

# Enhancing Cyber-attacks Awareness via Mobile Gamification Techniques

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**Abstract:** Nowadays, the changes in online behavior make data privacy extremely relevant which requires a suitable approach for raising cyber-attacks awareness. Every generation is constantly relying on the cyber world to run their life and they often are lacking in knowledge on security, which exposes them to attackers. Gamification techniques is chosen to be implemented in this research as the use of gamification are increasingly used in education to improve learner's motivation and engagement. This research introduces a cyber-attacks awareness via mobile gamification techniques known as CYBERPOLY. This quiz-based game combined with the board game concept assists in increasing cyber-attacks awareness and reduces the incidents report and victim risk of any cyber traps. CYBERPOLY promotes Naqli (Revealed knowledge) and Aqli (Rational knowledge) (iNAQ) via board game where users can learn a few Arabic terms that are related to Muslim life such as Tawakkal (hibah, infaq, waqaf, qard, sedeqah), Ta'alim, Iktikaf, Muhasabah. CYBERPOLY offers password complexity indicator feature while offering portability, accessibility, off-line service (anytime, anywhere) and fun learning. It provides four levels of interactive quiz which are beginner, moderate, advanced, and professional that implement the Bloom's Taxonomy keyword for more effective learning process. The user will be rewarded with score by earning their own money via security awareness quiz that will be used later as their initial salary to begin the board game. The game will end when the player's money balance reached negative. Thus, this game is mainly developed to educate netizen about cyber-attacks in fun and interactive. Based on the end user feedbacks of functional testing and security authentication, the results show that CYBERPOLY has huge potential as an education tool on cultivating cyber-attacks awareness for digital society. For future planning, the additional scope can be expanded by creating more quiz questions according to specific cyberattack topics, add multiplayer game mode, made available for the iOS platform and save the game result for monitoring the learning performance of each user.

**Keywords:** online behavior, mobile gamification, cyber-Attacks, netizen, iNAQ

## 1. Introduction

The Internet is significant in today's world. According to the Malaysian Communications and Multimedia Commission's (MCMC) Internet Users Survey (IUS), the percentage of Internet users in 2020 grew by 1.3% from 87.4% in 2018 to 88.7%. The survey also aims to understand Internet activity trends among users. Most people use the Internet to communicate with one

another, visit social networking sites, obtain information and entertainment (MCMC, 2020). Although admittedly it is advantageous, there are hidden risks which people need to be conscious including the cyberattacks that might occur (J.Fruhlinger, 2019).

## **2. The Issues**

There are three issues addressed in this research. The first one is on the changes in online behavior. New behavior during the Covid-19 pandemic affects every aspect of our life and give us a tremendous impact. Threats have increased in response to the growing need for information technology management, resulting in a lack of control over confidential data (Almarabeh, 2019). Almarabeh (2019) also stated that malicious systems have spread across various mechanisms and are constantly increasing in complexity, making it more difficult to avoid their harmful and devastating effects. Furthermore, Almarabeh (2019) reported that the usage rate of social networks is increased significantly at a global level in recent years. For instance, there were 3.8 billion social media users in this world based on the Digital 2020 Global Overview Report, making data piracy and privacy extremely relevant.

Second is the lack of knowledge on how to prevent cyber-attacks. Even people go online every day, many of them still do not know on how to protect their data and network from cyberattacks. According to cybersecurity incident statistics prepared by Cybersecurity Malaysia's Cyber999 Assistance Centre, it was reported that there were 9,042 cases of fraud, crimes, and harmful codes up to October 2020. Datuk Dr. Amirudin Abdul Wahab, the Chief Executive Officer of Cybersecurity Malaysia, said that there were 8,770 cases in the same timeframe in 2019, representing a 3.1 percent increase. According to the statistics, users are unaware of credential information protection, making them vulnerable when going online.

The third issue, there is a need to use the best approach to increase awareness on cyber-attacks. Previous approach is more towards traditional way of learning where the users may have to read materials on how to handle cyber-attacks. However, the approach of using mobile gamification is appealing to many people of any generation, thus may be effective in increasing and maintaining their motivation to learn (Masakazu and Megumi, 2019). The learning experiences are located at the forefront of the learning curve by playing a good game. Moreover, according to Grabosky (2016), one of the most effective techniques for preventing and controlling cybercrime is raising public awareness of threats.

## **3. Related Existing Works**

There are several existing mobile applications that provides a platform for cybersecurity education, cyberattacks case studies, and cybersecurity certificates.

