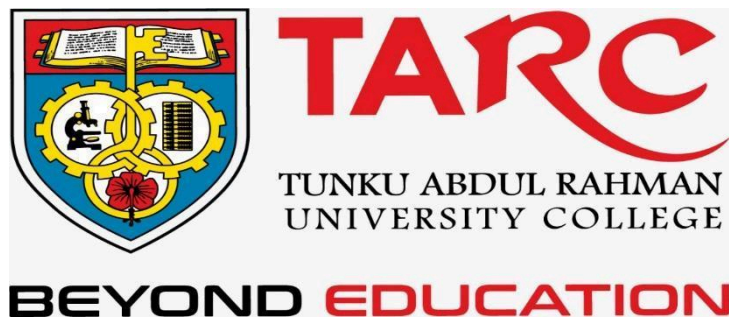


# TARUC Game-based Learning System

By

Yap Yoon En



FACULTY OF COMPUTING AND  
INFORMATION TECHNOLOGY

TUNKU ABDUL RAHMAN UNIVERSITY COLLEGE  
KUALA LUMPUR

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# TARUC Game-based Learning System

By

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A project report submitted to the  
Faculty of Computing and Information Technology  
in partial fulfillment of the requirement for the  
Bachelor of Information Technology (Honours)

**Department of Software Engineering and Technology**  
Faculty of Computing and Information Technology  
Tunku Abdul Rahman University College  
Kuala Lumpur

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## Declaration

The project submitted herewith is a result of my own efforts in totality and in every aspect of the project works. All information that has been obtained from other sources had been fully acknowledged. I understand that any plagiarism, cheating or collusion or any sorts constitutes a breach of TAR University College rules and regulations and would be subjected to disciplinary actions.



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Bachelor of Information Technology (Honours) in Software Systems Development

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# Chapter 1

## **Introduction**

# 1 Introduction

TARUC Game-based Education System is a proposed system for TARUC instructors and students to conduct their teaching and learning in a game-based mode through any internet-connected devices. The major problem faced by existing systems is the poor user interface which makes it difficult for users to use the systems. Most of the existing systems are focused on fulfilling all the needs that may be required by the public, therefore the existing systems usually consist of too many useless functions and result in a cluttered user interface. For example, the Kahoot! Kids feature in the Kahoot! platform is designed for kids and it is useless for college students.

From the perspective of TARUC, the existing systems lack uniqueness and time consuming for students to find the function they want to use from the cluttered user interfaces. TARUC wanted to have a system that could meet all their requirements and have some unique features compared to existing systems but there are no superfluous or useless functions in the system. Therefore, this proposed system is specifically designed for TARUC in order to come up with a system that they are satisfied with.

In this proposed system, instructors and students can login to the system by using their taruc email and password. After logging in, instructors are allowed to maintain their accounts profile, maintain the classrooms and games, manage classrooms with students and manage power exchange stores. Students are allowed to maintain their account profile, participating in classrooms and games, exchange powers for games and view score and ranking.

In order to provide more fun to the students, this proposed system will provide a unique feature which is a power exchange store. This feature can help to improve the entertainment of the game for students, so that the game is no longer monotonous and simple. Students can exchange various powers in their best interests to achieve higher scores and higher rankings among players.

## 1.1 Objective

### **To enhance the user experience by offering all games for free**

Most of the existing game-based learning systems are charging players a fee to unlock certain games, which results in limited games that free players can play and the majority of those using the systems are students who do not have an income. This may degrade the user experience for players when they find a game they are interested in but cannot play. To promote their learning experience, all games are free for them to play.

### **To allow students to play the games anywhere anytime**

TARUC game-based learning system is a web-based system that can be accessed through an internet-connected pc or laptop. Students can access the website and play games anytime and anywhere as long as they have a device and internet.

### **To provide students with more control over the game**

Most of the game-based learning systems on the market provide players with less control, for example Quizizz provides the power-ups features, but players gain the power randomly. Therefore, a power exchange store is provided in the TARUC game-based learning system; this store allows players to exchange the powers they want by using the accumulated points in the game. This feature may reduce players' dissatisfaction with the system's random allocation of powers.

### **To provide students with a more competitive atmosphere**

TARUC game-based learning system provides a score and ranking function that can create a competitive atmosphere for students. With this function, students' scores are made public and ranked according to their scores to motivate students to put more effort on study for better scores and rankings. Creating a competitive atmosphere can make the learning environment more positive and fun.

## 1.2 Background

There are several existing similar products or systems that were developed and launched on the market, one of them is Kahoot!. Kahoot! is a game-based education platform that is targeting the public as their market and it provides a lot of functions and features to meet the public's needs. Kahoot! does provide a free version which is the Basic version for their users but it limits some functions of the system. Three advanced versions are also available in Kahoot! which is Pro, Premium and Premium+, the more advanced the version, the more features users can use. It also offers both free games and paid games to its players; some games are charged some fees to unlock it. There are various main functions that Kahoot! offering such as registration and login, create and play games, create and join classrooms and so on.

There are a few limitations of current business processes and the environment of the existing systems. Firstly, the user interface of existing systems or platforms are commonly complex and poor which make it harder for users to find the function they want. Since the existing systems or platforms are designed to meet the needs of the public, it usually consists of too many functions and this leads to a messy user interface. Second, existing systems generally have a simple and similar game process, resulting in the fun level of the game cannot be improved. These systems are usually regular quizzes and no special or interesting features are added to the game such as power-ups features.

The TARUC Game-based Education System is specifically designed for Tunku Abdul Rahman University College (TARUC). TARUC needs a platform that can provide their students with an interactive learning environment, but the existing game-based learning systems in the market do not meet all their requirements and they prefer to have a unique system. Therefore, the target market of the proposed system is the instructors and students of TARUC.



## **1.3 Advantages and Contributions**

### **Free of Charge for All Functions**

The main competitive advantage is all the functions and features that are provided by the TARUC game-based learning system are totally free of charge, students can access all the games without paying any fees. For other game-based learning systems on the market such as Kahoot!, they charge some fees to unlock certain games because the target market for these systems is not just students.

### **Additional Feature - Power-ups Store**

The TARUC game-based learning system offers an additional feature that is not found in other systems on the market, which is Power-ups Store. Students can exchange the power they need from the store to help them gain a better score in the game. Other systems on the market such as Quizizz do not allow players to exchange powers, it just randomly assigns powers to their players. Some systems like Kahoot! do not even provide power-ups feature to their players.

### **Information Updated Instantly - Score and Ranking**

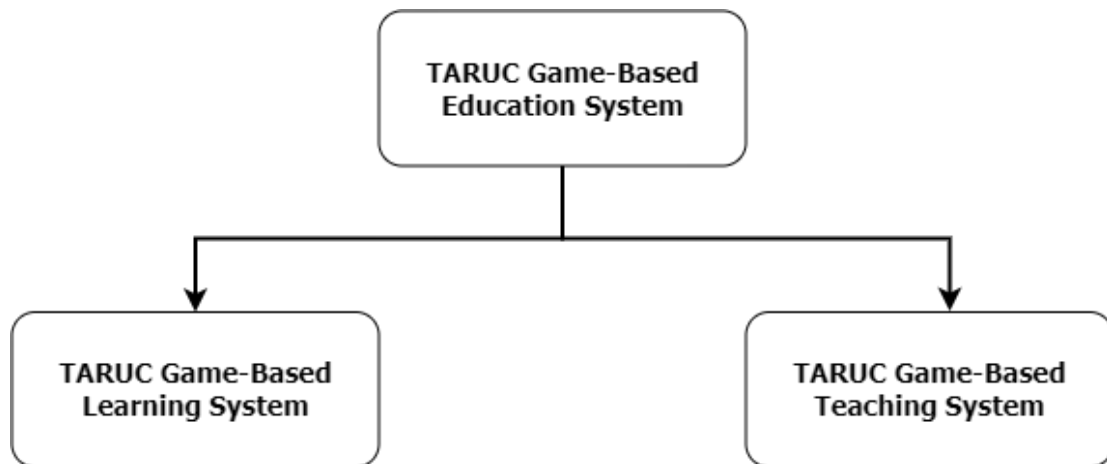
The score and ranking function of the TARUC game-based learning system is instantly updated as new players play the game and leave new records. Instructors and students can always get the most accurate score and ranking information for each game. Providing accurate information at all times is a characteristic of a good system and it means the system is reliable.

### **User-friendly User Interface**

The user interface design of the TARUC game-based learning system is simple and clean since the system only consists of the major functions that TARUC needs and there are no other unimportant functions because our target market is only TARUC. Most of the systems on the market contain too many functions because they need to meet the needs of the public and the user interface becomes complicated, making it difficult for users to find the functions they want.

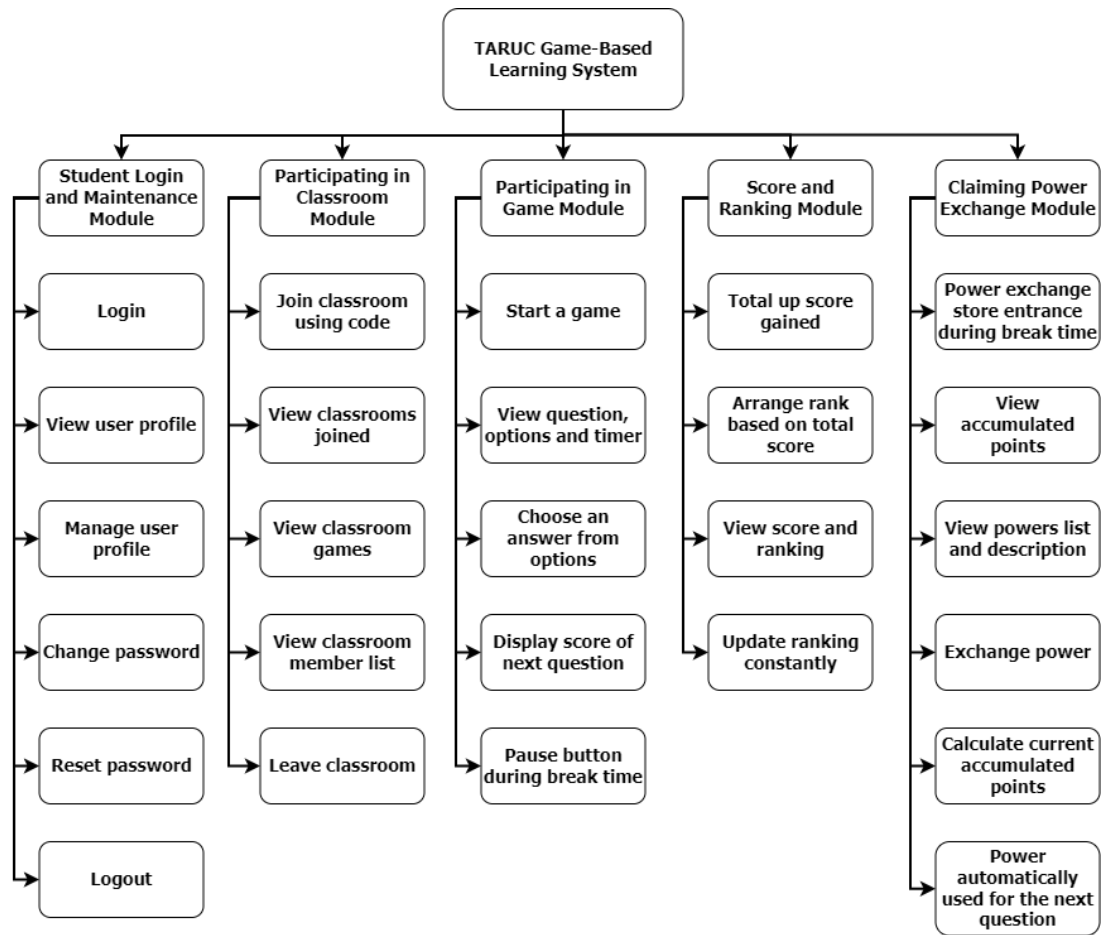
## 1.4 Project Plan

### 1.4.1 Project Scope



*Figure 1.1 : Hierarchical Chart of the TARUC Game-based Education System*

Figure 1.1 shows that the TARUC game-based education system consists of 2 subsystems which are TARUC game-based learning system as the frontend system and game-based teaching system as the backend system. This system will be developed by 2 people, the author (Yap Yoon En) and the author's partner (Muk Yin Man). The author is responsible for the TARUC game-based learning system and TARUC game-based teaching system will be handled by the author's partner.



*Figure 1.2 : Hierarchical Chart of the TARUC Game-based Learning System*

Figure 1.2 shows that the TARUC game-based learning system consists of 5 modules which are student login and maintenance module, participating in classroom module, participating in game module, score and ranking module and claiming power exchange module.

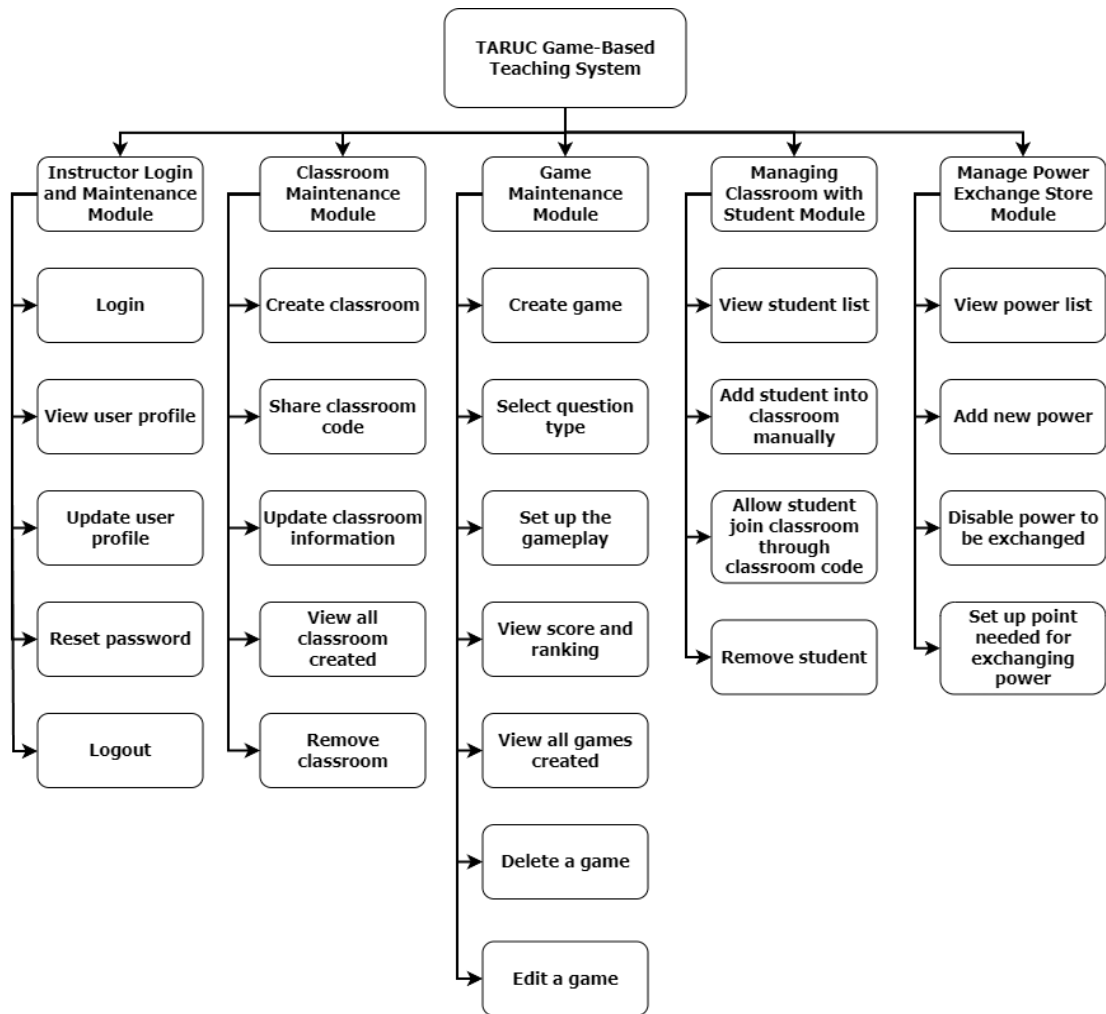
Student login and maintenance module allows students to log in to the system by using their TARUC student email and password. TARUC will register an account for each student and use the student's Identity Card number as the default password for the account. After logging into the system, students are allowed to view their account profile and modify their account password and account profile such as profile picture and username. Students are also able to log out their account. Not only that, the system allows students to reset their password when students forgot their password.

Participating in classroom module allows students to join classrooms by using codes that are shared by instructors. After joining classrooms, all the classrooms joined will be displayed on the page and students are able to enter into the classroom to launch the games that are created by instructors. After entering the classroom, students can view a list of members of that classroom. Students are also allowed to leave the classroom by clicking the leave button.

Participating in game module allows students to select and start the game they want to play. After students start the game, questions, answer options (if any) and timer will be displayed and students should choose an answer from answer options or provide an answer in text before the time ends. The question will be automatically skipped if the student is not answering before the time ends. Students will not get a score for the question if they are not answering or answered incorrectly. The score of the next question will be shown during the break time before the next question so that students can decide whether they need to exchange power or which power they want to exchange. The pause button will be shown during the break time so that students are able to pause the game only during the break time.

Score and ranking module allows students to view their scores and ranking when the game ends. The score gained for every question will be totalled up and the rank will be arranged based on the total score of each student. The ranking will be constantly updated as new players play the game and leave a new record.

Claiming power exchange module allows students to exchange powers during the break time of the games. Before every question starts, the entrance of the power exchange store will be shown and students are allowed to enter the store to exchange a power by using the accumulated points in the game and the power will be automatically used for the next question. Students can view their accumulated points after entering the store so that students can know how many points they have earned. Powers list and description are included in the store so that students can understand what powers are and how powers work. The default powers provided are double scores power(used for ranking), double points power(used for power exchange), and eliminating a wrong answer power(remove one incorrect answer in a multiple-choice question).



*Figure 1.3 : Hierarchical Chart of the TARUC Game-based Teaching System*

Figure 1.3 shows that the TARUC game-based teaching system consists of 5 modules which are instructor login and maintenance module, classroom maintenance module, game maintenance module, managing classroom with student module and manage power exchange store module.

Instructor login and maintenance module allows instructors to log in to the system by using their TARUC staff email and they can modify their account setting after logging in. Classroom maintenance module allows instructors to view, create, update or delete classrooms for different subjects or courses and share the classroom codes to their students. Game maintenance module allows instructors to create, update, view or delete games for particular classrooms and they can set question type, points, score, time, questions and answers for the game. Managing classroom with student module allows instructors to add, view and remove students from their classroom. Manage power exchange store module allows instructors to add new power and set the points needed in the store for students exchanging the powers.

