discusses implementation such as the source code applied in the EdQuizy application. Anti-screenshot and randomized quiz answer option order are the two anti-cheating features that have been implemented in EdQuizy. The results of functional testing and user acceptance are also presented in this section.

4.1 Implementation of Anti-cheating Features

Anti-cheating features are implemented according to the role-based access control. Therefore, the features are implemented only for students' role in the student's module. The screen capture will be prohibited for students and an error toast message will come out if a student tries to screenshot anything in the application. For admin and teacher, both are allowed to screenshot in the application.

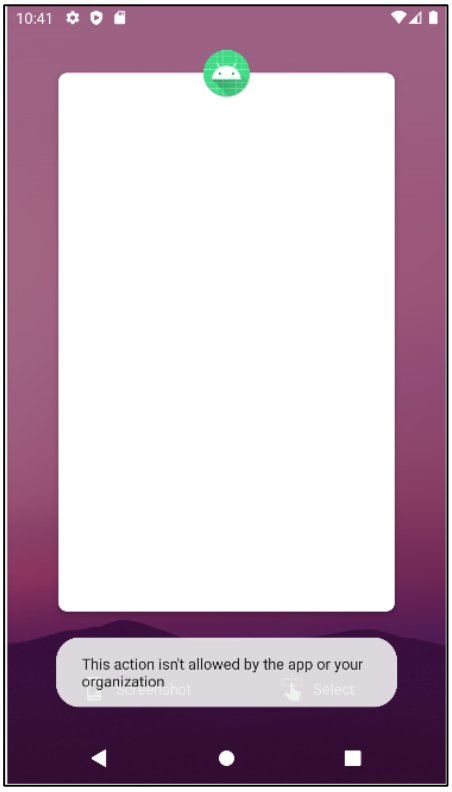

Figure 14: Error toast message for blocking screenshot

```
getWindow().addFlags(WindowManager.LayoutParams.FLAG_SECURE); //block screenshot
```

Figure 15: Code for blocking screenshot

Figure 14 depicts the error toast message that appears when a student takes a screenshot in the EdQuizy application. When a student attempts to screenshot a page, the page becomes blank. FLAG_SECURE is used to prevent the window's content from being viewed on non-secure displays. Figure 15 displays the code used for blocking user screenshots.

Other anti-cheating features are randomized quiz answer option order. Figure 16 shows adding a question-and-answer page for the teacher. When the teacher adds the question, the order for the answer option will be randomized from one student to another student. Figure 17 shows the randomization for the inserted answer option from the teacher when students answer the quiz.

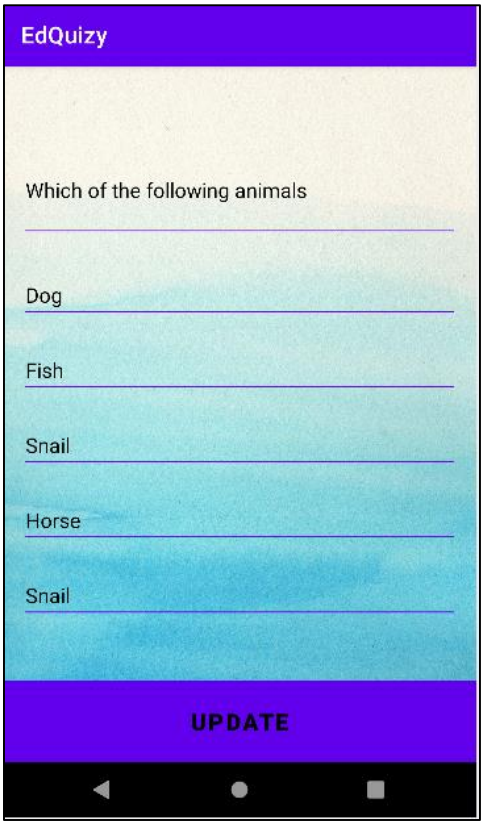

Figure 16: Adding question and answer page

Figure 17: Quiz page for student

The fisher-Yates algorithm is used during the implementation by shuffling the elements in the array. Figure 18 shows the code that is used to shuffle the answer option.

```
private void setStdQuestion()
{
    timer.setText(String.valueOf(10));

    //randomize options
    String[] options = new String[4];
    options[0] = stdQuestionList.get(quesNum).getQuestion_option1();
    options[1] = stdQuestionList.get(quesNum).getQuestion_option2();
    options[2] = stdQuestionList.get(quesNum).getQuestion_option3();
    options[3] = stdQuestionList.get(quesNum).getQuestion_option4();
    shuffleArray(options);


    question.setText(stdQuestionList.get(quesNum).getQuestion_name());
    option1.setText(options[0]);
    option2.setText(options[1]);
    option3.setText(options[2]);
    option4.setText(options[3]);

    qCount.setText(String.valueOf(1) + "/" + String.valueOf(stdQuestionList.size())); //numquestion

    SimpleDateFormat sdf = new SimpleDateFormat( pattern: "dd/MM/yyy hh:mm a", Locale.getDefault());
    dateTime = sdf.format(new Date());

    startTimer();

    quesNum = 0;
}
```

Figure 18: Code for randomizing the quiz answer option

4.3 Application Testing

This application testing is to test EdQuizy to ensure that the application functions effectively and the objectives are achieved. Table 2 shows the results of the application testing for EdQuizy.