### 3.1 Cyber Attack - English



**Figure 3.1: Screenshot of Cyber Attack – English**

This application was developed in collaboration with Coastline Community College's Cyber Security program and the Santa Ana Unified School to help students improve their performance on English placement tests. The concept of attacking servers is what makes it so intriguing, and the player must prevent a hacker from taking over the target locations. The gameplay is available in single-player mode only, thus no interaction with other players. Plus, the quiz is in Multiple Choice Question (MCQ) format.

### 3.2 Cyber Security Quiz



**Figure 3.2: Screenshot of Cyber Security Quiz**

This application intends to assist Computer Science, engineering students, and anyone interested in assessing their knowledge and learning new things about cybersecurity. It has many quiz questions and categories, making it worthwhile for users to install the apps. The highlighted unique feature is the coin-based app implementation, which requires users to study more and earn points. However, there are a lot of advertisements and need to upgrade to the pro version with a one-time payment for ad-free. Plus, it only has a single-player mode available and the MCQ quiz format.

### 3.3 Cyber Security Practice Tests



Figure 3.3: Screenshot of Cyber Security Practice Tests App

This Cyber Security exam practice app provided by EduGorilla is prepared by intellectual people who are skilled in dealing with cyber threats. Thus, they have made all the complex topics cut short into simple parts that students can easily understand. Besides, it has updates on daily news about the latest cyber threats across the world. The available mode is single player only with no player interaction.

### 3.4 Learn Cyber Security & Online Security Systems

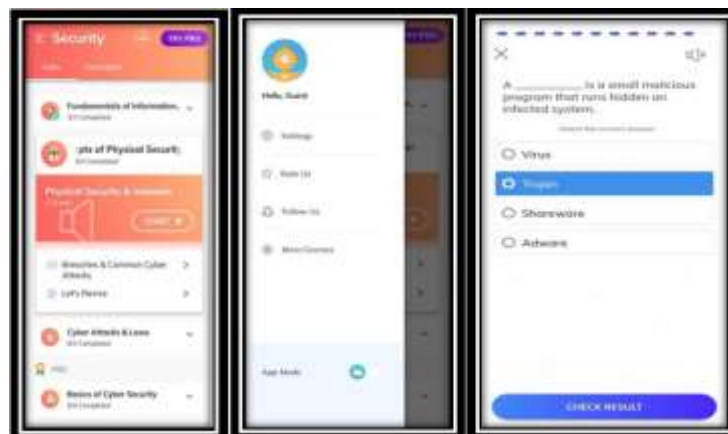


Figure 3.4: Screenshot of Learn Cyber Security & Online Security Systems

This application contains a collection of Cyber Security Tutorials organized into various categories. It includes Layer of Security, Cyber Attack Law, Digital Forensic, and many more. A verified certificate is provided for course completion and has a reasonable price of the pro version, which is RM 26.99 for a lifetime. However, the quiz available for single-player mode only in MCQ, open and closed-ended question format.

### 3.5 Cybersecurity Quizz



**Figure 3.5: Screenshot of Cybersecurity Quizz Systems**

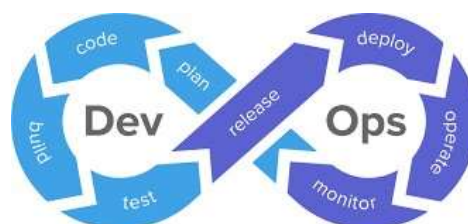
This quiz is designed to raise awareness about threats and how to deal with them. There are various types of questions that assess knowledge of cybersecurity vocabulary, concepts, and acronyms. Other questions offer scenarios to appraise attitude and behaviour. It is available for single-player mode only and in MCQ format.

It is summarised that the existing mobile applications employ a single-player mode with no player interaction. As a result, this study proposed to develop more user-friendly mobile gamification in which players can compete with the machine. CYBERPOLY will implement the *Naqli* and *Aqli* (INAQ) board game concept together with the quiz-based game to attract users. Therefore, CYBERPOLY employed integration knowledge to stimulate student's soul in every learning process.

In brief, CYBERPOLY is proposed with three features. First, user is required to register when they want to start the game. Profile details such as username and password will be stored to keep track of the user's account. There are also password complexity features to add more security authentication elements. The second function requires users to complete a quiz about cyberattacks in thirty seconds for each question and receive points if the answer is correct. One point value RM100 and this accumulated money has become capital for the user to continue the board game. The third is that the user can explore the board game which exposes a few Arabic terms and concepts, related devices, and various types of cyberattacks.