## 1.4.2 Project Schedule

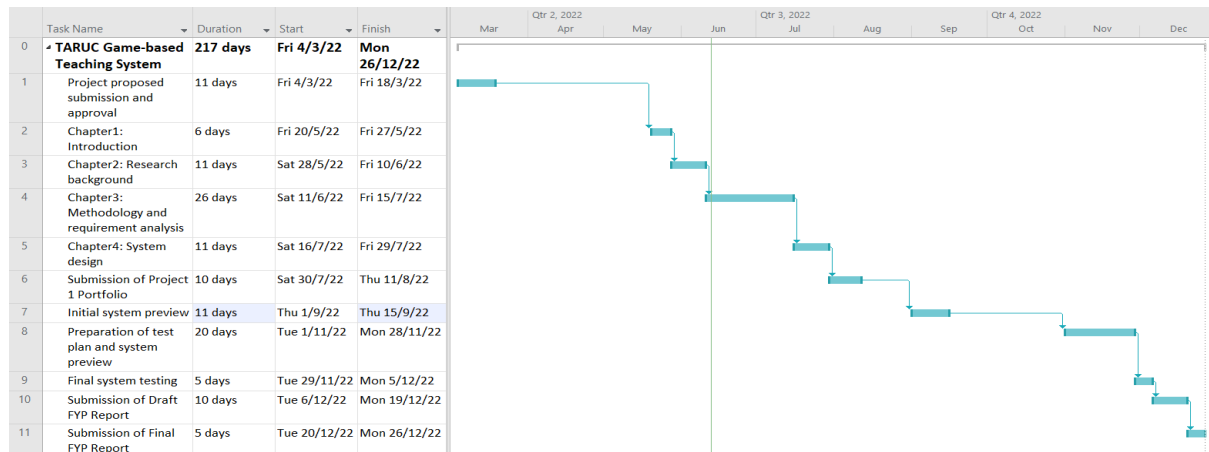


Figure 1.4 : Project Schedule Gantt Chart

Table 1.1 : Project Schedule

Schedule	Schedule Goal	Deadline
Project proposed submission and approval	To get approval for proposed idea	18/03/2022
Chapter1: Introduction of the project	To provide clear project objectives and background	27/05/2022
Chapter2: Background and related work of the project	To better understand the proposed system	10/06/2022
Chapter3: Methodology and requirement analysis	To gather and analyze the requirement information	15/07/2022
Chapter4: System design	To make a draft for system design	29/07/2022
Submission of Project 1 Portfolio	To submit the Project 1 Portfolio from chapter 1 to 4	12/08/2022
Initial system preview	The system has all of the necessary functionality and can run normally	15/09/2022
Preparation of test plan and system preview	To create test plan for system testing	28/11/2022
Final system testing	To conduct a final testing for the system	05/12/2022
Submission of Draft FYP Report	To submit the draft of FYP report and ensure everything is well-organized	19/12/2022
Submission of Final FYP Report	To submit the final version of FYP report and associated deliverables	26/12/2022

## 1.5 Project Team and Organization

*Table 1.2 : Project Team and Organization for TARUC Game-based Education System*

Sub-Module	Yap Yoon En	Muk Yin Man
Module 1 : Student Login and Maintenance	x	
Module 2 : Participating in Classroom	x	
Module 3 : Participating in Game	x	
Module 4 : Score and Ranking	x	
Module 5 : Claiming Power Exchange	x	
Module 6 : Instructor Login and Maintenance		x
Module 7 : Classroom Maintenance		x
Module 8 : Game Maintenance		x
Module 9 : Managing Classroom with Student		x
Module 10 : Manage Power Exchange Store		x

## 1.6 Chapter Summary and Evaluation

This chapter has introduced the TARUC Game-based Education System and discussed the project plan and modules handled by author and author's partner in detail. The author is convinced that this system is able to be developed as planned and it will be able to compete with other existing systems through its benefits such as free of charge, additional features, information updated instantly and user-friendly user interface.

The difficulty that the author faced is identifying the unique features of the system compared to other existing systems on the market. Since too many similar systems have been developed and launched on the market, systems without unique features will lack competitiveness and will not be able to stand out from the crowd. But the problem is that unique features are not easy to think of because most of the systems on the market are very complete and it is difficult to identify areas that need to be strengthened.

In order to solve this difficulty, the author brainstormed with the author's partner and did a lot of research to find out where the existing systems need to be improved and come up with ways to improve.

## Chapter 2

# **Literature Review**



## **2 Background and Related Work**

The project background including the nature of the proposed system, target users, business environment and existing real life business processes will be covered in this chapter. A literature review discussing similar research work that has been done by others in relation to game-based learning systems will also be included. Other than that, a feasibility study will be done in this chapter to explain and show how this proposed system is feasible from various aspects.

### **2.1 Project Background**

The proposed system is a system for educational purposes that can help in improving the overall teaching and studying experience of TARUC. This system mainly focuses on enhancing the user experience by improving the gameplay and user interface. The system includes all the main functions that allow users to create, manage, view and participate in classrooms and games. In order to achieve user experience enhancement, power-ups and power-ups store features are provided to improve gameplay and only main functions are developed for better and cleaner user interface.

The proposed system is specifically designed for TARUC and this system will only be used in TARUC for teaching and learning purposes, so the targeted users will be TARUC instructors and students.

Since the targeted users will be TARUC instructors and students, the business environment of the proposed system will be TARUC campuses. The system will be used by the targeted users in TARUC campuses for education purposes.

There are many similar game-based education systems that have been developed and released to the market such as Kahoot!, Quizizz and Archy Learning. Kahoot! charges students to unlock certain games and charges instructors from \$0 to \$9 per month. It does not provide the power-ups and power-ups store features in their gameplay. Quizizz does not charge any fees to play the games but it charges instructors from \$0 to \$149 per month. It does provide the power-ups feature in their gameplay but it does not offer a store for players to exchange the power on their own. Archy Learning does not charge any fees for students but it charges instructors from \$15 to \$100 per month. It also does not provide the power-ups and power-ups store features in their gameplay. Even though Kahoot! and Quizizz does provide a free plan for instructors, it has a huge restriction on using the systems.

## **2.2 Literature Review**

### **Efficiency of Game-based Learning System**

People are constantly looking for more interesting, fun and motivating learning methods. Nowadays, technology is increasingly integrated into educational environments (Licorish, S. A., Owen, H., Daniel, B. K., & George, J. L., 2018) and online game-based learning systems have become a trend. In a game-based learning system, the content of the lessons are mapped into the games, offering a scenario environment of learning and continuous interaction and feedback to enhance the interest and motivation of learning. Game-based learning is usually designed to increase learners' desire for competition and goal achievement, while games can also be a good way to facilitate teacher-student interaction.

From the research done by Teerawat, K., Ier-on, H., Pattaraporn, K. & Noppon, W. (2017), it compared the learning performance between two experimental groups, Group A and Group B, in order to investigate the effectiveness of the game-based learning system. Group A consists of 17 students learnt using the game-based system while Group B consists of 14 students learnt using the traditional learning approach. The results showed that the Group A students' performance was higher than Group B students.

Other than that, the research done by Ching-Hsue, C. & Chung-Ho, S. (2012) also indicated that compared to traditional face-to-face learning methods, game-based learning has a higher student achievement. In the pre-test, the average score of Group A who used the game-based learning method was 71.36 while the average score of Group B who used the traditional method was 72.37. In the post-test, the average score of Group A improved to 80.24, while the average score of Group B dropped to 72.14. A comparison of the pre-test average score and post-test average score showed that students who used the game-based learning method have improved significantly in their average score while students who used the traditional method did not change much in their average score.

To conclude, using a game-based learning system in the learning process is efficient in improving student performance compared to the traditional face-to-face method.

### **Competition in Learning Process**

According to Tom Malone's theory of intrinsically motivating instructions, three categories that can make learning become fun are Challenge (goals with uncertain outcomes that make learning more challenging), Fantasy (captivate through intrinsic or extrinsic fantasy) and Curiosity (making learners curious about things through human curiosity about graphics and audio) (Sabandar, G., Supit, N. & Suryana, E., 2018).

Research done by Worm, B. S. & Buch, S. V. (2014) has conducted an experiment between competing groups and non-competing groups and this experiment has verified that competition in the learning process helps in motivating the students since students' scores are shown on the completed test and it can be compared with other students. Compared to the non-competing groups, competing groups all wanted to be better in their results and they showed a positive attitude towards the competition.

The results of Corell, A., Regueras, L. M., Verdú, E., Verdú, M. J. & de Castro, J. P. (2018) also showed that students who used competitive learning tools performed better in their academic outcomes. The students enjoyed learning by participating in competitions and they were motivated to find learning information in different ways to improve their position in the rankings.

As a conclusion, the quiz module with competition widgets can help to encourage students to spend more time in the learning process in order to gain better results. The use of competitive learning techniques can also increase the challenge of learning as well as motivate students, may build a sense of competition among students and construct a more fun learning environment.

### **Student Perceptions of Game-based Learning**

According to the research conducted by Zi-Yu, L., Zaffar, A. S. & Farida, G. (2020), 88.55% of study group students expressed a high interest in continuing to study using game-based learning. Moreover, none of the participants in the study group indicated that the learning process was uninteresting. Thus, participants showed a very high degree of involvement, interest and motivation. Therefore, the research hypothesis 1 which is “the use of game-based learning increases student attraction, motivation, the desire to continue learning and make it more intense” has been confirmed.

The results of Felszeghy, S., Pasonen-Seppänen, S., Koskela, A. & et al. (2019) also show that students are satisfied with how the game-based learning system enhances their practical abilities and creates a new interactive, relaxed place for communication between students and instructors. From their results, 77.5% respondents indicated that the system increased their motivation to learn, 86.88% respondents indicated that the system enables students to overcome individual difficulties, 66.88% respondents felt the gamification system helps to build collaboration and 68.13% respondents felt the system can help them to promote interest in learning.

From these research results, it can be known that the students have an active and positive attitude towards game-based learning and most students are willing to continue this kind of learning style.

## **2.3 Feasibility Study**

### **Technical Feasibility**

Technical feasibility is the process of figuring out how to produce the proposed system to determine whether it is possible. The proposed system is an online web-based system so that laptops are required for coding and testing. Software tools and IDE that are needed for coding are Apache Netbeans, XAMPP and MySQL. The programming languages that will be used to develop the proposed system are PHP and CSS, both the author and the author's partners have relevant knowledge and familiarity with these programming languages. Therefore, the technical area of this project is feasible.

### **Economic Feasibility**

The software tools and IDE required for development purposes (Apache NetBeans, XAMPP and MySQL) can be downloaded and accessed for free. As a result, there are no extra costs charged for the tools that will be used to develop the proposed system. Other than that, both the author and the author's partner have their own hardware devices that can be used for coding and testing, therefore there is no need to purchase any hardware devices.

### **Schedule Feasibility**

Schedule Feasibility is to estimate how much time the system will take to complete and determine if your project schedule is achievable so that the project can be completed on time. The author and the author's partner estimate that this proposed system will take approximately 10 months to complete. The documentation parts which are Chapter 1 to 4 are given approximately 5 months to complete and another 5 months are given to complete the system development and testing. 5 months for 4 Chapter documentation are reasonable so that the risk of the system cannot be completed in time is very low. Apart from that, 5 months for system development and testing is achievable since the proposed system focuses only on the main functions. Therefore, the schedule of this proposed system is reasonable and achievable.

## **2.4 Chapter Summary and Evaluation**

Since the proposed system is specifically designed for TARUC, the business environment will be the TARUC campuses and the targeted users will be TARUC instructors and students. The project is considered as feasible to develop after conducting the feasibility study from various perspectives because the required hardware and software tools are available, the cost required are affordable, the schedule is achievable and the proposed system can solve the problems of existing systems.

The problem that the author faced when producing Chapter 2 was lack of understanding of the feasibility study. Since the author has no experience in doing feasibility studies, it is not easy for the author to prepare the feasibility study. In order to solve the problem, the author did a lot of research on Google and referred to the feasibility studies that have been done by others to better understand the feasibility study.

## Chapter 3

# **Methodology and Requirements Analysis**

### **3 Methodology and Requirements Analysis**

In this chapter, methodology applied during the development phase and the techniques used by the author to gather requirements will be explained. Other than that, the functional and non-functional requirements of the system will be discussed and the development environment will be specified. Finally, the author will give an overview use case diagram to illustrate the modules of the whole system and a detailed use case diagram of each module that the author deals with.

#### **3.1 Methodology**

First and foremost, the author will use a use case diagram to specify the events in the system and show the relationship between the users and their related use cases. The overview use case diagram will be used to show the modules of the whole system and detailed use case diagram used to illustrate the modules that are handled by the author. Use case description will also be used by the author to describe step-by-step what actions that actors should take in order to achieve a specific goal. By using use case diagrams and use case description, the author can learn and have a better understanding of the different kinds of users and use cases of the proposed system.

Next, an activity diagram for each module that is handled by the author will be prepared during the chapter of system design. An activity diagram visually presents a sequence of actions or control flow in a system, similar to a flowchart or data flow diagram. Not only that, the entity relationship diagram (ERD) will also be prepared to illustrate the relationship between sets of entities stored in the database, which helps to better understand the logical structure of the database.

Other than that, the prototyping model was jointly decided by the author and the author's partner as the approach for system development. A prototype model is a system development model in which a working system prototype is designed, built, tested, and reworked until an acceptable prototype is obtained, which also provides the basis for producing the actual system. Since a working prototype of the proposed system will be created before the actual system is developed, it can help to detect bugs and find missing functionality earlier. Not only that, the prototype model also helps to reduce the effort required to develop the actual system and the possibility of errors in the actual system since the development of the actual system does not begin until all specifications are clear.

Last but not least, the author and the author's partner will perform unit testing and black box testing for the proposed system to verify that all the requirements and functions of the system are fully developed. The unit testing will be done by the author and the author's partner to test

individual units and ensure that every unit of the system works as expected. The black box testing will be done by the testers who do not understand the internal code structure, implementation details and internal paths of the system and the testing will mainly concentrate on input and output of the system.

## **3.2 Requirements Gathering Techniques**

### **Brainstorming**

In order to gather the requirements of the proposed system, the author and the author's partner have conducted multiple brainstorming sessions. Brainstorming is a collective creativity technique that strives to come to a conclusion for a particular problem by gathering a list of ideas contributed spontaneously by members. During the brainstorming sessions, the author and the author's partner came up with the ideas and summarized the functions, roles and modules that the proposed system should have and how the system differs from existing systems. Other than that, the author and the author's partner have discussed the user interface design of the proposed system in order to produce a system with a clean and user-friendly interface.

### **Document Inspection**

The author and the author's partner searched for documentation of similar existing systems as a reference and identified what functionality and requirements that the proposed system might need to have. By referring to the documentation found on the web, the author and the author's partner have improved and more completely collected the requirements and functionality of the proposed system.

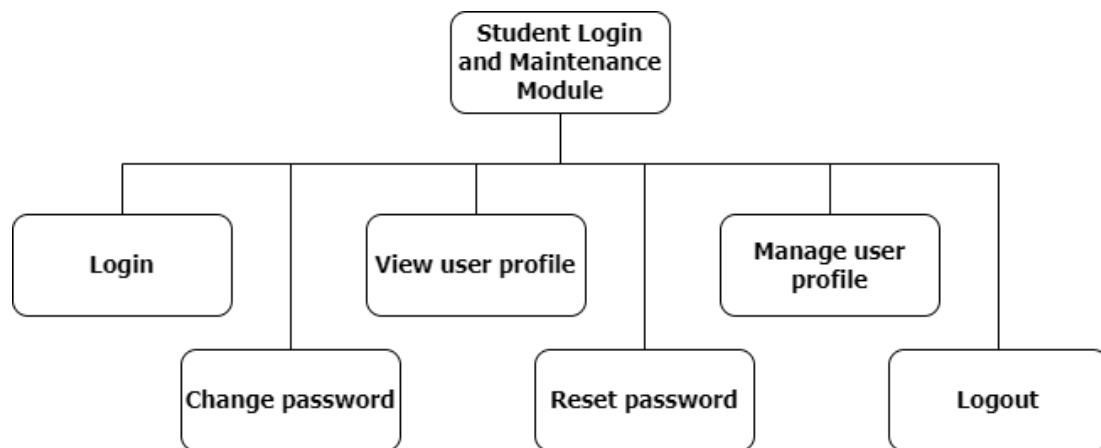


## 3.3 Functional and Non-Functional Requirement

### 3.3.1 Functional Requirements

The proposed system is separated into a frontend system which is handled by the author (Yap Yoon En) and the backend system which is handled by the author's partner (Muk Yin Man). There is 5 modules in frontend system include student login and maintenance module, participating in classroom module, participating in game module, score and ranking module and claiming power exchange module. While the 5 modules in the backend system include instructor login and maintenance module, classroom maintenance module, game maintenance module, managing classroom with student module and manage power exchange store module. For the overall system, readers could refer to Chapter 1 Section 1.4.1.

#### Student Login and Maintenance Module



*Figure 3.1 : Student Login and Maintenance Module Hierarchical Chart*

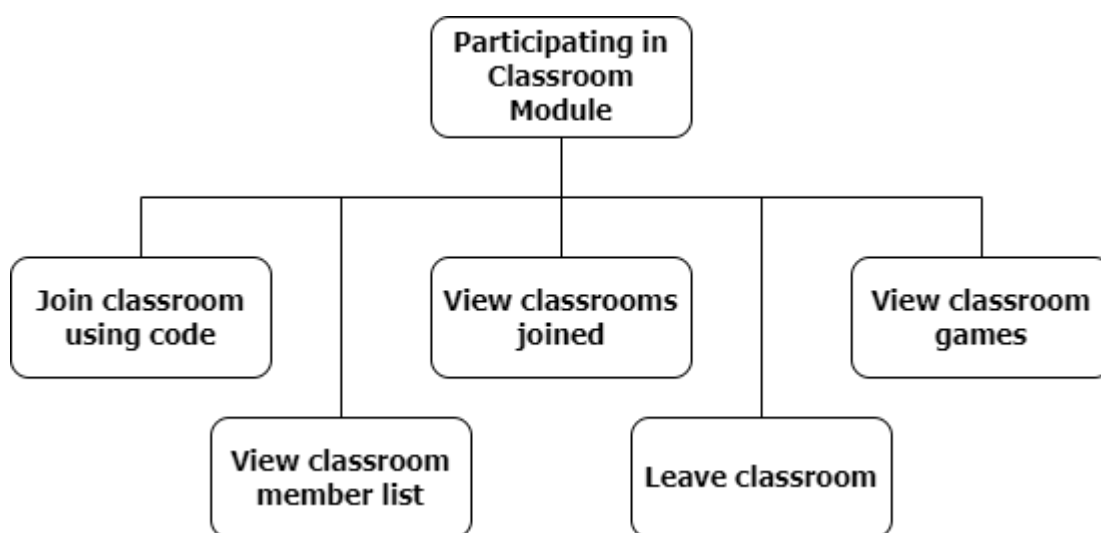
Student login and maintenance module allows users to log in to the system by using their TARUC student email and password. TARUC will register an account for each student and use the student's Identity Card number as the default password for the account. If the email or password field is empty or not found in the database, the system will request users to re-enter again and prompt an error message to provide some guidance for users. If the email and password are correct, the user will be redirected to the home page.