Table 2: Testing on the anti-cheating scenario

Checklist Statement	Pass	Fail
The buttons should be provided with the required sizes.	Pass	
The buttons and interface should be consistent on all pages or sections.	Pass	
All pages are working well in the application.	Pass	
The application should verify the user based on roles according to the details that are stored in the database.	Pass	
Validation is able to perform on the required input fields.	Pass	
The application is able to display an error toast message when the selected user screenshots anything in the application.	Pass	
The application is able to randomize the order of quiz answer options.	Pass	

Table 3 displays the results of the anti-cheating scenario. The testing will verify the anti-cheating features that are implemented into the application to see whether the features are performing well.

Table 3: Testing on the anti-cheating scenario

Cheating Scenario	Expected Output	Actual Output
Students trying to screenshot quizzes in the application.	An error toast message will be shown	As expected
Quizzes are in randomized order.	The randomized of answer option for the quiz	As expected

4.3 User Acceptance Test Results

The user acceptance test is conducted to obtain feedback from users on the EdQuizy application. Login module, student module, teacher module and admin module are the modules that are being tested. The results are collected through questionnaires that are conducted online using Google Forms. 15 respondents are involved in testing the system.

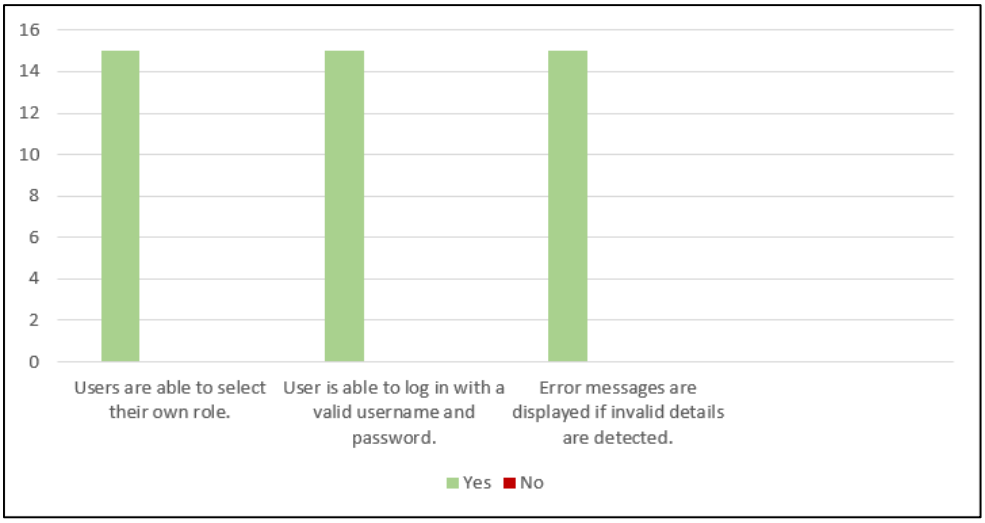

Figure 19: Result of system testing on login module

Figure 19 shows the results of system testing on the login module. All respondents agree that the login module is well-functioning. The results of system testing on the three users' modules are shown in Figure 20, Figure 21 and Figure 22. The feedback that is gathered for each module is as expected and all the modules can be accessed by all the respondents. All the respondents can manage the student module, teacher module and admin module according to their user role.