### 4. Methodology

Cyberpoly employs DevOps as the methodology. In total, there are eight DevOps phases, but only five are implemented in Cyberpoly development as depicted in Figure 4.1.



**Figure 4.1: DevOps Methodology**

## 4.1 Project Planning

This section explains the process before coding begins, which includes scheduling the project timeline, distributing the preliminary survey form, and analysing the results. The respondents are from Terengganu secondary and university students. There are 120 female respondents and 90 male respondents, accounting for 10.5 percent of the sample size. More than half of those respondents are between the ages of 18 and 25, with the remainder falling between the ages of 13 and 17. 84.8 percent of respondents use the internet almost every day, and each has at least one social media account, making cybersecurity awareness important to them.

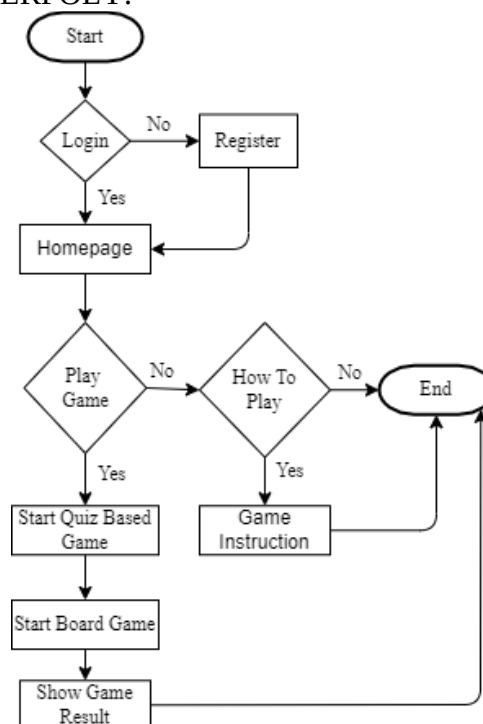
This survey contains three analyses: self-perception of cybersecurity skills, password and access security awareness, and online gaming awareness. Knowledge about the various types of cyberattacks has also been gathered, and it has shown that secondary school and university students have little knowledge about this. However, they have a positive self-perception of their cybersecurity abilities, and this is something to be worried about as they did not know the actual thing. Thus, leading to an insufficient defender in protecting themselves. Furthermore, they are well-versed in social network security, as well as online gaming awareness. However, password and security awareness remain low, with only 33 percent of respondents are aware of this based on the preliminary results of the survey.

## 4.2 Continuous Code Development

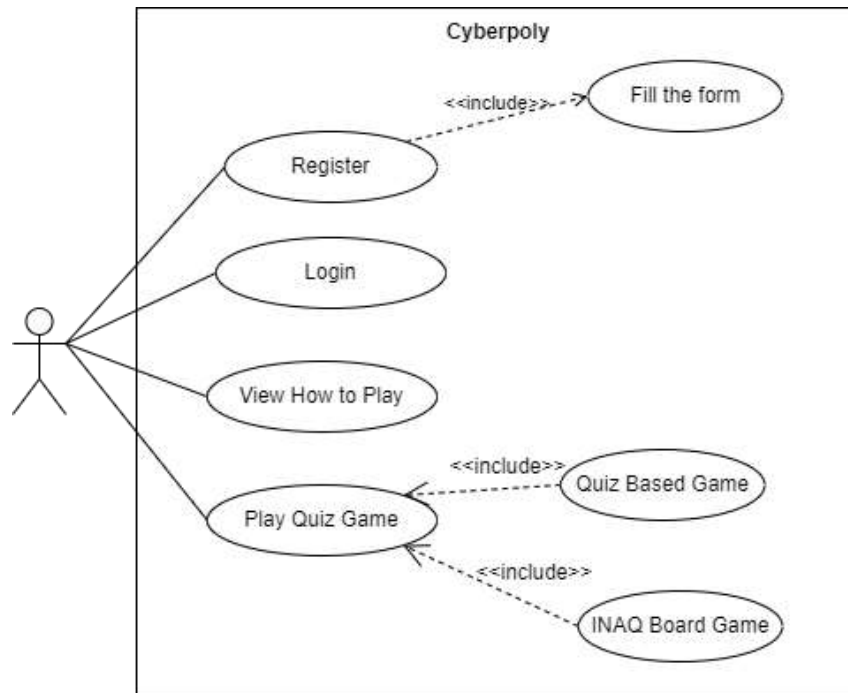
Since the application objectives are known, the primary goal of this phase is to code the requirements. It entails tasks such as application and database design, the code generation, and code review.