After logging in, users can modify their account passwords, view and manage their user profiles, such as profile picture and usernames. On the homepage, there will be a user profile picture button and a logout button at the top-right corner, if users click on the profile picture button, the system redirects users to their user profile page, where users can decide whether to change their password or update their profile. The system will verify the information entered

by users before updating the data to the database. If the information is invalid, users will be required to re-enter the information again. If users click on the logout button, the sessions will be terminated and users will be redirected back to the login page.

Not only that, users are able to reset their password on the login page if they forgot their password. After users click on the “Forget Password?” button, the system will require the users to enter their email address for validation purposes and the system will send a verification code to the email address. Once users have entered the correct verification code, the system will allow them to reset the password.

### **Participating in Classroom Module**



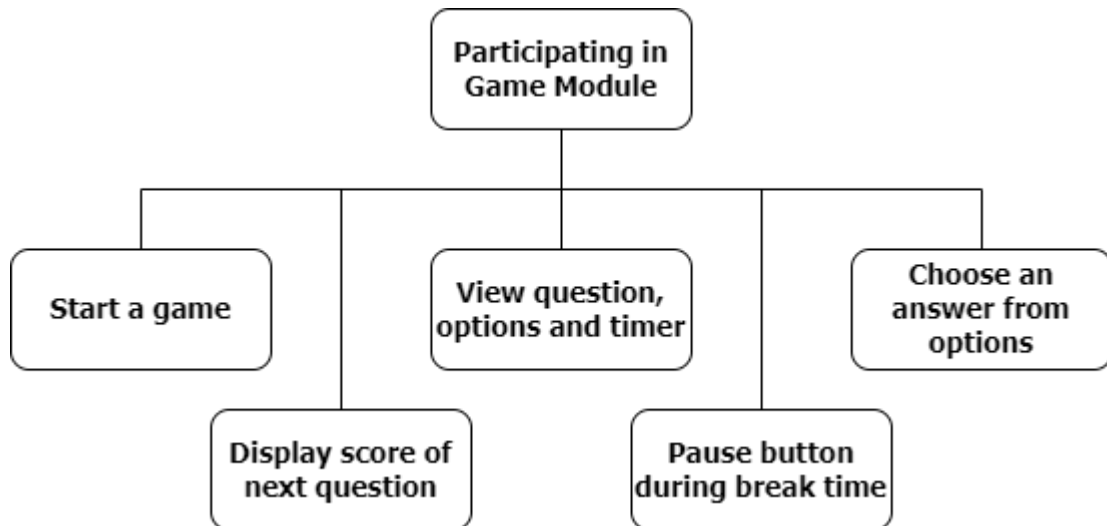
*Figure 3.2 : Participating in Classroom Module Hierarchical Chart*

Participating in classroom module allows users to join classrooms by using codes that are shared by instructors when they are on the home page. Users can redirect to the classroom joining page by clicking the “Join Classroom” button on the home page. After users fill in the classroom code and click the Join button, the system will verify whether the classroom code exists. If the classroom code is not found in the database, users will be required to re-enter the classroom code again. If the classroom code is found, the system will update the users' joined classroom to the database.

After joining classrooms, the system redirects users to the home page. All the joined classrooms will be displayed on the home page and users are able to enter into one of the classrooms by clicking the classroom. After entering the classroom, users are able to view all the contents of the classroom including the games that are created by the instructor and the members list of that classroom. Users are also allowed to leave the classroom by clicking the

leave button. When users decide to leave the classroom, the system will prompt a confirmation box for users to confirm their action. After users confirm to leave, the system will update the database.

### Participating in Game Module



*Figure 3.3 : Participating in Game Module Hierarchical Chart*

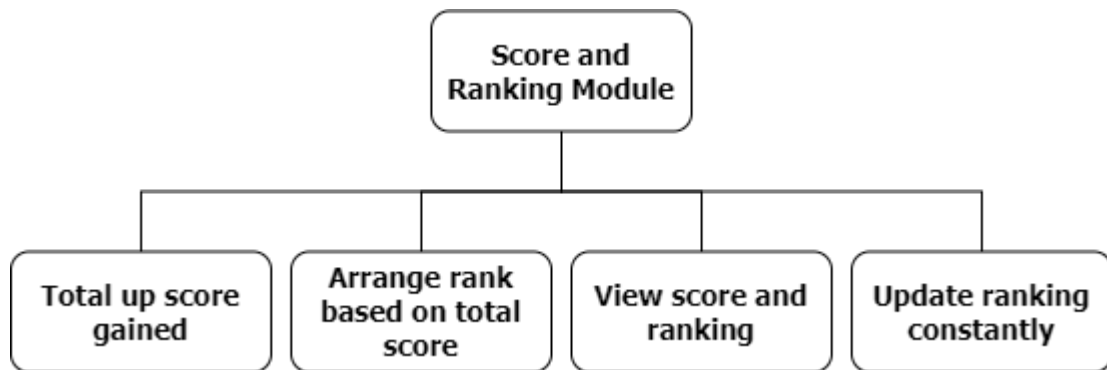
Participating in game module allows users to select and start the game they want to play. After users start a game, the first question, answer options (if any) and timer will be displayed on the screen and users should choose their answers from answer options (multiple-choice question, true-false question) or provide answers in text (fill-in-the-blank question) before the time ends.

For multiple-choice and true-false questions, if the selected option is correct, the system will change the background color of the selected option into green color, otherwise the background color will be changed into red color. For fill-in-the-blank questions, if the answer is correct, the system will display a green tick, otherwise the system will display a red cross. The question will be automatically skipped if the user is not answering before the time ends. Users will not get a score for the question if they are not answering or answered incorrectly.

A 10 seconds timer and the score for the next question will be shown during the break time before the next question so that users can decide whether they need to exchange power or which power they want to exchange. The pause button and entrance of the power exchange store will be shown during the break time so that users are able to pause the game or enter into the store during the break time only. If users click on the pause button, the system will

pause the timer and display a “Resume” button to let the user resume the game. When the 10 seconds timer expires, the system will start the next question immediately.

### Score and Ranking Module

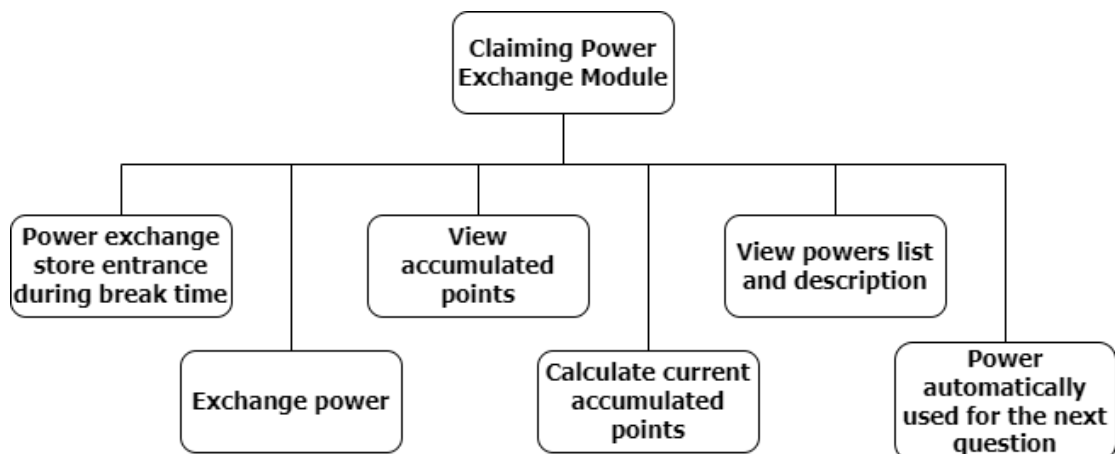


*Figure 3.4 : Score and Ranking Module Hierarchical Chart*

Score and ranking module allows users to view their scores and ranking when the game ends. When the game comes to the end, the system will display an end game page, telling the user that the game is over and the user can click anywhere on the screen to view the score and ranking for that game.

The system will total up the score the user gained on every question and arrange the rank based on the total score of each user who has played that game. The ranking will be sorted from the highest total score to the lowest total score and the ranking will be constantly updated as new players play the game and leave new records.

### Claiming Power Exchange Module



*Figure 3.5 : Claiming Power Exchange Module Hierarchical Chart*

Claiming power exchange module allows users to exchange powers during the break time of the games. Before every question starts, the entrance of the power exchange store will be shown and users are allowed to enter the store to exchange a power by using the accumulated points in the game.

Users can view their accumulated points after entering the store so that users can know how many points they have earned in the game and powers list and description are also included in the store so that users can understand what powers are and how powers work. The default powers provided are double scores power(used for ranking), double points power(used for power exchange), and eliminating a wrong answer power(remove one incorrect answer in a multiple-choice question).

When a user decides to exchange the desired power, the system will prompt a confirmation box to prevent accidental clicks. Then, the system will check whether the user's point is enough to exchange the power. If the point is enough, the system will calculate the user's current point and update it into the database, else the system will prompt an error message to tell the user that the exchange process is unsuccessful. After the user exchanges a power successfully, the system will start the next question immediately and use the exchanged power automatically.

### **3.3.2 Non-functional Requirements**

#### **Usability**

Usability measures how friendly and easy for users to use the TARUC Game-based Education System. The user interface of the system is simple and clean since the system only consists of the major functions that TARUC needs, therefore users are able to find the features they want easily. Next, the system also provides error messages and guidance for users to handle the errors. For example, if the user enters an invalid email or password, the system will check it and display the error message “Invalid email or password, Please try again.” to let users know what they have to do to fix the error.

#### **Performance**

Performance is the ability of a system in the form of responsiveness to various actions within a certain period of time. The TARUC Game-based Education System has a fast response for various actions of users. For example, when the user chooses an answer, the system immediately responds to the user whether the selected answer is correct.

#### **Availability**

Availability means the degree to which a software system can be accessed by the users when it is required. TARUC Game-based Education System is a web-based system that can be accessed through an internet-connected pc or laptop and it is available 7 days per week and 24 hours per day. Therefore, users can access the website anytime and anywhere as long as they have a device and internet.

#### **Security**

Security refers to the degree to which a software system safeguards the information or data so that users or other systems have the degree of access to these data based on the authorization level. The TARUC Game-based Education System has no self-registration function and is only available for TARUC emails. Therefore, the risk of information leakage is reduced since external emails are not able to access the system.

### 3.4 Development Environment

#### 3.4.1 Hardware Specification

*Table 3.1 : Hardware specification for system development*

Hardware	Specification
Operating System	Windows 10 Home, 64-bit OS
Processor	Intel I5 Processor, 7th Generation with 330 Megahertz(MHz) or above
RAM	192 Megabytes(MB) or above
Hard Disk Space	75 Megabytes(MB) of HDD Storage Space or above
Screen Resolution	800(width) x 600(height)

For the frontend of TARUC Game-based Education System, the minimum hardware requirement for the development device is Windows 10 Home with 64-bit operating system. The processor requirement is Intel I5 Processor, 7th Generation with 330 Megahertz(MHz) or above at least 192 Megabytes(MB) of RAM. Next, a development device also requires at least 75 Megabytes(MB) of HDD storage space and a screen resolution of 800(width) x 600(height).

### 3.4.2 Software Specification

*Table 3.2 : Software specification for system development*

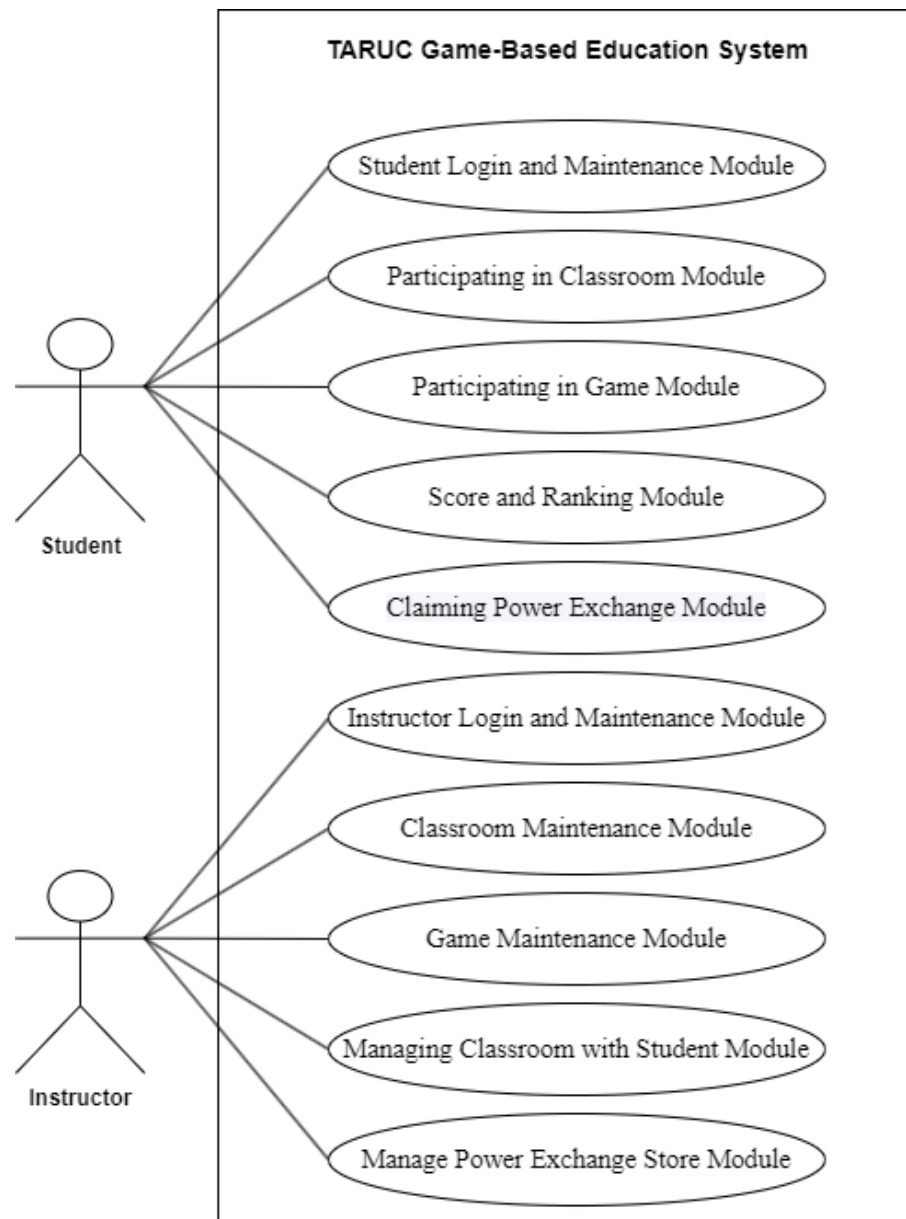
Software	Software Specifications
Operating System	Windows 10 Home, 64-bit OS
IDE	Apache Netbeans IDE 12.0
Programming Language	PHP 7.4.27, HTML, Javascript, CSS
Database	MySQL
Web Server	XAMPP 7.4.27 and above
Browser	Google Chrome on Windows with version 103.0.5060.134(64-bit)

For the frontend of TARUC Game-based Education System, the minimum software requirement for the development device is Windows 10 Home with 64-bit operating system. The programming languages are PHP 7.4.27, HTML, Javascript and CSS, which are used to develop web-based applications with Apache Netbeans IDE 12.0. MySQL is used as the database for the proposed system and it can be managed through phpMyAdmin. XAMPP 7.4.27 and above used by the author to create a web server on the development device and browses the proposed system using Google Chrome on Windows with version 103.0.5060.134(64-bit).



## 3.5 Requirements Analysis

### 3.5.1 Overview Use Case Diagram



*Figure 3.6 : TARUC Game-based Education System Overview Use Case Diagram*

Figure 3.6 represents the overview of the TARUC Game-based Education System. There are two actors that will concern in this system which is student and instructor. The author is in-charge of the modules that can be performed by students which are student login and maintenance module, participating in classroom module, participating in game module, score and ranking module and claiming power exchange module. Besides, the rest of the modules that are mainly related to instructors will be handled by the author's partner.

### 3.5.2 Detailed Use Case Diagram

#### Student Login and Maintenance Module Detailed Use Case Diagram

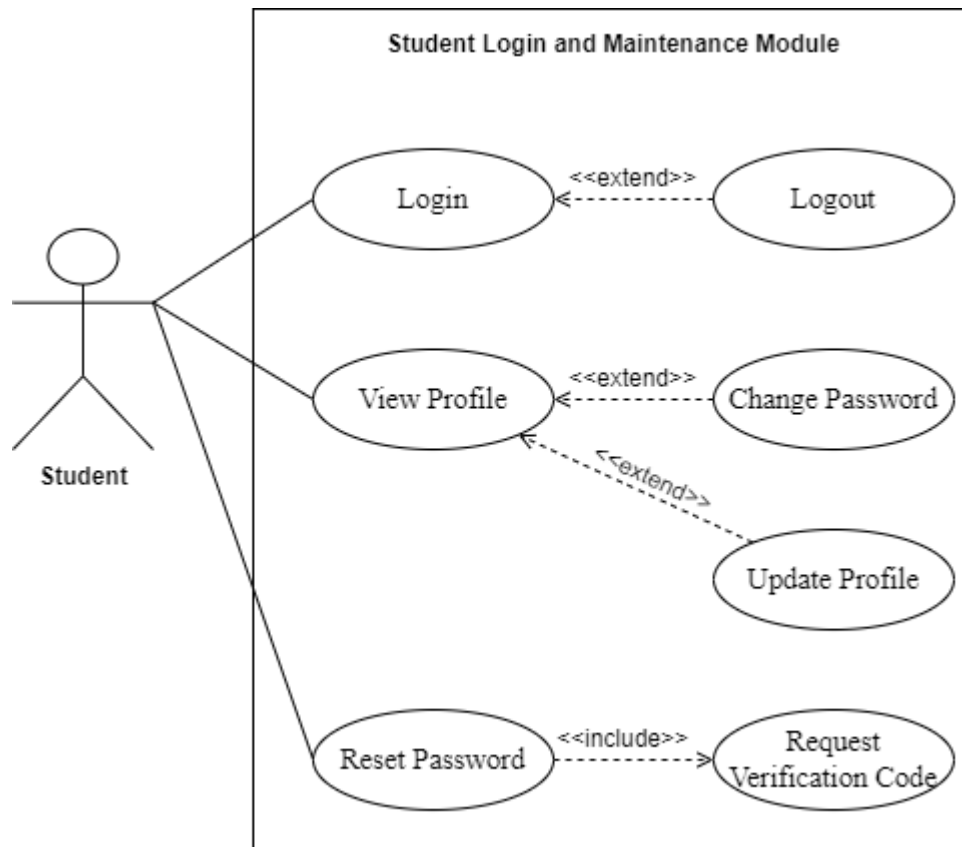


Figure 3.7 : Student Login and Maintenance Module Detailed Use Case Diagram

#### Student Login and Maintenance Module Detailed Use Case Description

<b>Use Case Name:</b> Student Login and Maintenance Module	
<b>Actor:</b> Student	
<b>Brief Description:</b> System allows users to reset password, login, view and update their account.	
<b>Pre-condition:</b> The user must have an account. The system is displaying the frontend login page.	
<b>Main Flow:</b>	
Actor Action	System Respond
1. User clicks on the “Forget Password” Button.	2. System redirects the user to the verify email page.
3. User fills in the email address.	
4. User clicks on the “Verify” Button.	5. System verifies the email address.