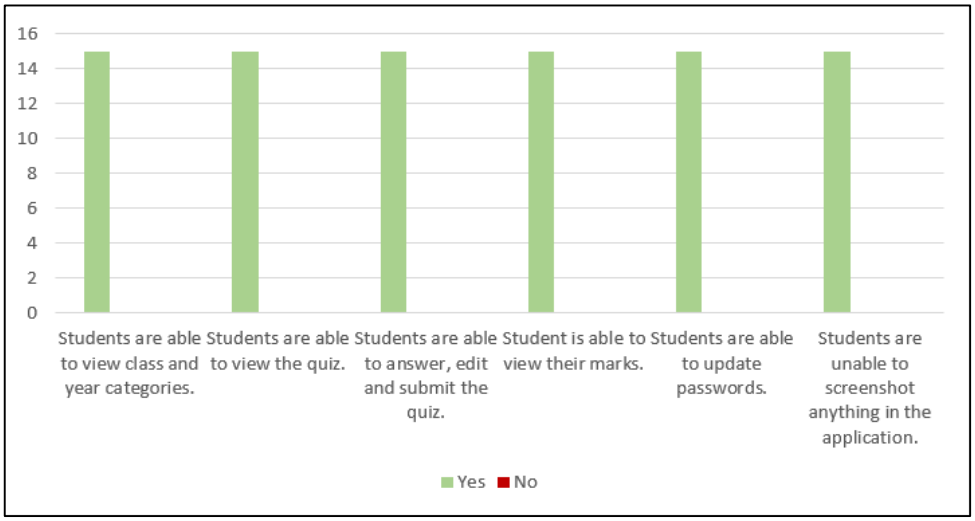

Figure 20: Result of system testing on student module

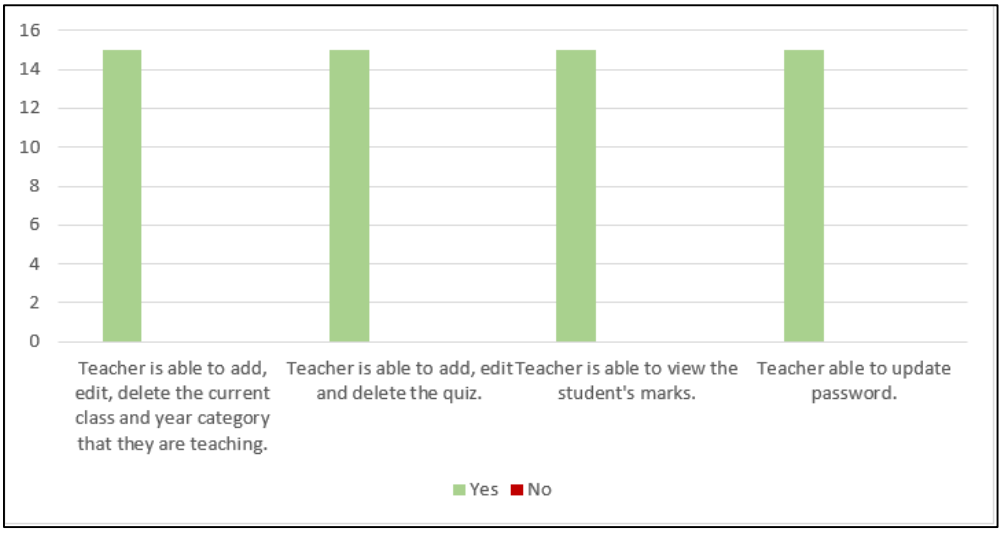

Figure 21: Result of system testing on teacher module

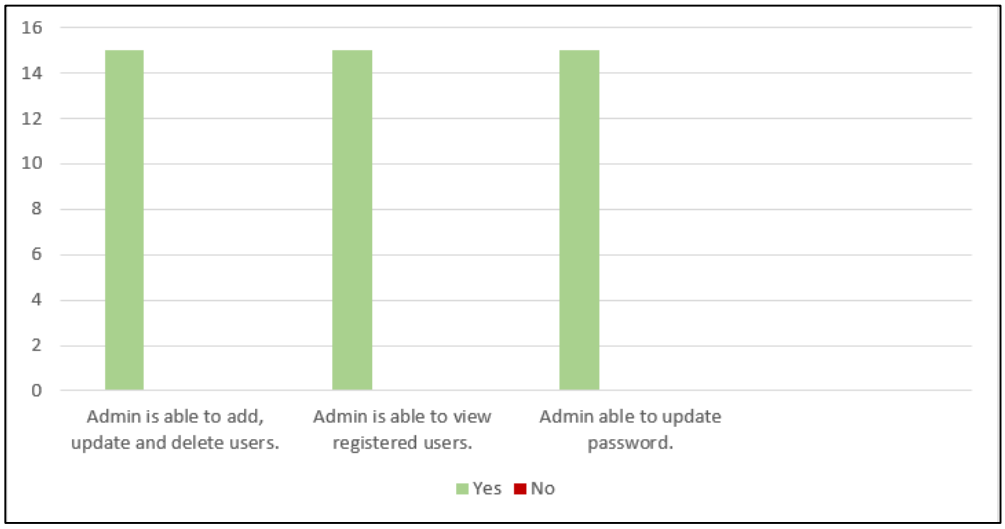

Figure 22: Result of system testing on admin module

5. Conclusion

The development of EdQuizy may help students and teachers in SK Fakeh Abdul Samad for their online assessments. Even though Covid-19 has reached the endemic phase and education has been back to normal, EdQuizy is still relevant for teachers to analyze the students' academic performance. Anti-cheating features that are implemented in EdQuizy are expected to minimize students cheating during the quiz session. Therefore, the development of this online quiz mobile application with anti-cheating features may prevent students from taking screenshots and cheating during the quiz and increase students' honesty when answering the quiz.

Acknowledgment

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