### 4.2.1 Application Design

The design phase includes both the user interface (UI) and the user experience (UX). These oversee the overall style of the application (Tammy Coron, 2019). The UI design for CYBERPOLY is shown in Result and Discussion part. The flowchart in UX design focuses on how users move through an interface to complete the quiz game as in Figure 4.2. Figure 4.3 shows the use case of CYBERPOLY.



**Figure 4.2: Flowchart for CYBERPOLY**



**Figure 4.3: Use Case of CYBERPOLY**

### 4.3 Continuous Testing

CYBERPOLY goes through three stages of testing before it can be released. These include the unit testing to ensure that the individual modules of the source code, such as the quiz game flow, have been thoroughly tested. Next is the system testing that tests the fully integrated application from the registration process until the completion of the quiz game, following that is acceptance testing to obtain user signoff.

### 4.4 Continuous Operation

This phase ensures that CYBERPOLY's database system on MySQL is running smoothly. It logs all database activity over a specified period, in this case, two weeks, and then generate a detailed report to troubleshoot database performance issues and identify problem areas.

### 4.5 Continuous Monitoring

The purpose of this phase is to monitor the application output and identify problem areas. It handles inappropriate system behaviour or bugs and resolves issues based on user feedback. The feedback loop is critical because no one knows what they want better than the user. Users provide feedback via the Google Form platform, which includes functional and security authentication testing.

## 5. Result and Discussion

The following section describes the mobile app interfaces of CYBERPOLY.

### 5.1 Application Interface

Figure 5.1 shows the interface of a menu page with the main theme colour; purple as a combination of grey and white colour reasoned to have a soothing effect on the eyes. The available options are 'Play Game', 'How to Play', and 'Exit Game' buttons.



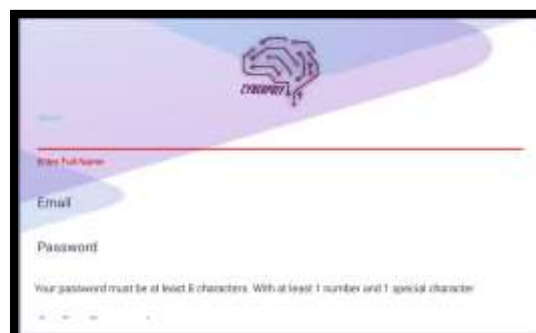
**Figure 5.1: Menu Page of CYBERPOLY**

The registration needs the user to fill in the name, email, and password shown in Figure 5.2. Password must be at least eight characters with at least one number and one special character. There is an indicator to assess the password complexity whether it is weak, medium, strong, or very strong as shown in Figure 5.2. The already registered email will not be acceptable. The user needs to enter email and password for login purposes.



**Figure 5.2: Register, Login Page and Password Complexity Feature (From left)**

There are a few error handlings for these interfaces where the user needs to enter all the required information. For example, when a user does not enter any name, a pop-up caption in red colour will display as in Figure 5.3. There is also a warning message when the user did not enter the matching password for registration purposes or enter the wrong username or password when login into the app as in Figure 5.4.



**Figure 5.3: Error handling when user does not enter all required information**



**Figure 5.4: Error handling when user does not enter matching password or wrongly enter username or password.**

## 5.2 Types of Cyberattack

The board game exposes players to various types of cyberattack which include signs of attack and how to prevent the attack as in Figure 5.5. The player can get to know the attacks and be aware of not being one of the victims.



**Figure 5.5: Types of cyberattack is displayed when user steps on attack's icon box**

## 5.3 Gamification Techniques

CYBERPOLY implements three gamification techniques which are level, point, and timer. This is related to an extrinsic ranked layer that provides the user with new challenges as they are progressing. In Figure 5.6, the first level is for a beginner, the second level is for moderate, the third level is for advanced, and the fourth level is for professional. The increasing level will expose the user to more challenging tasks. Next, is a point also known as scores and it is a clear-cut way to offer feedback to the users' acts. In CYBERPOLY, the user will get one point for every correct answer in a quiz question as shown in Figure 5.5. Every point will be converted to RM100 for a user to continue the next game in a form of a board game. Countdown timers are another way to symbolize time pressure. It is concerned to the use of time to apply pressure on the learners' actions. There are 30 seconds given for the user to answer each question in this game as shown in Figure 5.7. Thus, this research promotes interactive edugame in learning styles on cyber-attacks awareness.