7. User fills in the verification code.	6. If the email exists in the database, the system redirects the user to the verify code page and sends a verification code to the email.
8. User clicks on the button.	9. If the user clicks on the “Verify” Button, the system verifies the verification code.
11. User fills in the new password.	10. If the verification code matches the code that the system sent to the email, the system redirects the user to the reset password page.
12. User clicks on the “Reset” Button.	13. If the password format is valid, the system updates the database and redirects to the login page.
14. User fills in the email and password.	
15. User clicks on the “Login” Button.	16. System verifies the email and password entered.
18. User clicks on the “Profile Picture” Button.	17. If inputs exist in the database, the system redirects the user to the home page.
20. User decides to either change password or update profile.  If the user decides to change password <b>S1: Change Password</b> is performed.  If the user decides to update profile <b>S2: Update Profile</b> is performed.	19. System shows the user profile with two buttons: Change Password and Update Profile.
<b>Sub Flow:</b>  <b>S1: Change Password</b> <ol style="list-style-type: none"> <li>1. User clicks on the “Change Password” button.</li> <li>2. System shows the password editing page with two options: Change and Cancel.</li> <li>3. User enters all the required fields and clicks on the “Change” button.</li> <li>4. System verifies the input.</li> <li>5. If input formats are valid, the system updates the password into the database and prompts a success message.</li> </ol> <b>S2: Update Profile</b> <ol style="list-style-type: none"> <li>1. User clicks on the “Update Profile” button.</li> <li>2. System shows the profile editing page with two options: Update and Cancel.</li> <li>3. User edits the profile data in the text field and clicks on the “Update” button.</li> </ol>	

4. System verifies the input.
5. If input formats are valid, the system updates the user profile into the database and prompts a success message.

**Alternative Flow:**

A1. Step 6:

If the email does not exist in the database, the system prompts an error message and requests the user to re-enter again.

A2. Step 9:

If the user clicks on “Resend” Button, the system will resend the verification code to the email.

A3. Step 10:

If there is an empty field or verification code is not matched, the system prompts an error message and requests the user to re-enter again.

A4. Step 13:

If there is an empty field or password format is invalid, the system prompts an error message and requests the user to re-enter again.

A5. Step 17:

If there are empty field(s) or incorrect email or password, the system prompts an error message and requests the user to re-enter again.

A6. S1, Step 3:

If the user clicks on the “Cancel” button, the system redirects back to the home page.

A7. S1, Step 5:

If the input formats are invalid, the system prompts an error message and requests the user to re-enter again.

A8. S2, Step 3:

If the user clicks on the “Cancel” button, the system redirects back to the home page.

A9. S2, Step 5:

If the input formats are invalid, the system prompts an error message and requests the user to re-enter again.

### Participating in Classroom Module Detailed Use Case Diagram

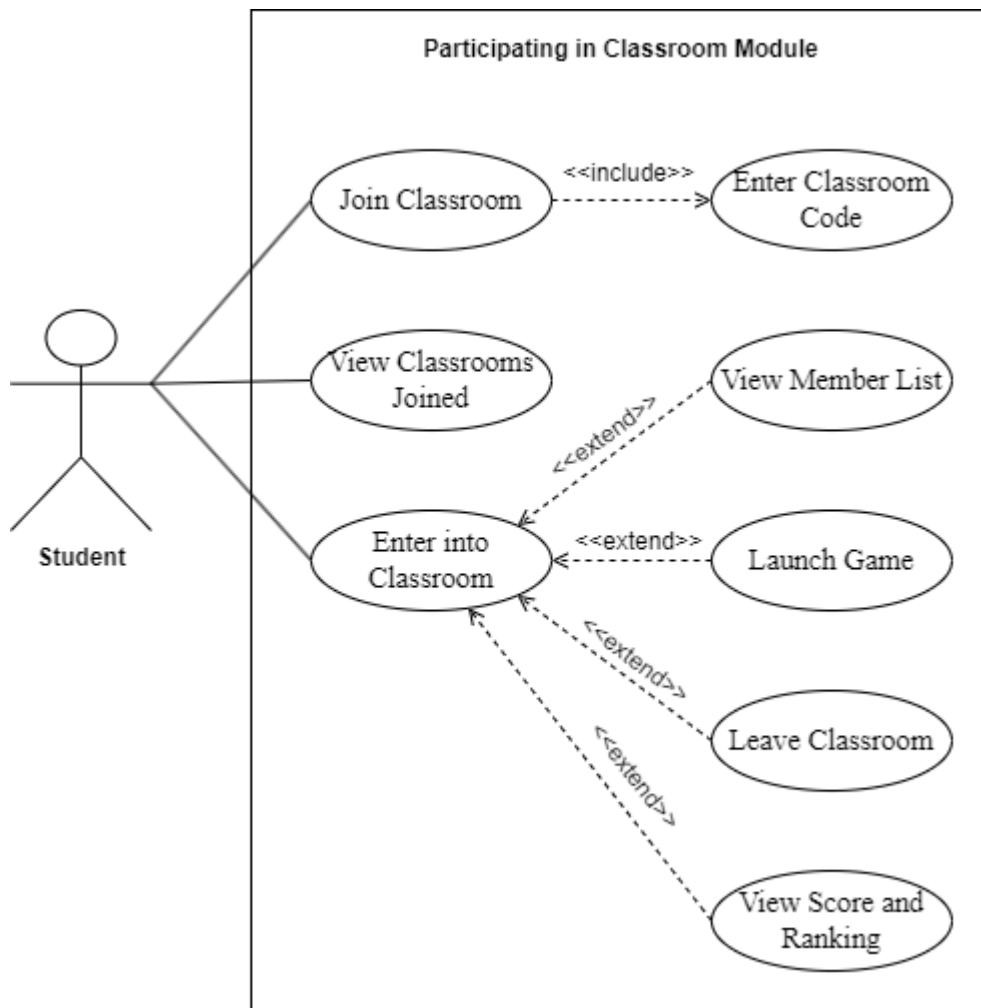


Figure 3.8 : Participating in Classroom Module Detailed Use Case Diagram

### Participating in Classroom Module Detailed Use Case Description

<b>Use Case Name:</b> Participating in Classroom Module	
<b>Actor:</b> Student	
<b>Brief Description:</b> System allows users to join, view, enter and leave classrooms.	
<b>Pre-condition:</b> The user must be logged in. The system is displaying the frontend home page (classroom listed).	
<b>Main Flow:</b>	
<b>Actor Action</b>	<b>System Respond</b>
1. User decides whether to join a new classroom.	
If the user decides to join a new classroom	

<b>S1: Join Classroom</b> is performed.	
2. User clicks on the classroom that wants to enter.	3. System redirects the user to the selected classroom main page.
4. User decides to either view the member list, launch the game, leave the classroom or view score and ranking.  If the user decides to view the member list <b>S2: View Member List</b> is performed.  If the user decides to launch the game <b>S3: Launch Game</b> is performed.  If the user decides to leave the classroom <b>S4: Leave Classroom</b> is performed.  If the user decides to view score and ranking <b>S5: View Score and Ranking</b> is performed.	

#### **Sub Flow:**

##### **S1: Join Classroom**

1. User clicks on the “Join Classroom” button.
2. System shows the classroom joining page with two options: Join and Cancel.
3. User enters the classroom code and clicks on the “Join” button.
4. System verifies the classroom code.
5. If classroom code is found in the database, the system updates the joined classroom lists into the database and prompts a success message.
6. System redirects the user to the home page.

##### **S2: View Member List**

1. User clicks on the “View Member List” button.
2. System redirects the user to the selected classroom member list.

##### **S3: Launch Game**

1. User clicks on the “Launch Game” button.
2. System redirects the user to the selected game page.

##### **S4: Leave Classroom**

1. User clicks on the “Leave Classroom” button.
2. System prompts the confirmation box with two options: Leave and Cancel.
3. User clicks on the “Leave” button.
4. System updates the joined classroom lists into the database and prompts a success

message.

5. System redirects the user to the home page.

#### S5: View Score and Ranking

3. User clicks on the “View Score and Ranking” button.
4. System redirects the user to the selected score and ranking page.

#### Alternative Flow:

##### A1. S1, Step 3:

If the user clicks on the “Cancel” button, the system redirects back to the home page.

##### A2. S1, Step 5:

If the classroom code is not found in the database, the system prompts an error message and requests the user to re-enter again.

##### A3. S4, Step 3:

If the user clicks on the “Cancel” button, the system redirects back to the selected classroom main page.

### Participating in Game Module Detailed Use Case Diagram

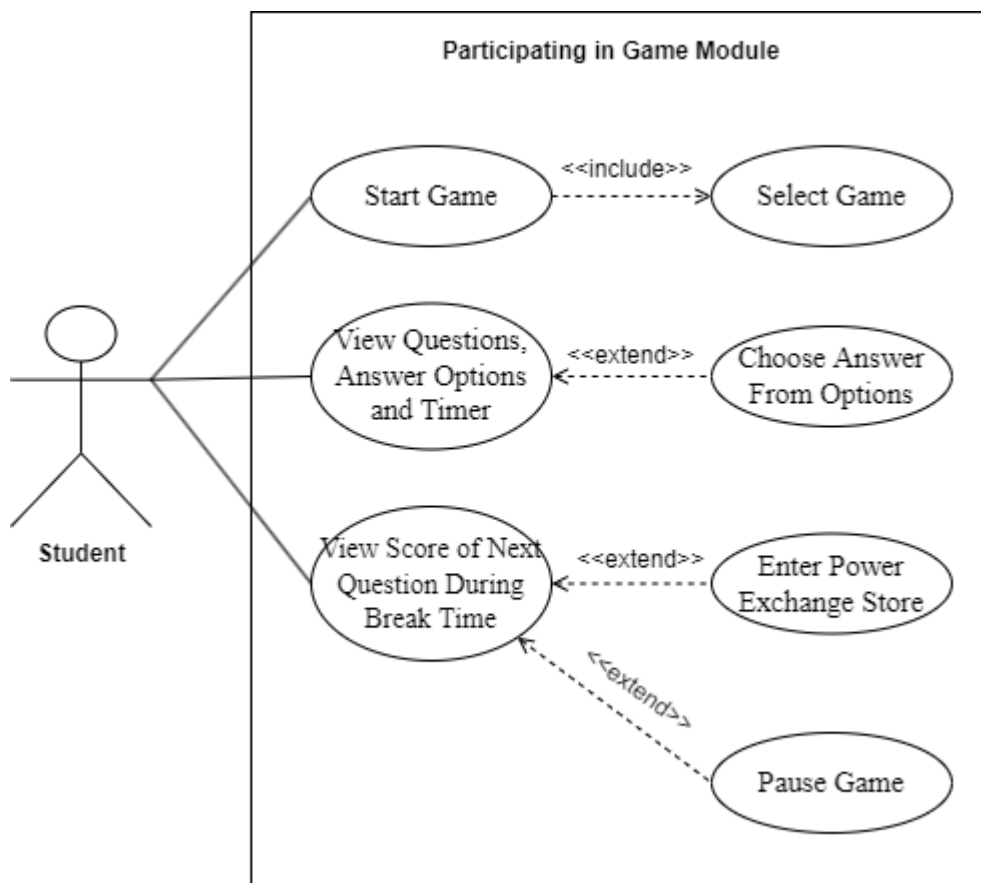


Figure 3.9 : Participating in Game Module Detailed Use Case Diagram

### Participating in Game Module Detailed Use Case Description

<b>Use Case Name:</b> Participating in Game Module	
<b>Actor:</b> Student	
<b>Brief Description:</b> System allows users to start and play games.	
<b>Pre-condition:</b> The user must be in a classroom that contains games.	
<b>Main Flow:</b>	
Actor Action	System Respond
1. User starts a game.	2. System redirects the user to the game starting page.
4. User selects the answer from options or provides an answer in text before time ends.	3. System displays the question, answer options (if any) and timer.
	5. System responds to the user whether the answer is correct.
	6. System checks whether the next question exists.
8. User decides whether to enter the power exchange store or pause the game.  If the user decides to enter the power exchange store <b>S1: Power Exchange Store</b> is performed.  If the user decides to pause the game <b>S2: Pause Game</b> is performed.	7. If the next question exists, the system displays a game breaks page that shows a 10 seconds timer and the score for the next question.
	9. After the 10 seconds timer expires, the system loops back to Step 3.
<b>Sub Flow:</b>	
S1: Power Exchange Store	
<ol style="list-style-type: none"> <li>1. User enters the power exchange store.</li> <li>2. System redirects the user to the power exchange store page.</li> </ol>	
S2: Pause Game	
<ol style="list-style-type: none"> <li>1. User clicks on the “Pause” button.</li> <li>2. System pauses the timer and displays a “Resume” button to let the user resume the</li> </ol>	



game.
<b>Alternative Flow:</b> <u>A1. Step 7:</u> If the next question does not exist, the system redirects the user to the end game page. <u>A2. S2, Step 2:</u> If the user clicks on the “Resume” button, the system continues the timer.

### Claiming Power Exchange Module Detailed Use Case Diagram

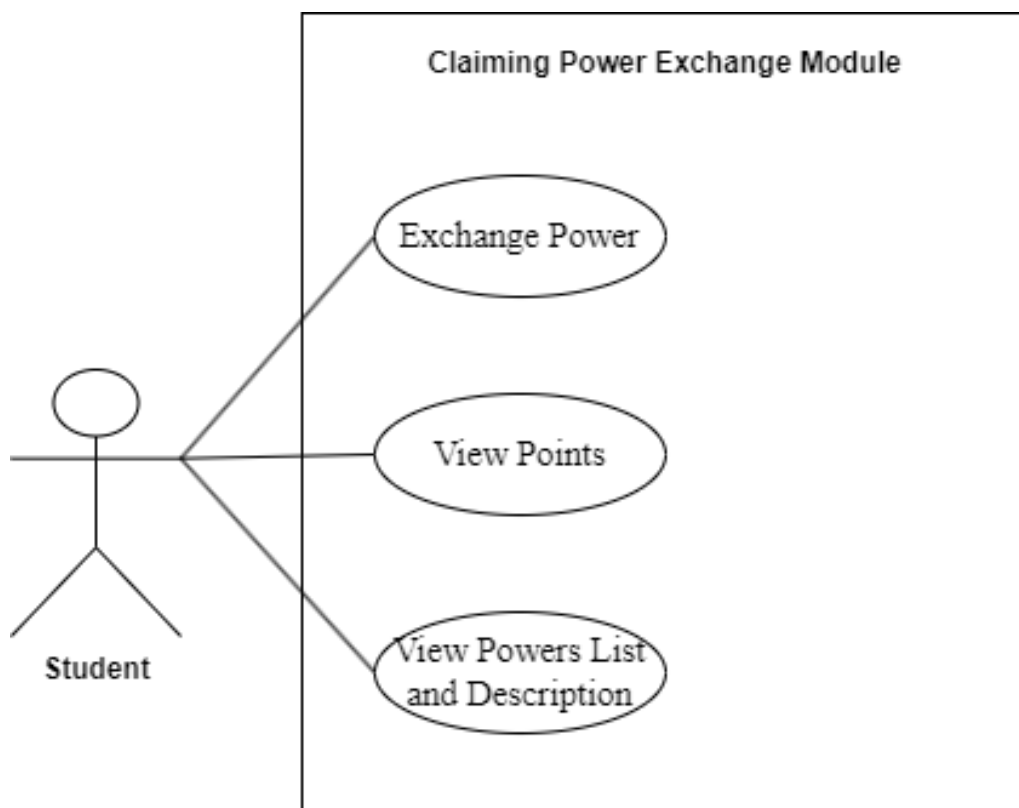


Figure 3.10 : Claiming Power Exchange Module Detailed Use Case Diagram

### Claiming Power Exchange Module Detailed Use Case Description

<b>Use Case Name:</b> Claiming Power Exchange Module
<b>Actor:</b> Student
<b>Brief Description:</b> System allows users to exchange powers during game breaks.
<b>Pre-condition:</b> The user must be in game break.

**Main Flow:**

Actor Action	System Respond
1. User clicks on the entrance to enter into the power exchange store.	2. System redirects the user to the power exchange store page.
3. User decides whether to view the powers list and description.  If the user decides to view the powers list and description <b>S1: Power List</b> is performed.	
4. User clicks on the “Exchange” button for the desired power.	5. System displays a confirmation box with two options: Exchange and Cancel.
6. User clicks on the “Exchange” button.	7. System determines the number of points that will be claimed based on the power that the user selected.
	8. System checks whether the user's point is enough to exchange the power.
	9. If the user's point is enough, the system deducts the points to be claimed from the user's points.
	10. System displays the next question, answer options (if any) and timer.
	11. System uses the power automatically.

**Sub Flow:****S1: Power List**

1. User clicks on the “Power List” button.
2. System redirects the user to the powers list and description page.

**Alternative Flow:****A1. Step 6:**

If the user clicks on the “Cancel” button, the exchange power process cancels and the point remains unchanged.

**A2. Step 9:**

If the user's point is not enough, the system prompts the error message and the user's point remains unchanged.