Figure 5.6: Skill Level in CYBERPOLY and Game Instruction (From left)

#### 5.4 Question Type

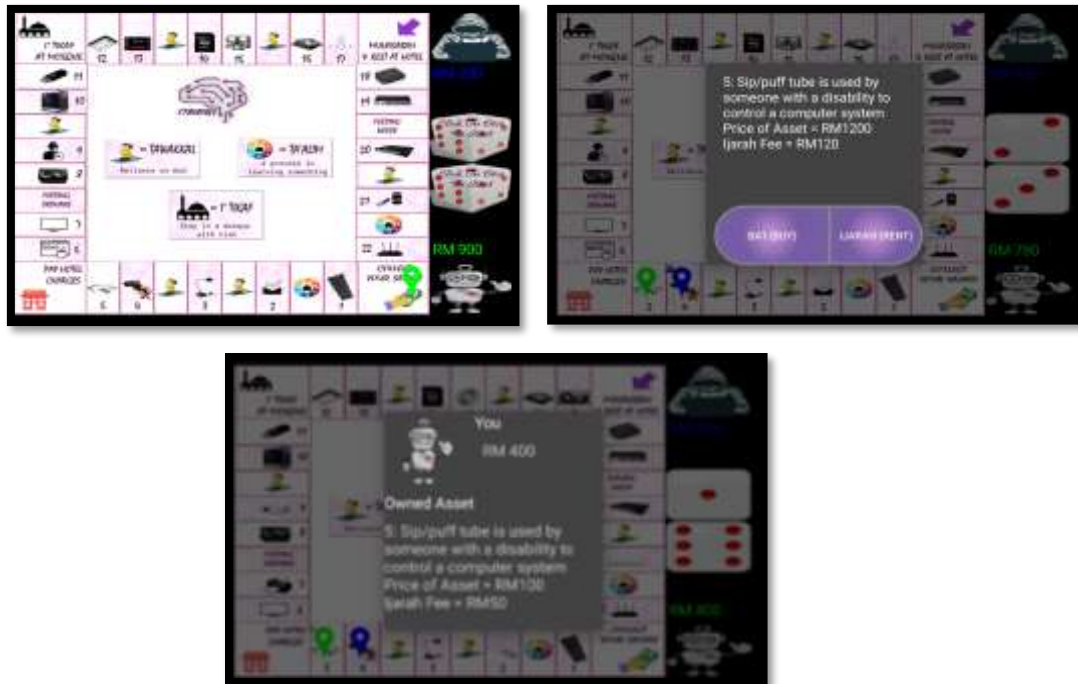
According to the revised version of Bloom's Taxonomy, there are six levels of cognitive learning: remembering, understanding, applying, analysing, evaluating, and creating. However, CYBERPOLY implements only four levels of difficulty. Firstly, is remembering or recalling relevant knowledge from long-term memory. The second is understanding which demonstrates comprehension through one or more forms of explanation. Applying is the ability to use learned material in new situation. The next stage is to break down the material into its essential parts and determine how the parts relate to one another, also known as the analysing level.



Figure 5.7: Different Quiz Question for Each Level

#### 5.5 Board Game Concept with Integration of Naqli and Aqli Knowledge

CYBERPOLY introduces the Muamalat concept which defines rulings governing commercial transactions. It is a part of Islamic jurisprudence or fiqh. In CYBERPOLY, the player has a chance to purchase computer hardware and get to know each of the device's functions and shape. As technology has been applied in our daily life, the input or output device, storage device, and networking device should be familiar. The device description for the student to learn will be provided in each device's box like shown in Figure 5.8.



**Figure 5.8: CYBERPOLY Board Game Concept**

The Arabic terms include in this game are ta'alim, tawakkal, i'tikaf and muhasabah. Ta'alim is a learning process in which education is the responsibility of each and every individual in Islam. Players will always get noticed on this obligation when stopping at ta'alim boxes as shown in Figure 5.9. CYBERPOLY suggests students learn and practice the knowledge they learn because of one's fear of Allah SWT.



**Figure 5.9: Ta'alim Concept**

Tawakkal is when we as Muslims always reliance on God no matter what happens in our life. As Allah will not test a servant unless he is able to do so. In this game, the player will be trained to always believe in God's plan like when they stop at tawakkal boxes, they will need to pay something or receive some money as shown in Figure 10.