### **3.6 Chapter Summary and Evaluation**

In this chapter, the author has discussed methodology applied, the techniques used to gather requirements, the functional and non-functional requirements, the development environment, overview use case diagram, a detailed use case diagram and description for each module that the author deals with.

The problem that the author faced was lack of understanding when producing detailed use case diagrams and detailed use case description since the author has not reviewed this knowledge for a long time. In order to solve the problem, the author did a lot of research on Google and referred back to the previous diagrams done when the author learned the OOAD subject.

## Chapter 4

# **System Design**

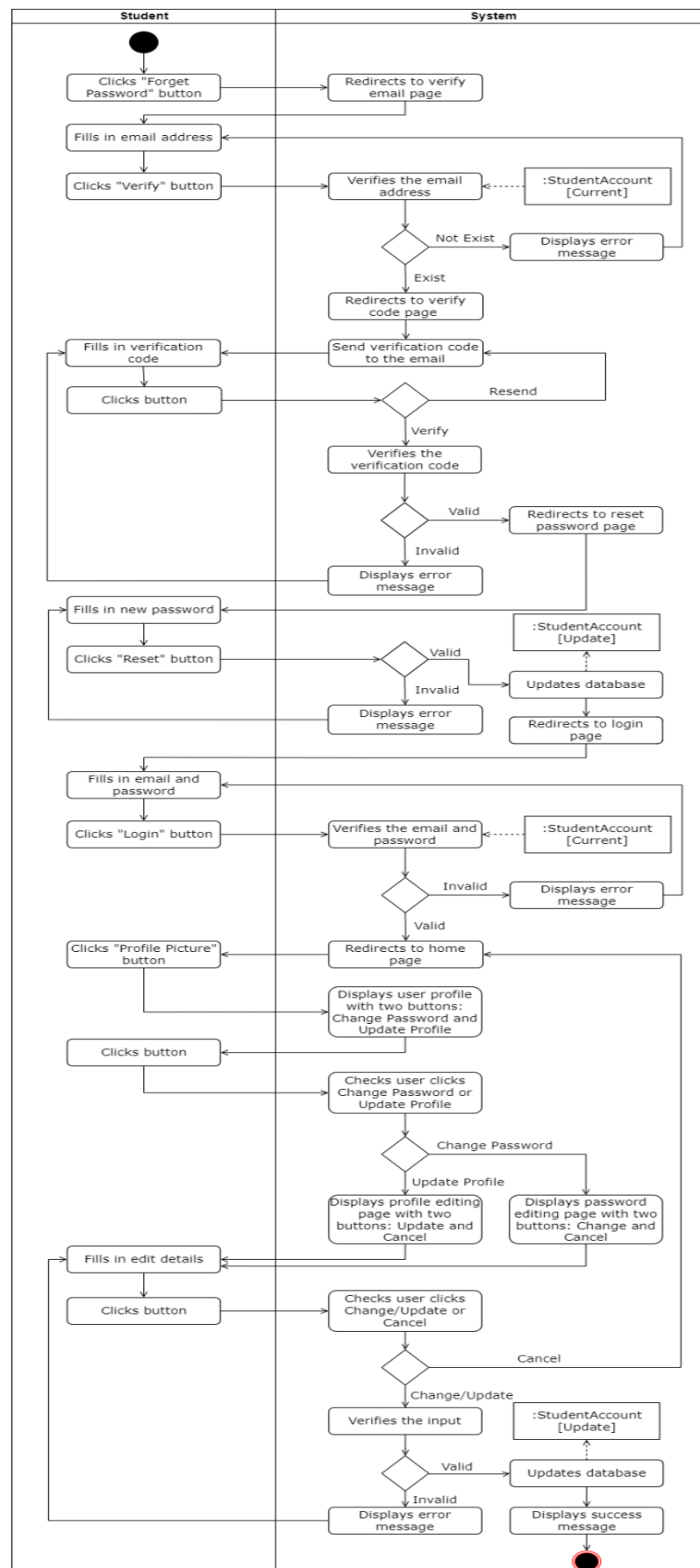
## **4 System Design**

In this chapter, the author will discuss the system design which includes activity diagram, database design and user interface design. For the activity diagram, only the modules that are handled by the author will only be prepared. For the database design, the author will use an entity relationship diagram (ERD) to illustrate the overall database structure and the relationship between sets of entities stored in the database. The author will also prepare a data dictionary to describe the details of entity structure for each database table. Lastly, the user interface design of the proposed system will be presented.

### **4.1 Activity Diagram**

In this part, the activity diagram will be prepared to help the author to visually present a sequence of actions or control flow in a system. An activity diagram illustrates the steps in an activity and the order in which they are presented. Student login and maintenance module, participating in classroom module, participating in game module, score and ranking module and claiming power exchange module will be presented with activity diagrams.

## Student Login and Maintenance Module Activity Diagram



*Figure 4.1 : Student Login and Maintenance Module Activity Diagram*

The figure above shows the logic flows of the Student Login and Maintenance Module. First, when the user forgot the account password, the user can click on the “Forget Password” button to reset the password and the system will redirect to the verify email page. The user is required to fill in the email address and click on the Verify button. After that, the system will redirect to the verify code page and send the verification code to the email if the email exists in the database. If the email is not found in the database, the system prompts an error message and requires the users to re-enter again.

On the verify code page, the user can request the system to resend the verification code by clicking the Resend button. After the user fills in the verification code and clicks the Verify button, the system will verify the verification code. If the code is invalid, the system prompts an error message and requires the users to re-enter again, else the user will be redirected to the reset password page. The user is required to fill in the new password and click the Reset button. If the input format is valid, the system will update the database and redirect to the login page, else the user will be required to re-enter again.

On the login page, the user needs to fill in the email and password and click on the Login button. Then, the system checks whether the email and password is valid. If invalid, the system prompts an error message and requires the user to re-enter again, else the user will be redirected to the home page.

Next, the user clicks on the profile picture and the system will display the user profile with two buttons: Change Password and Update Profile. If the user clicks on Change Password, the system displays the password editing page, else the system displays the profile editing page. If the user wants to edit their profile or password, the user is required to fill in the edit details and click on the Change or Update button. The user can cancel this operation by clicking the Cancel button and then the system will redirect back to the home page. After the user clicks on the Change or Update button, the system verifies the input. If the input is invalid, the system prompts an error message and the user is required to re-enter again, else the system updates the database and displays the success message.

## Participating in Classroom Module Activity Diagram

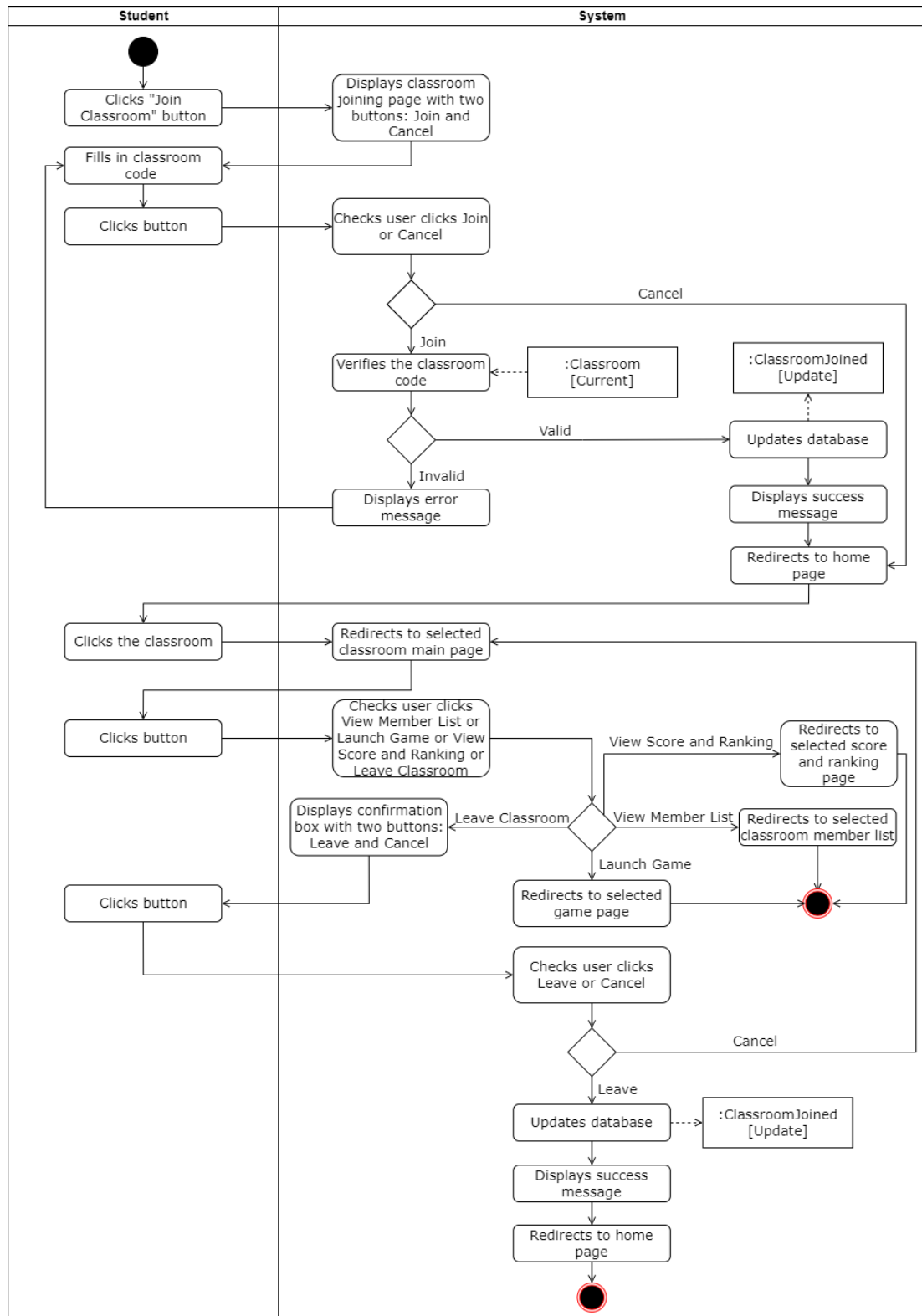


Figure 4.2 : Participating in Classroom Module Activity Diagram

The figure above shows the logic flows of the Participating in Classroom Module. First, the user clicks on the Join Classroom button and then the system displays the classroom joining



page with two buttons: Join and Cancel. Then, the user is required to fill in the classroom code and clicks on the Join button. The user can cancel this operation by clicking the Cancel button. After the user clicks on the Join button, the system checks whether the classroom code exists. If classroom code is not found, the system prompts an error message and requires the user to re-enter again, else the system updates the database, prompts a success message and redirects the user to the home page.

Next, the user clicks on the classroom and the system will redirect to the selected classroom main page. If the user clicks on View Member List, the system redirects to the selected classroom member list page, else if the user clicks on Launch Game, the system redirects to the selected game page, else if the user clicks on View Score and Ranking, the system redirects to the selected score and ranking page, else if the user clicks on Leave Classroom, the system displays the confirmation box with two buttons: Leave and Cancel. The user can cancel the leave classroom operation by clicking the Cancel button and then the system will redirect back to the selected classroom main page. After the user clicks on the Leave button, the system updates the database, displays a success message and then redirects the user to the home page.

## Participating in Game Module Activity Diagram

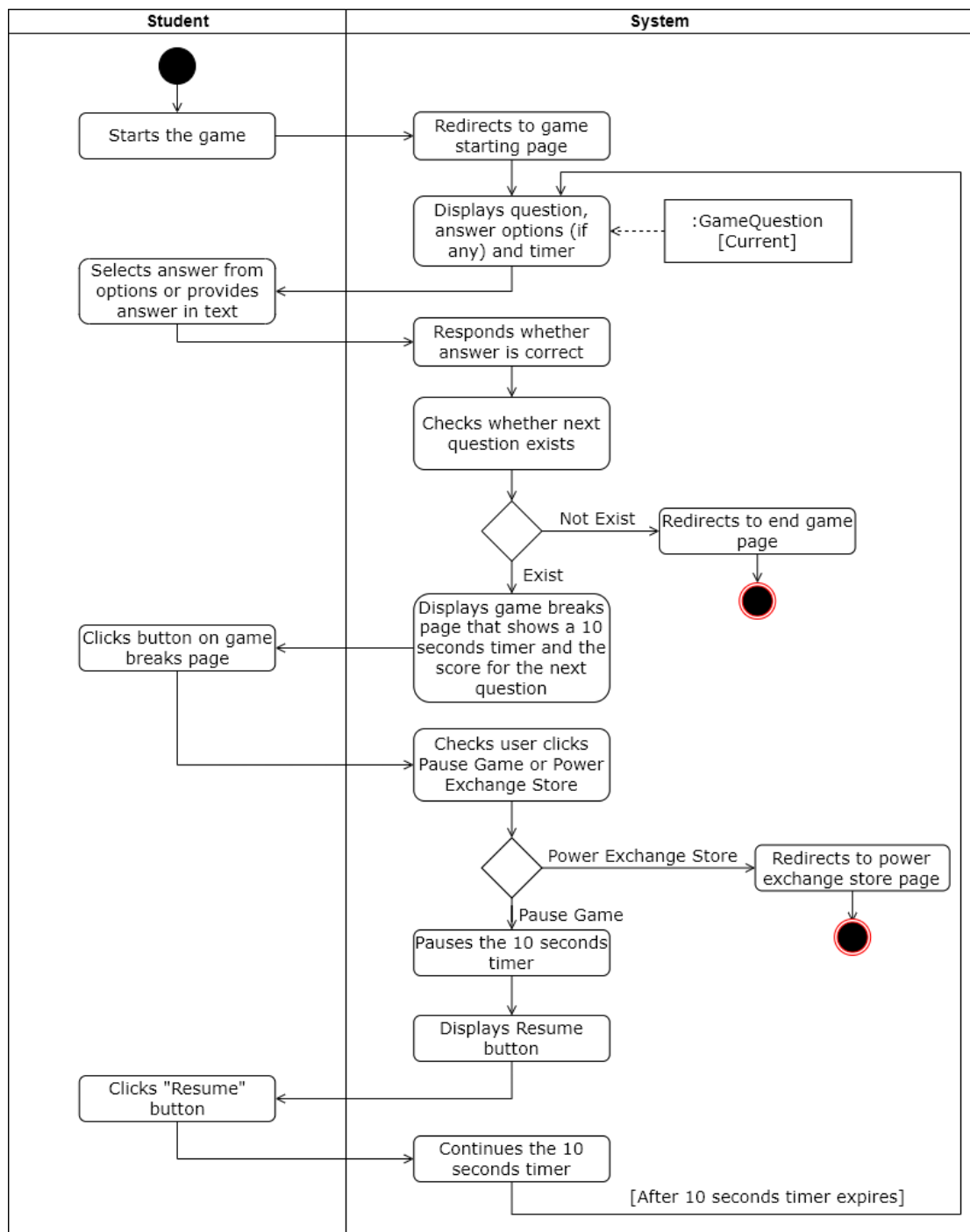


Figure 4.3 : Participating in Game Module Activity Diagram

The figure above shows the logic flows of the Participating in Game Module. First, the user starts a game and then the system redirects to the game starting page and displays the question, answer options (if any) and timer. The user chooses answer(s) from the options or provides the answer in text and the system responds to the user whether the answer(s) is correct. After that, the system checks whether the next question exists in the database, the system will redirect to the end game page if the next question does not exist.

If the next question exists, the system displays the game breaks page that shows a 10 seconds timer and the score for the next question. When the user is on the game breaks page, the user is allowed to pause the game and enter into the power exchange store. If the user decides to enter into the power exchange store, the system redirects to the power exchange store page. If the user decides to pause the game, the system pauses the 10 seconds timer and displays a Resume button. The timer will be continued if the user clicks on the Resume button. After the 10 seconds timer expires, the system displays the next question, answer options and timer.

## Claiming Power Exchange Module Activity Diagram

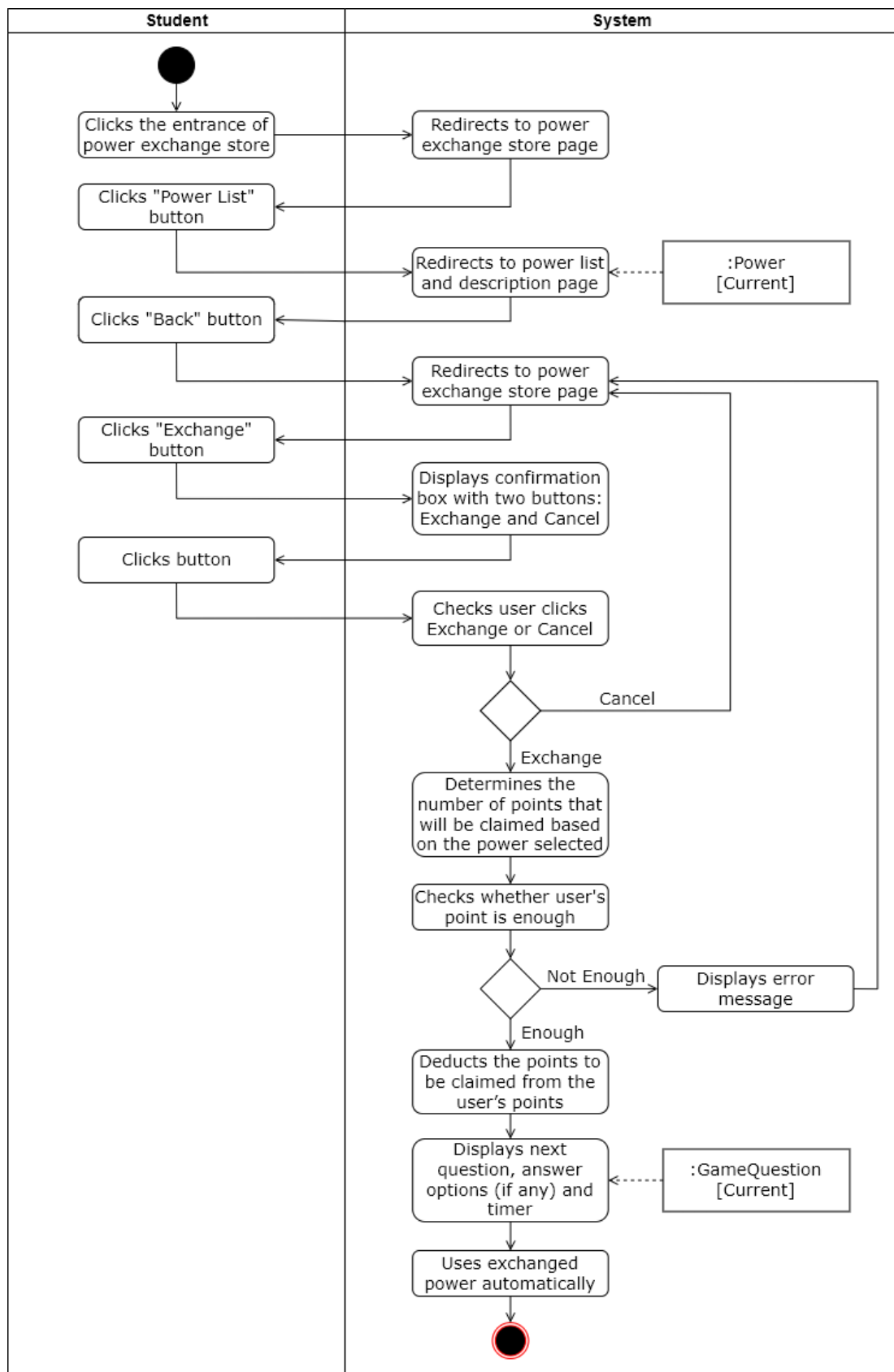


Figure 4.4 : Claiming Power Exchange Module Activity Diagram

The figure above shows the logic flows of the Claiming Power Exchange Module. First, the user clicks on the entrance of the power exchange store and then the system redirects to the power exchange store page. Then, the user clicks on the Power List button and the system redirects to the powers list and description page. If the user clicks on the Back button, the system redirects back to the power exchange store page.