Figure 5.10: Tawakkal Concept

Then is the i'tikaf which means to stay in the mosque with an intention or niat as in Figure 5.11. It exposes the player with the hadith that tell benefits of doing i'tikaf for people always be reminded to do so when he or she has a chance. Lastly, muhasabah is an action for Muslim to always repent for all the wrongdoings he or she did as in Figure 5.11.



Figure 5.11: I'tikaf and Muhasabah Concept (From left)

Furthermore, CYBERPOLY also introduces the concept of ba'i and ijarah as in Figure 5.12. Ba'i is the exchange of exchanging either between goods with goods, goods with money, or money with money and with the existence of akad. On the other hand, ijarah refers to a contract in which one party transfers the right to use an item he owns to another party for a set period in swap for a monetary payment. Players learn how to manage their finances during the whole game, as everybody cares about a financial plan. You must think wisely about what you ought to purchase. Is it valuable or not?

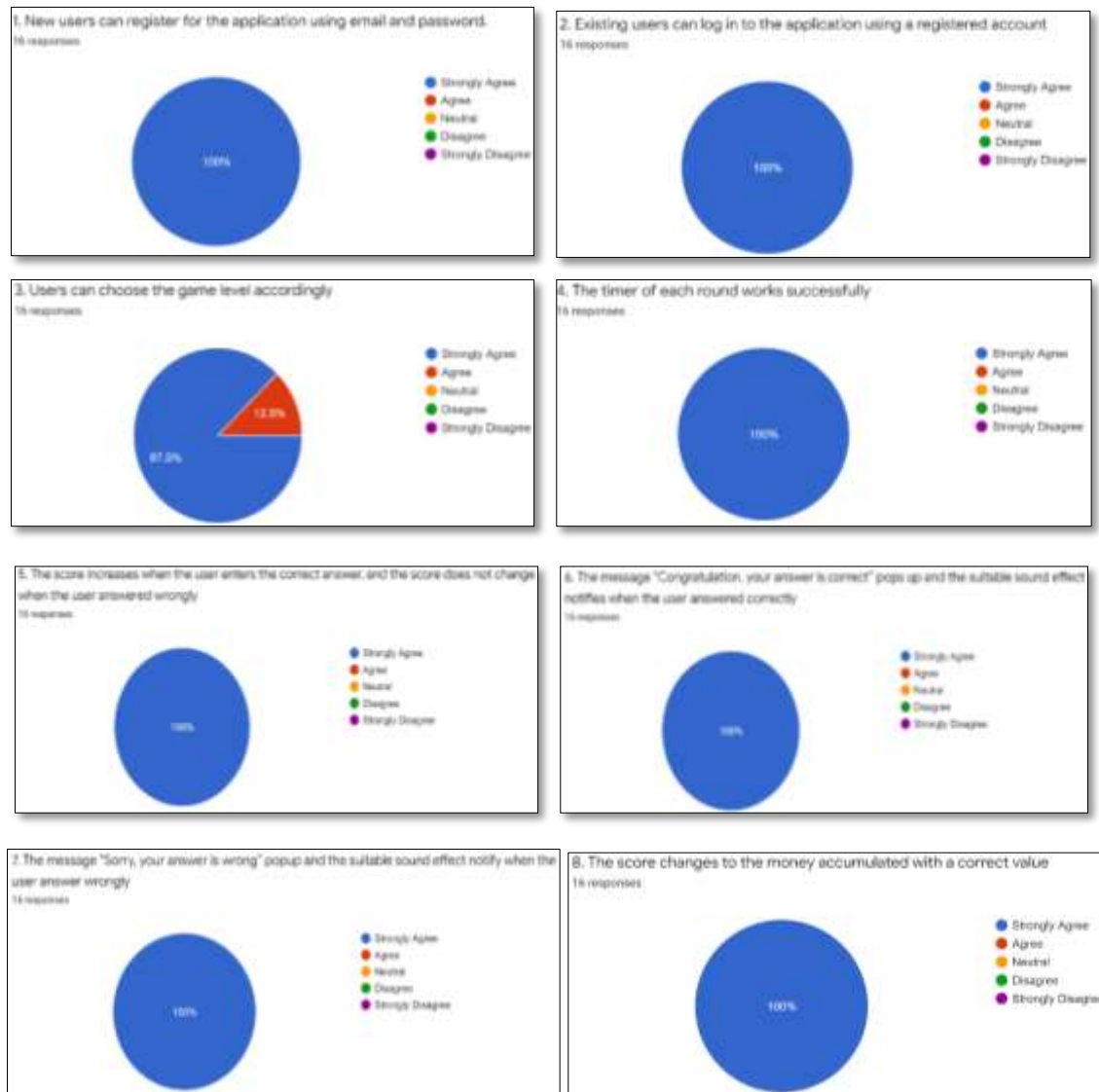


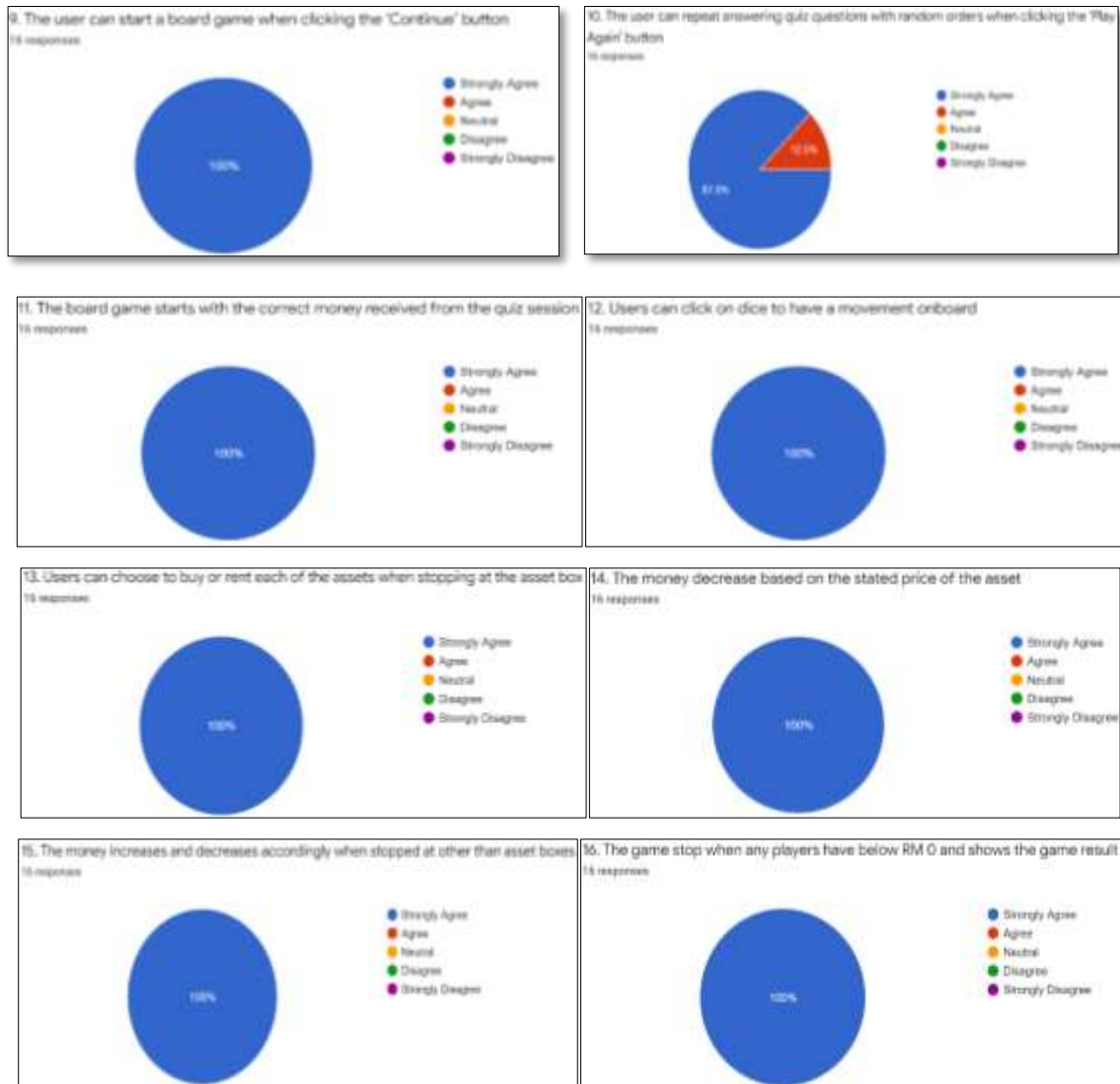