After that, the user clicks on the Exchange button of the desired power and then the system prompts a confirmation box with two buttons: Exchange and Cancel. The user can cancel this operation by clicking the Cancel button. After the user clicks on the Exchange button, the system determines the number of points that will be claimed based on the power the user selected and then the system checks whether the user's point is enough. If the point is not enough, the system prompts an error message and redirects back to the power exchange store page. If the point is enough, the system deducts the points to be claimed from the user's point. After that, the system displays the next question, answer options (if any) and timer and then the system uses the exchanged power for that question automatically.

## 4.2 Database Design

### 4.2.1 Overall System Entity Relationship Diagram (ERD)

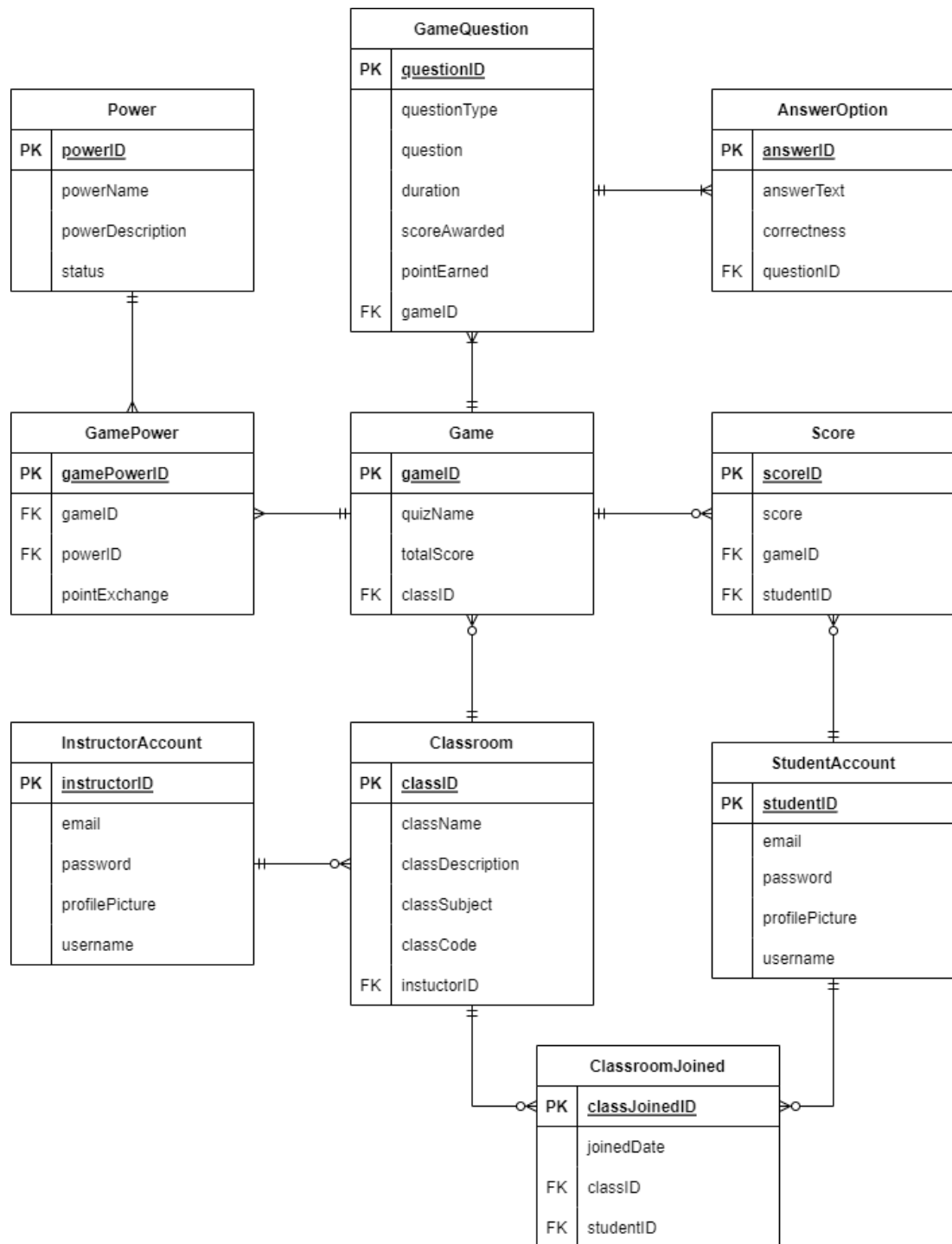


Figure 4.5 : Entity Relationship Diagram of Overall TARUC Game-based Education System

#### 4.2.2 Data Dictionary

**Table Name: StudentAccount**

Description: This table stores the students' information that are registered by TARUC.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
studentID	VARCHAR (8)	The id of the student table. E.g.: "ST000001" "ST" refers to a student, followed by 6 digit numbers.	No	PK	-
email	VARCHAR (50)	TARUC student email. E.g.: "xxxxx-xx19@student.tarc.edu.my"	No	-	-
password	VARCHAR (100)	The password of the student account. Minimum length is 8 and maximum length is 100, the password must include minimum 1 alphabet and letter. Default: Student's IC number	No	-	-
profilePicture	VARCHAR (20)	The profile picture of the student account. Default: Blue Profile Picture	No	-	-
username	VARCHAR (50)	The username of the student account. Default: Student's IC name	No	-	-

**Table Name: InstructorAccount**

Description: This table stores the instructors' information that are registered by TARUC.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
instructorID	VARCHAR (8)	The id of the instructor table. E.g.: "IN000001" "IN" refers to an instructor, followed by 6 digit numbers.	No	PK	-
email	VARCHAR (50)	TARUC instructor email. E.g.: "xxxxx@tarc.edu.my"	No	-	-
password	VARCHAR	The password of the	No	-	-

	(100)	instructor account. Minimum length is 8 and maximum length is 100, the password must include minimum 1 alphabet and letter. Default: Instructor's IC number			
profilePicture	VARCHAR (20)	The profile picture of the instructor account. Default: Red Profile Picture	No	-	-
username	VARCHAR (50)	The username of the instructor account. Default: Instructor's IC name	No	-	-

**Table Name: Classroom**

Description: This table stores the classrooms' information that are created by instructors.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
classID	VARCHAR (8)	The id of the classroom table. E.g.: "CL000001" "CL" refers to a classroom, followed by 6 digit numbers.	No	PK	-
className	VARCHAR (50)	The name of the classroom. E.g.: "202205 MPU3232 Lecture"	No	-	-
classDescription	VARCHAR (100)	A statement that describes the purpose of the classroom.	Yes	-	-
classSubject	VARCHAR (50)	The subject that the classroom will focus on. E.g.: "Entrepreneurship"	No	-	-
classCode	VARCHAR (6)	A random 6-digit code consisting of alphabets and numbers. E.g.: "bQ2h7J"	No	-	-



instructorID	VARCHAR (8)	The id of the instructor table. E.g.: "IN000001" "IN" refers to an instructor, followed by 6 digit numbers.	No	FK	InstructorAccount
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**Table Name: ClassroomJoined**

Description: This table stores the joined classroom of students.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
classJoinedID	VARCHAR (8)	The id of the joined classroom table. E.g.: "CJ000001" "CJ" refers to a joined classroom, followed by 6 digit numbers.	No	PK	-
joinedDate	DATETIME	The date that the student joined the classroom. E.g.: "2022-12-12 09:30:05"	No	-	-
classID	VARCHAR (8)	The id of the classroom table. E.g.: "CL000001" "CL" refers to a classroom, followed by 6 digit numbers.	No	FK	Classroom
studentID	VARCHAR (8)	The id of the student table. E.g.: "ST000001" "ST" refers to a student, followed by 6 digit numbers.	No	FK	StudentAccount

**Table Name: Game**

Description: This table stores the game details that are created by instructors.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
gameID	VARCHAR	The id of the game table.	No	PK	-

	(8)	E.g.: "GA000001" "GA" refers to a game, followed by 6 digit numbers.			
quizName	VARCHAR (50)	The name of the game. E.g.: "Quiz 1: Chapter 1"	No	-	-
totalScore	INT	The maximum score that students can get in the game. Default: 0	No	-	-
classID	VARCHAR (8)	The id of the classroom table. E.g.: "CL000001" "CL" refers to a classroom, followed by 6 digit numbers.	No	FK	Classroom

**Table Name: GameQuestion**

Description: This table stores the question details of the games.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
questionID	VARCHAR (8)	The id of the game question table. E.g.: "GQ000001" "GQ" refers to a game question, followed by 6 digit numbers.	No	PK	-
questionType	VARCHAR (30)	Refers to how questions and answers are presented. E.g.: "multiple-choice question" allows players to choose multiple answers for the question. "true-false question" allows players to choose "True" or "False" for the question. "fill-in-the-blank question" allows players to answer the question in text.	No	-	-
question	VARCHAR (100)	The text of the question. E.g.: "Which of the following statements is NOT TRUE about	No	-	-

		fragment?"			
duration	INT	The duration in seconds for students to answer the question. The options of duration in the system are "10", "20", "30", "45" and "60". E.g.: "10" refers to 10 seconds.	No	-	-
scoreAwarded	INT	The score given to the users if they answer the question correctly, for ranking purposes. Minimum is 1 and maximum is 20.	No	-	-
pointEarned	INT	The point given to the users if they answer the question correctly, for claiming power purposes. Maximum is 1 and maximum is 10.	No	-	-
gameID	VARCHAR (8)	The id of the game table. E.g.: "GA000001" "GA" refers to a game, followed by 6 digit numbers.	No	FK	Game

**Table Name: AnswerOption**

Description: This table stores the answer options for the questions.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
answerID	VARCHAR (8)	The id of the question answer table. E.g.: "QA000001" "QA" refers to a question answer, followed by 6 digit numbers.	No	PK	-
answerText	VARCHAR (50)	The text of the answer option. E.g.: "Fragment manages its own UI and lifecycle."	No	-	-
correctness	INT	To define whether this answer is correct.	No	-	-

		E.g.: “1” means correct, “0” means incorrect.			
questionID	VARCHAR (8)	The id of the game question table. E.g.: “GQ000001” “GQ” refers to a game question, followed by 6 digit numbers.	No	FK	GameQuestion

**Table Name: Power**

Description: This table stores the power information for the whole system.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
powerID	VARCHAR (8)	The id of the power table. E.g.: “PO000001” “PO” refers to a power, followed by 6 digit numbers.	No	PK	-
powerName	VARCHAR (30)	The name of the power. E.g.: “Eliminate Wrong Answer”	No	-	-
powerDescription	VARCHAR (100)	A statement that describes the function of the power. E.g.: “Eliminate one wrong answer from the options.”	No	-	-
status	INT	The status of the publication of the power. E.g.: “1” means enabled, “0” means disabled.	No	-	-

**Table Name: GamePower**

Description: This table stores the power details for the games.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
gamePowerID	VARCHAR (8)	The id of the game power table.	No	PK	-

		E.g.: "GP000001" "GP" refers to a game power, followed by 6 digit numbers.			
pointExchange	INT	The point needed to exchange the game power. Minimum is 1 and maximum is 100.	No	-	-
gameID	VARCHAR (8)	The id of the game table. E.g.: "GA000001" "GA" refers to a game, followed by 6 digit numbers.	No	FK	Game
powerID	VARCHAR (8)	The id of the power table. E.g.: "PO000001" "PO" refers to a power, followed by 6 digit numbers.	No	FK	Power

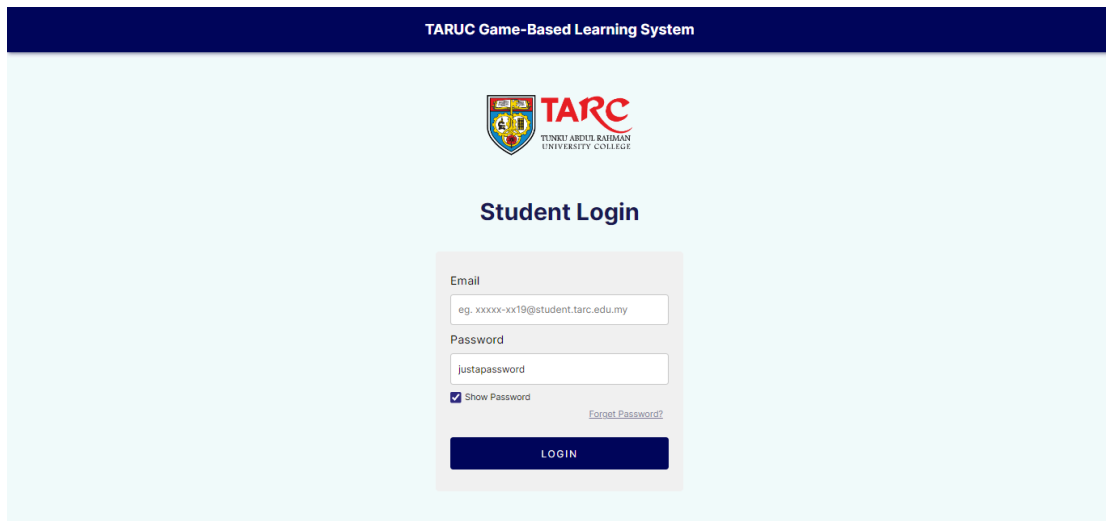
**Table Name: Score**

Description: This table stores the total score of students in the games.

Attribute Name	Data Type	Description	Allow Null	Key (PK/FK)	Reference
scoreID	VARCHAR (8)	The id of the score table. E.g.: "SC000001" "SC" refers to a score, followed by 6 digit numbers.	No	PK	-
score	INT	The total score of the student gets in the game.	No	-	-
gameID	VARCHAR (8)	The id of the game table. E.g.: "GA000001" "GA" refers to a game, followed by 6 digit numbers.	No	FK	Game
studentID	VARCHAR (8)	The id of the student table. E.g.: "ST000001" "ST" refers to a student, followed by 6 digit numbers.	No	FK	StudentAccount

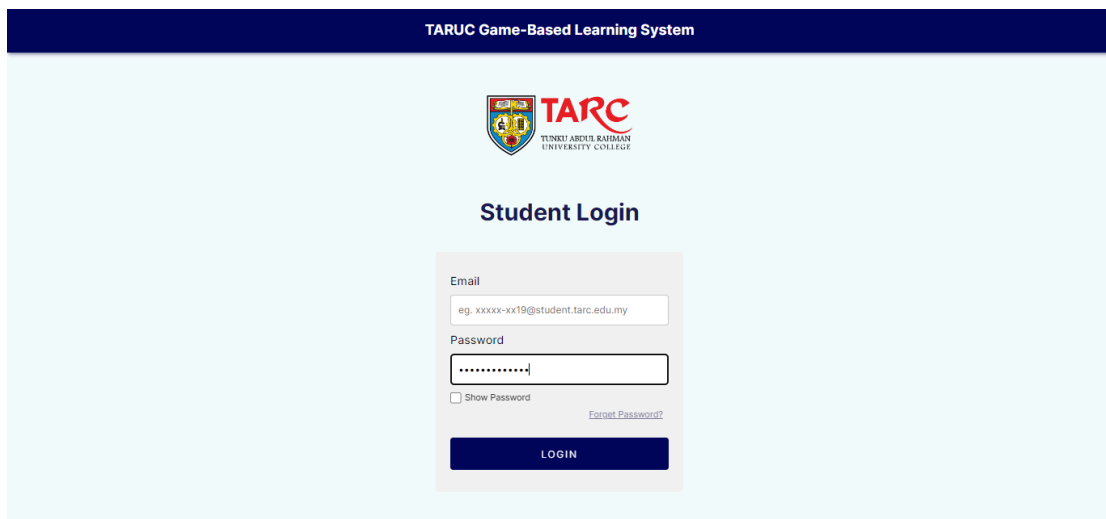
## 4.3 User Interface Design

### Student Login and Maintenance Module



The screenshot shows the 'Student Login' interface of the 'TARUC Game-Based Learning System'. At the top is a dark blue header with the system name. Below it is the TARUC logo and name. The main heading is 'Student Login'. The login form is centered and contains an 'Email' field with a placeholder 'eg. xxxxx-xx19@student.tarc.edu.my', a 'Password' field with the text 'justapassword', a checked 'Show Password' checkbox, a 'Forgot Password?' link, and a dark blue 'LOGIN' button.

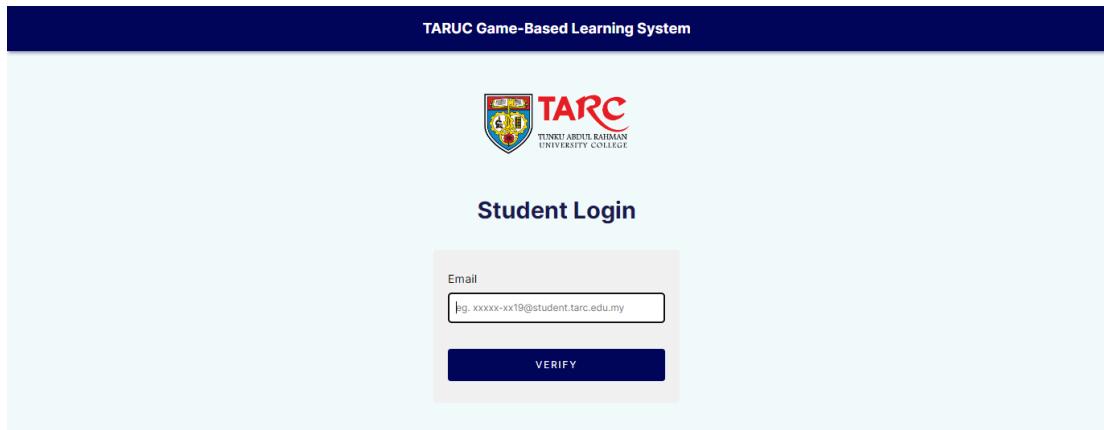
*Figure 4.6 : Student Login Screen Design (Password Visible)*



This screenshot shows the same 'Student Login' interface as Figure 4.6, but with the password field masked with dots. The 'Show Password' checkbox is now unchecked, and the 'Forgot Password?' link remains visible. All other elements, including the header, logo, and 'LOGIN' button, are identical to the previous figure.

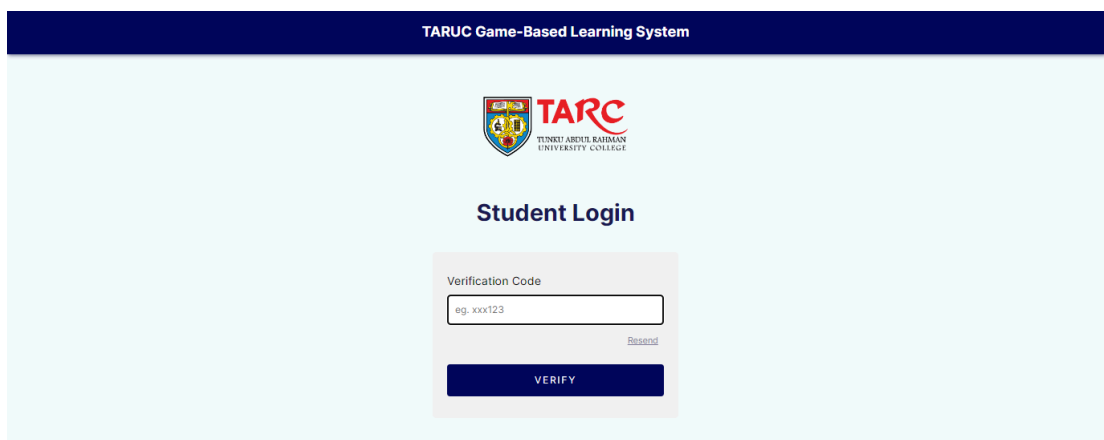
*Figure 4.7 : Student Login Screen Design (Password Invisible)*

Figure above shows the Login page of the TARUC Game-based Learning System, users are required to fill in their email and password in order to login to the system. The password is invisible by default (refer to Figure 4.7) and users can make the password visible by ticking the show password checkbox (refer to Figure 4.6).



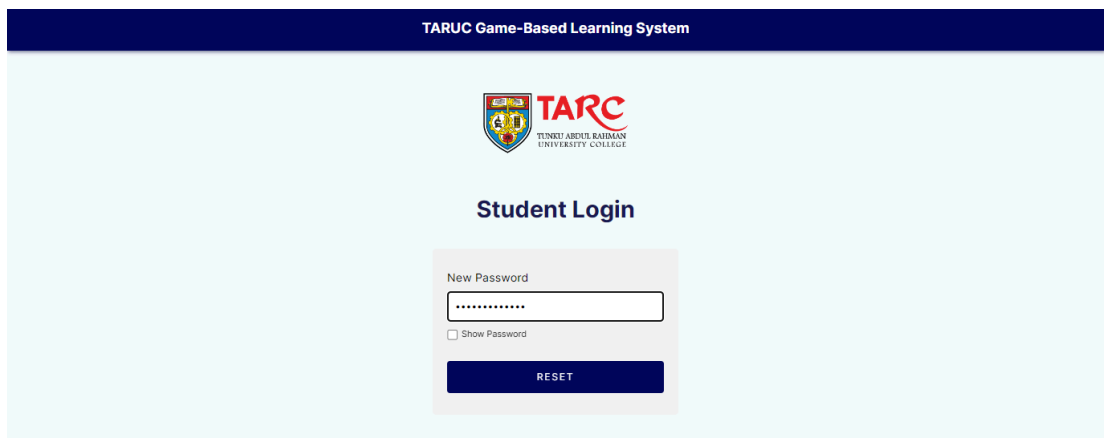
The screenshot shows the 'Verify Email' screen of the TARUC Game-Based Learning System. At the top is a dark blue header with the text 'TARUC Game-Based Learning System'. Below the header is the TARUC logo, which includes a crest and the text 'TARUC TUNKU ABDUL RAHMAN UNIVERSITY COLLEGE'. The main heading is 'Student Login'. The central form has a light pink background and contains an 'Email' label, a text input field with the placeholder 'eg. xxxx-xx19@student.tarc.edu.my', and a dark blue 'VERIFY' button.

*Figure 4.8 : Verify Email Screen Design for Reset Password*



The screenshot shows the 'Verify Code' screen of the TARUC Game-Based Learning System. It features the same header and logo as Figure 4.8. The heading is 'Student Login'. The central form has a light pink background and contains a 'Verification Code' label, a text input field with the placeholder 'eg. xxx123', a small blue 'Resend' link, and a dark blue 'VERIFY' button.

*Figure 4.9 : Verify Code Screen Design for Reset Password*

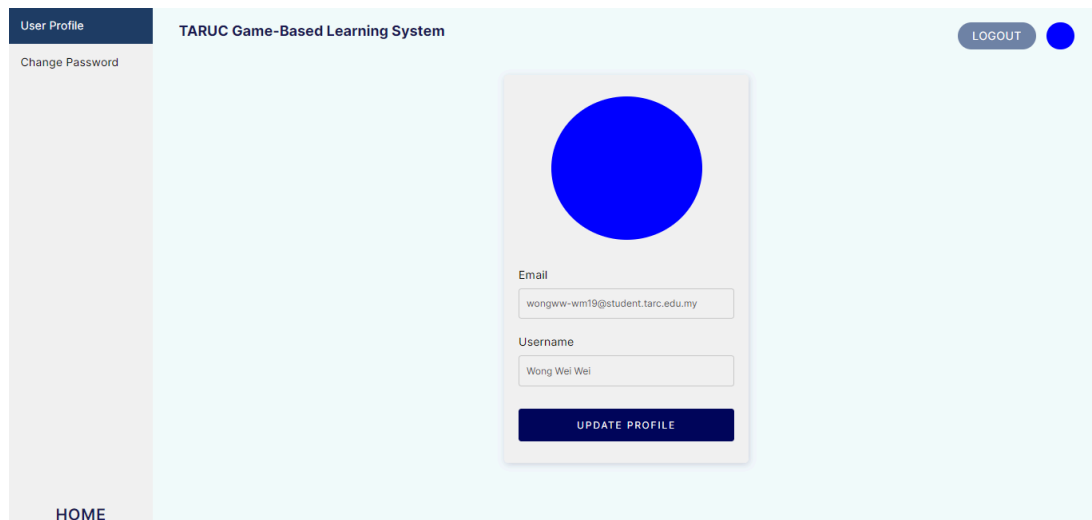


The screenshot shows the 'Reset Password' screen of the TARUC Game-Based Learning System. It features the same header and logo as the previous figures. The heading is 'Student Login'. The central form has a light pink background and contains a 'New Password' label, a password input field with masked characters, a 'Show Password' checkbox, and a dark blue 'RESET' button.

*Figure 4.10 : Reset Password Screen Design*

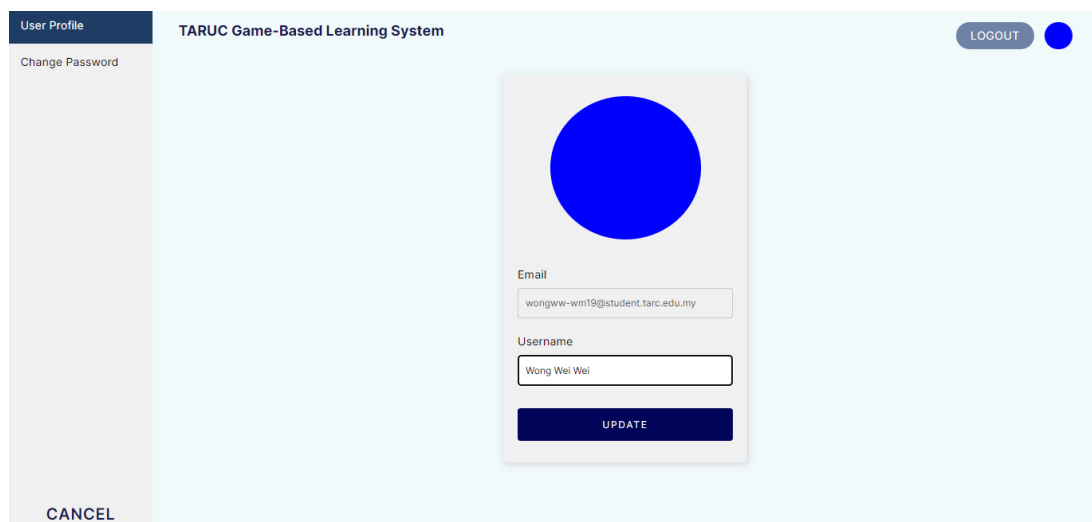
When users click on the "Forgot Password?" button on the Login page (refer to Figure 4.6), the system will redirect the users to the Verify Email page (refer to Figure 4.8). On this page, users are required to provide their email for verifying and verification code sending purposes.

After that, users will be redirected to the Verify Code page (refer to Figure 4.9) and users are required to enter the verification code that has been sent to their email. If the verification code is valid, the system will redirect to the Reset Password page (refer to Figure 4.10) and users can reset their password by providing their new password.



The screenshot shows the 'User Profile' screen of the 'TARUC Game-Based Learning System'. On the left is a dark blue sidebar with 'User Profile' at the top and 'Change Password' below it. At the bottom of the sidebar is a 'HOME' button. The main content area has a light blue background. At the top right of this area is a 'LOGOUT' button and a blue circular profile icon. In the center is a white profile card with a large blue circular placeholder for a profile picture. Below the placeholder are two text input fields: 'Email' with the value 'wongww-wm19@student.tarc.edu.my' and 'Username' with the value 'Wong Wei Wei'. At the bottom of the card is a dark blue button labeled 'UPDATE PROFILE'.

*Figure 4.11 : User Profile Screen Design*



The screenshot shows the 'Update Profile' screen, which is identical in layout to Figure 4.11. The sidebar on the left is the same. The main content area features the same 'LOGOUT' button and profile icon. The central white profile card contains the same email and username fields. However, the button at the bottom of the card is dark blue and labeled 'UPDATE' instead of 'UPDATE PROFILE'.

*Figure 4.12 : Update Profile Screen Design*



User Profile

TARUC Game-Based Learning System

LOGOUT

Change Password

Change Current Password

Current Password

☐ Show Password

New Password

☐ Show Password

Confirmed New Password

☐ Show Password

CHANGE

CANCEL

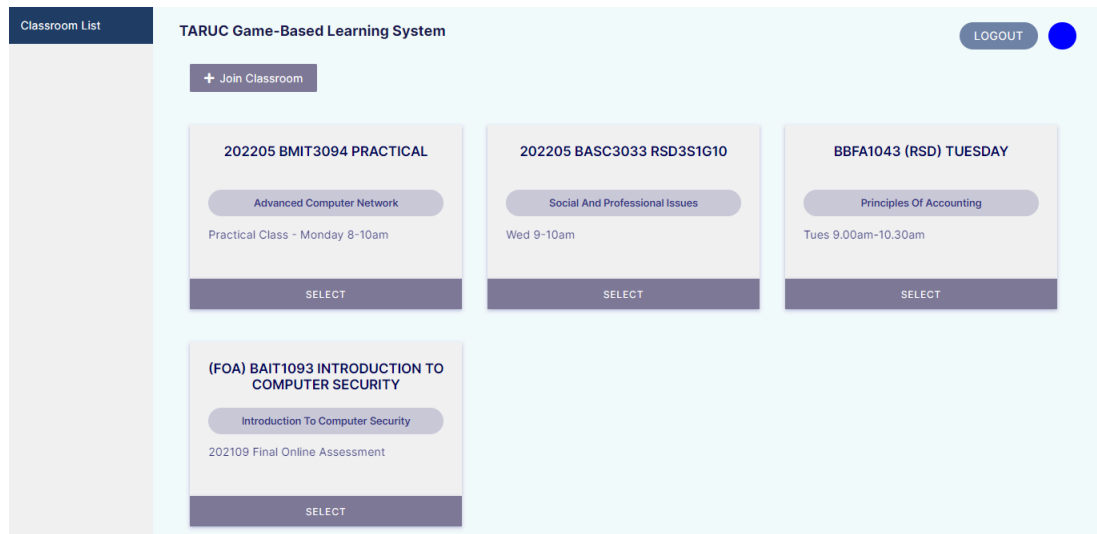
*Figure 4.13 : Change Password Screen Design*

After users click on the profile picture in the top-right corner of the Home page (refer to Figure 4.14), users will be redirected to the User Profile page (Figure 4.11). On the User Profile page, there are two buttons for users to change their password and update their profile. Users can also back to the Home page by clicking on the “Home” button in the left-bottom corner.

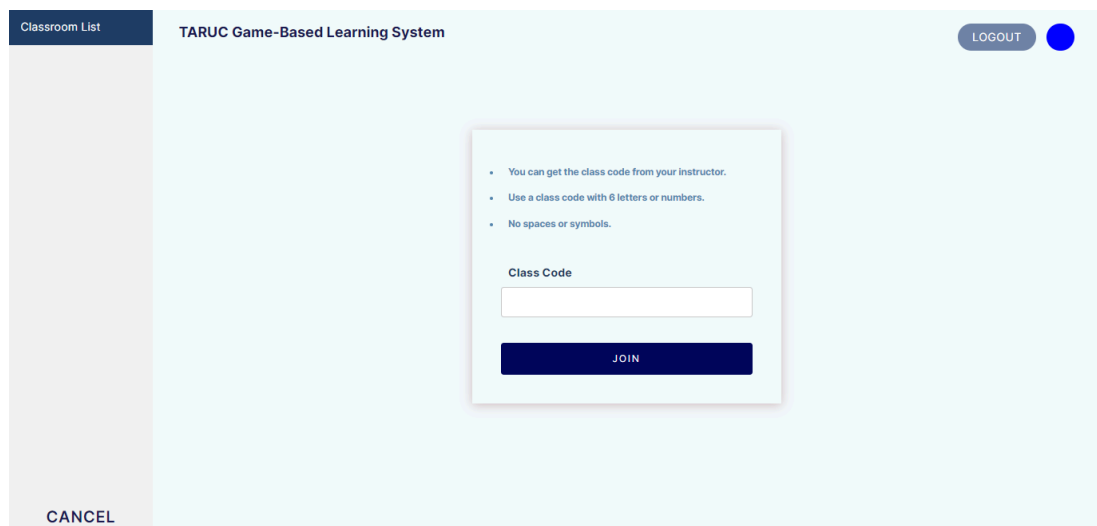
If users click on the “Update Profile” button on the User Profile page, the system will redirect them to the Update Profile page (refer to Figure 4.12). On this page, users are able to change their username and also their profile picture by clicking on the current profile picture. After they make changes, they can click on the “Update” button to save their updated profile.

If users click on the “Change Password” button on the User Profile page, the system will redirect them to the Change Password page (refer to Figure 4.13). Users are required to provide their current password, new password and confirmed new password on this page. After they fill in all the fields, they can click on the “Change” button to change their password.

## Participating in Classroom Module

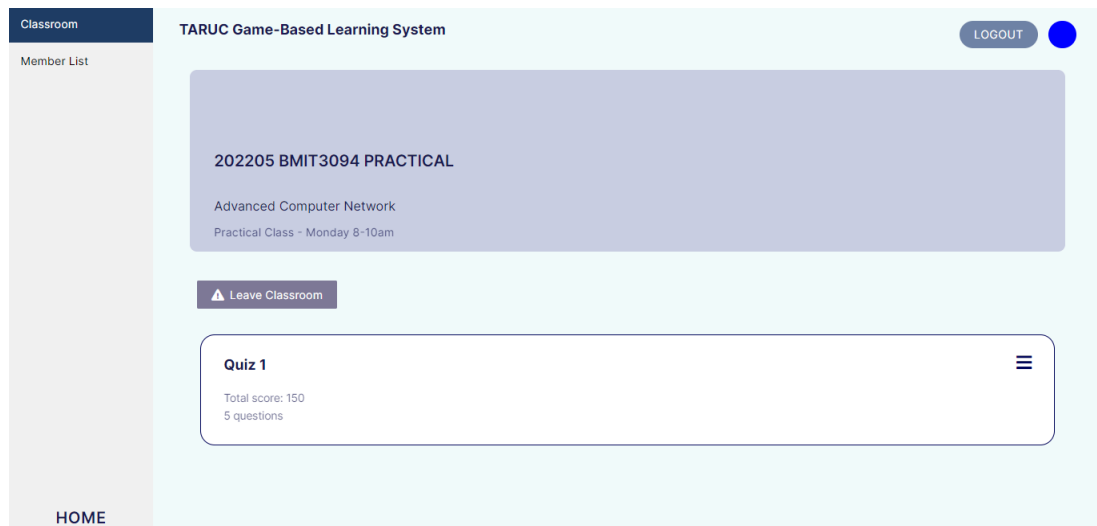


*Figure 4.14 : Student Homepage Screen Design*

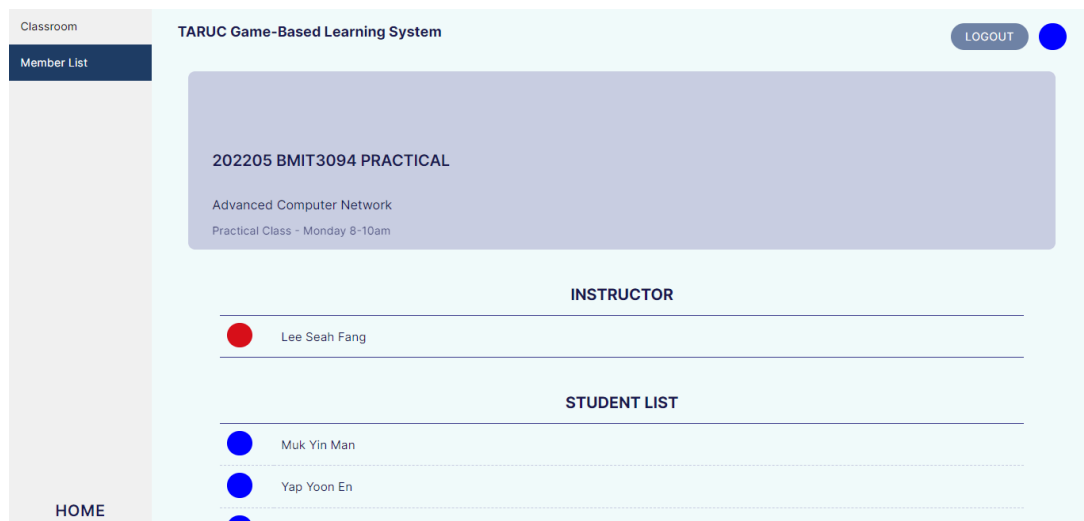


*Figure 4.15 : Join Classroom Screen Design*

Figure 4.14 shows the Home page of the TARUC Game-based Learning System. When users click on the “Join Classroom” button, they will be redirected to the Join Classroom page (refer to Figure 4.15) and they can join a classroom by providing class code that get from their instructors.