Figure 5.12: Ba'i and Ijarah Concept

## 5.6 Findings

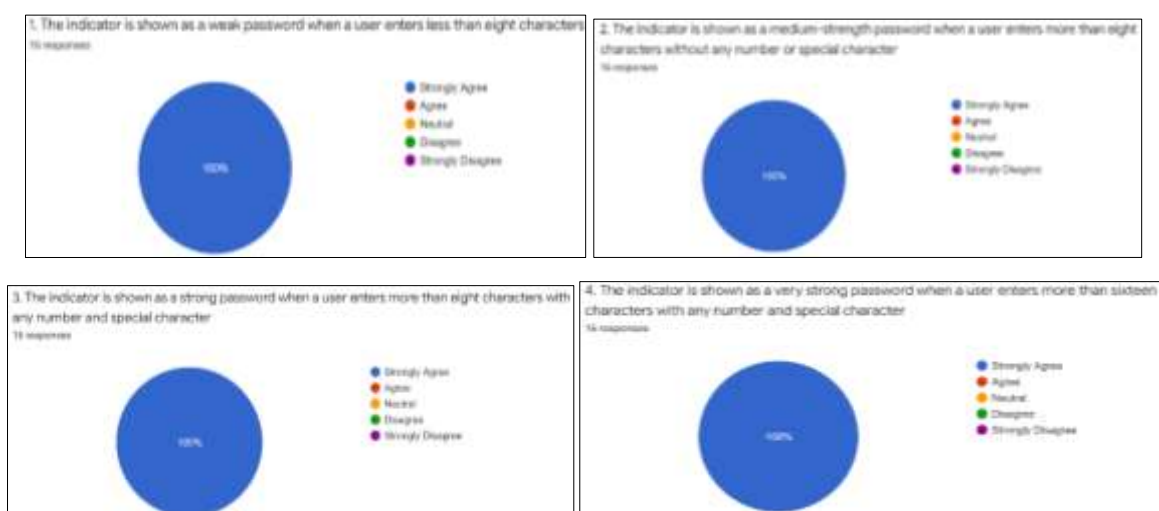
This research carried out the functional and security authentication testing. The survey response was conducted via Google form with 16 questions on the functionality. However, the user has experience in testing the app physically. All the respondents are USIM's students that stay at USIM accommodation from variety of programme. Functional testing aims to determine if CYBERPOLY is acting in accordance with predetermined guidelines. The survey result in

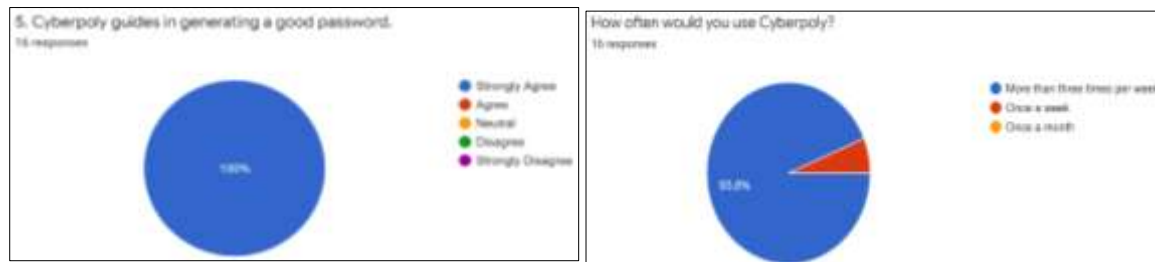
Figure 5.13 shows CYBERPOLY successfully achieved its requirement which 98.4% agree CYBERPOLY is well functioning and 100% agree this app provides good security authentication. The security authentication testing is on the registration page where the password complexity feature is implemented to guide users to generate a good password. The result of this authentication testing is shown in Figure 5.14.





**Figure 5.13: Functional Testing Result**





**Figure 5.14: Security Authentication Result**

## 6. Conclusion

Based on the evaluation of functional testing and security authentication, the results show that CYBERPOLY has successfully achieved its objective. Acceptance testing has been conducted to end user where 96.8% agree that CYBERPOLY is practical, smooth, and easy to use. Most respondents strongly agree that CYBERPOLY increases cyber-attacks awareness among students via fun and interactive learning. It offers cyber security quiz-based game, interactive game, and gamification elements such as level, points and timer to enhance engagement and motivation of the user. Hence, it is an on-demand product as it is aligned with industry driven on increasing security-literate society. Since the goal of this application is to provide awareness on cyberattack, the additional scope can be extended by creating more quiz questions according to specific cyberattack topics, add multiplayer game mode, made available for the iOS platform and save the game result for monitoring the learning performance of each user.

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