*Figure 4.16 : Selected Classroom Screen Design*



*Figure 4.17 : Member List Screen Design*

When users click on the “Select” button of a classroom (refer to Figure 4.14), they will be redirected to the Selected Classroom page (refer to Figure 4.16). On this page, users can view the contents of the classroom and users can also view the member list of selected classrooms (refer to Figure 4.17) by clicking on the “Member List” button.

## Participating in Game Module

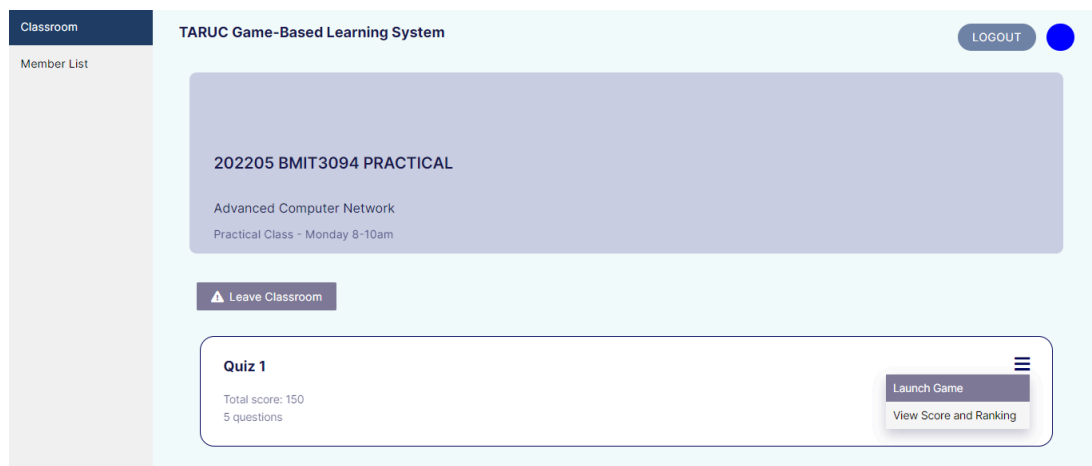


Figure 4.18 : Selected Classroom Screen Design (Launch Game Button)

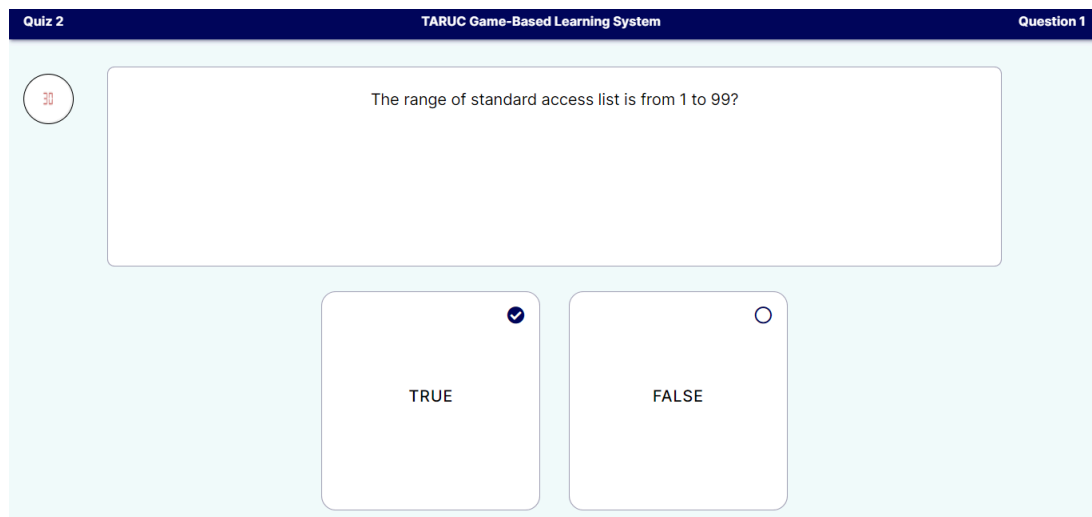
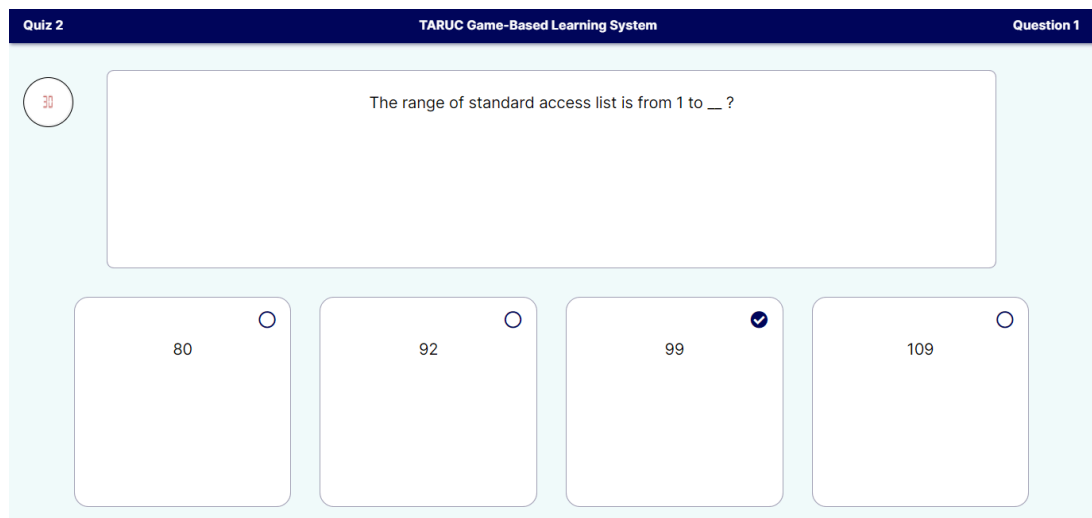


Figure 4.19 : True-False Question Screen Design



*Figure 4.20 : Multiple Choice Question Screen Design*

The screenshot shows a quiz interface for 'Quiz 2' in the 'TARUC Game-Based Learning System'. A circular timer in the top left corner shows 30 seconds. The question text is 'The range of standard access list is from 1 to \_\_ ?'. Below the question is a large empty rectangular box for the answer. At the bottom, there is an 'Answer:' label and a text input field with the placeholder 'Please type the answer here.'.

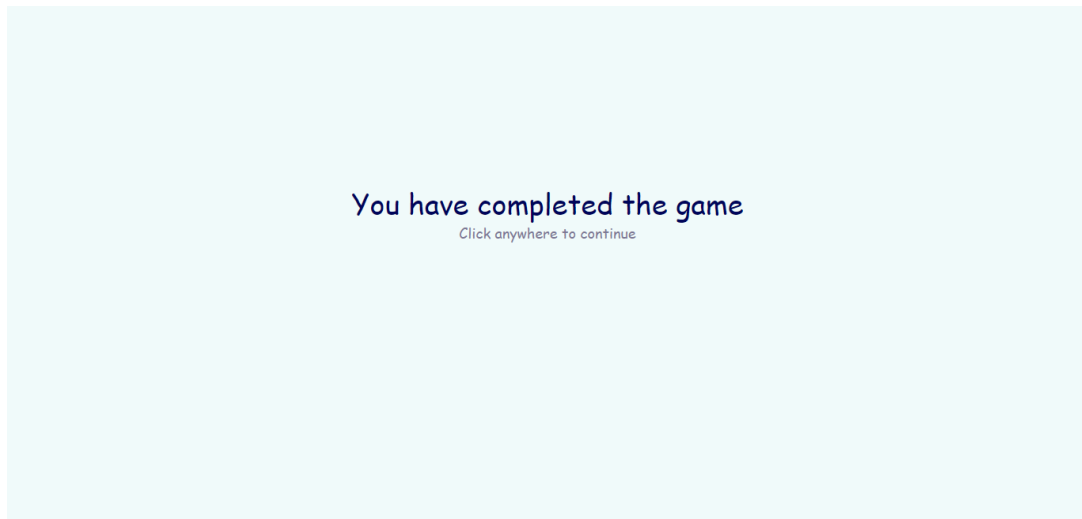
*Figure 4.21 : Fill-in-the-blank Question Screen Design*

When users click on the “Launch Game” button on the Selected Classroom page (refer to Figure 4.18), the selected game will be started and there are three types of questions that may be included in the game which are True-False questions (refer to Figure 4.19), Multiple Choice questions (refer to Figure 4.20) and Fill-in-the-blank questions (refer to Figure 4.21).

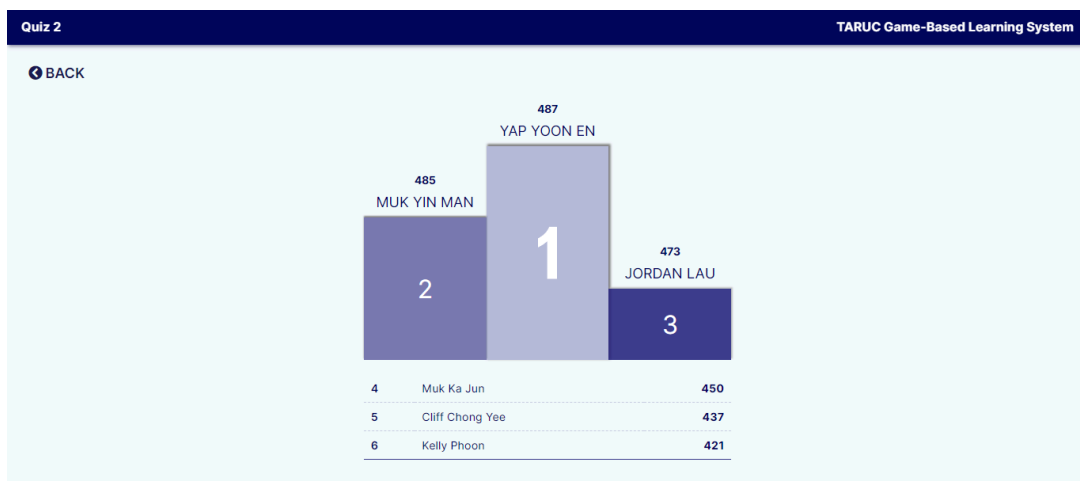
## Score and Ranking Module

The screenshot displays the 'Classroom' interface. On the left is a sidebar with 'Classroom' and 'Member List' options. The main area shows the course title '202205 BMIT3094 PRACTICAL', the subject 'Advanced Computer Network', and the class time 'Practical Class - Monday 8-10am'. Below this is a 'Leave Classroom' button. A 'Quiz 1' section shows a 'Total score: 150' and '5 questions'. To the right of the quiz section are two buttons: 'Launch Game' and 'View Score and Ranking'. A 'LOGOUT' button and a blue profile icon are in the top right corner.

*Figure 4.22 : Selected Classroom Screen Design (View Score and Ranking Button)*



*Figure 4.23 : End Game Screen Design*



*Figure 4.24 : Score and Ranking Screen Design*

Figure 4.24 shows the Score and Ranking page for a game, which users can access in two ways, the first way is by clicking the “View Score and Ranking” button on the Selected Classroom page (refer to Figure 4.22), the second way is to play the game and then click on the End Game page (refer to Figure 4.23).

# Claiming Power Exchange Module

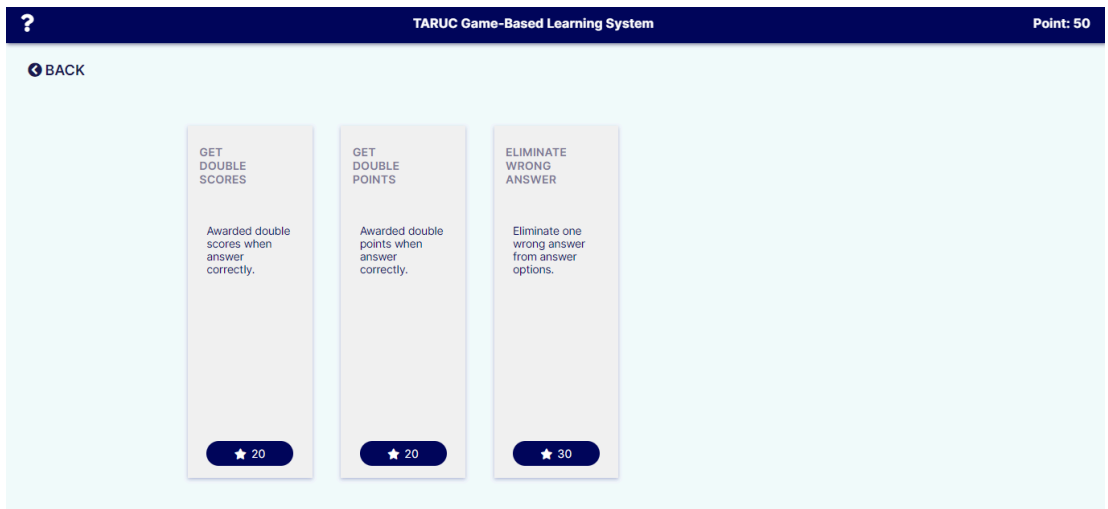


Figure 4.25 : Power Exchange Store Screen Design

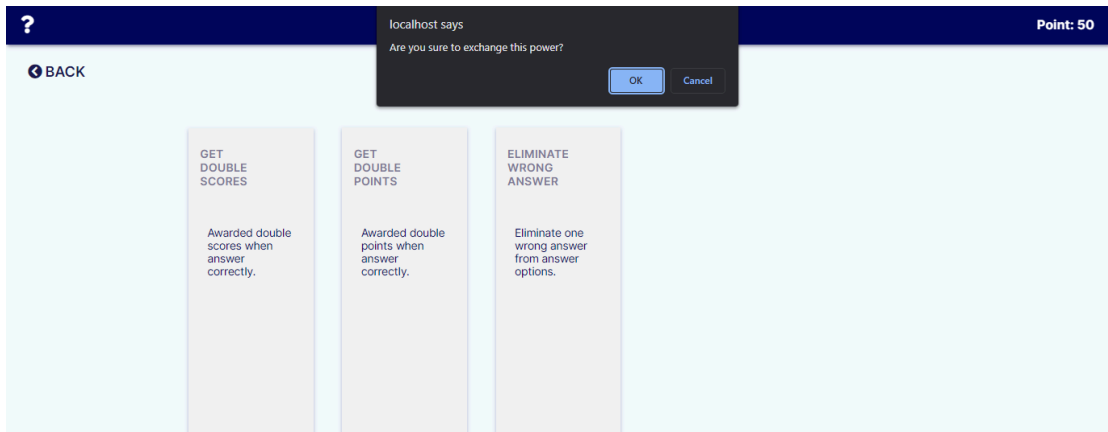
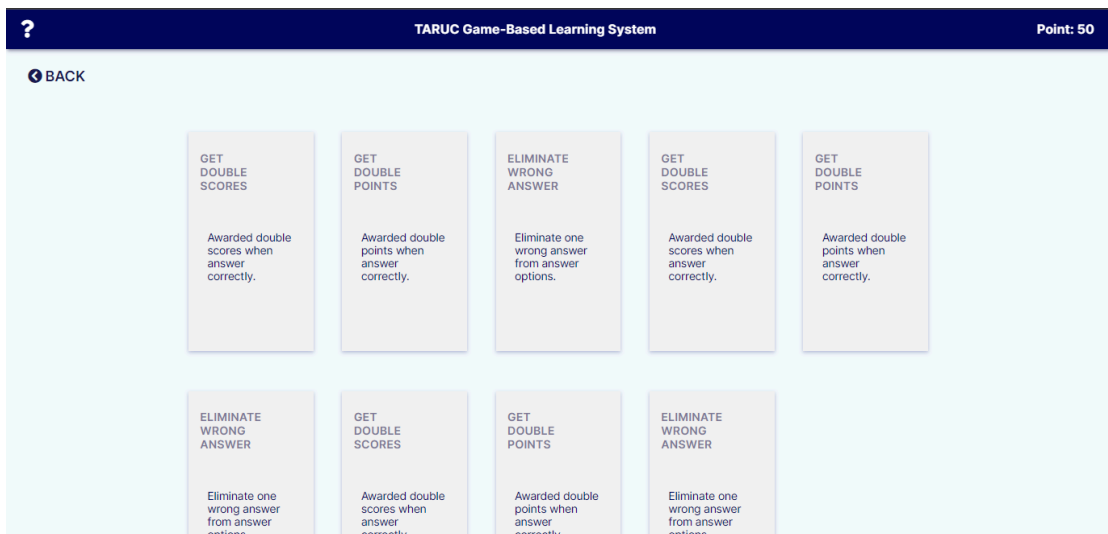


Figure 4.26 : Power Exchange Store Screen Design (Confirmation Box)



*Figure 4.27 : Powers List and Description Screen Design*

Figure 4.25 shows the Power Exchange Store page that users can access during game breaks. On this page, users can know how many points they have earned in the top-right corner and they can also access the Powers List and Description page (refer to Figure 4.27) by clicking the question mark button in the top-left corner. Not only that, users can also exchange one of the powers by clicking the button for the power in the Power Exchange Store page. When they decide to exchange the power, a confirmation box (refer to Figure 4.26) is prompted to avoid accidental clicks.

## **4.4 Chapter Summary and Evaluation**

In this chapter, the author has discussed the system design which includes activity diagram, database design and user interface design. For the activity diagram, only the modules that are handled by the author have been prepared. For the database design, the author has illustrated the overall database structure and the relationship between sets of entities stored in the database by using an entity relationship diagram (ERD). The author has also prepared a data dictionary to describe the details of entity structure for each database table. Lastly, the user interface design of the proposed system is also introduced.

The problem faced by the author was that since the author has not drawn an activity diagram for a long time, the author forgot how to use symbols and notations when producing an activity diagram for each module. In order to solve the problem, the author did research on Google to understand the function of the notations and also referenced the diagrams that the author did when learning the OOAD subject.



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