COMP 4801

FINAL YEAR PROJECT

INDIVIDUAL FINAL REPORT

Project Title: Lecture Gamification

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Abstract

Gamification is the application of game elements in non-game contexts. This project aims at developing a game application for secondary schools’ classroom, so as to increase the motivation of learning by applying game elements into lectures.

Our final product will be a game application called Plature. It means “play in a lecture”. It can be played on cross-platform electronic devices and computers. It is not a game for teaching course content, but a game to practice what students have learnt and test their knowledge level. We hope most subjects can apply this game to assist learning. Teachers can input their quizzes or tests easily by multiple choices format on a web interface and students can learn while they are playing the games on mobile devices.

Acknowledgement

I would like to express my gratitude to our supervisor, Dr. T. W. Chim. Thank you for giving us guidance and support on this project. I want to wholeheartedly thank my groupmate, Holly too. Thanks for giving the name, Plature, to our application. This project would not be accomplished without her continuous trying and effort.
# TABLE OF CONTENTS

ABSTRACT ........................................................................................................................................ 2  
ACKNOWLEDGEMENT .................................................................................................................. 2  
1 PROJECT DESCRIPTION ........................................................................................................... 4  
   1.1 PROBLEM IDENTIFICATION ................................................................................................. 4  
   1.2 PROJECT INTRODUCTION .................................................................................................. 4  
   1.3 PROJECT OBJECTIVES ....................................................................................................... 4  
   1.4 CASE STUDY ....................................................................................................................... 5  
   1.5 PROPOSED SOLUTION IN THIS PROJECT ........................................................................... 7  
2 SCOPE OF WORKS .................................................................................................................... 8  
   2.1 PROJECT SCOPE ................................................................................................................ 8  
   2.2 PROJECT DELIVERABLES ................................................................................................... 9  
   2.3 SCHEDULE AND MILESTONES ......................................................................................... 9  
3 PROJECT METHODOLOGY ........................................................................................................ 9  
   3.1 MAIN PROJECT FLOW ......................................................................................................... 9  
   3.2 SYSTEM ARCHITECTURE DESIGN .................................................................................. 10  
   3.3 DATABASE DESIGN .......................................................................................................... 11  
   3.4 SERVER SYSTEM DESIGN ............................................................................................... 11  
   3.5 APPLICATION DESIGN .................................................................................................... 14  
   3.6 DEVELOPMENT TOOLS .................................................................................................. 15  
4 PRODUCT DESIGN ...................................................................................................................... 17  
   4.1 USE CASE ......................................................................................................................... 17  
   4.2 LOGIN SYSTEM .................................................................................................................. 18  
   4.3 GAME ROOM SYSTEM DESIGN ...................................................................................... 19  
   4.4 GAME DESIGN .................................................................................................................. 21  
   4.5 TEACHER PANEL ............................................................................................................ 24  
   4.6 TESTING ........................................................................................................................... 28  
5 FUTURE DEVELOPMENT ........................................................................................................... 29  
   5.1 TYPE OF QUESTION .......................................................................................................... 29  
   5.2 IMPLEMENTATION OF GAMES ...................................................................................... 29  
   5.3 SELF-LEARNING TOOL ..................................................................................................... 29  
   5.4 SECURITY .......................................................................................................................... 29  
APPENDIX A – PROJECT TEAM DETAILS ............................................................................... 30  
   PROJECT TEAM ..................................................................................................................... 30  
APPENDIX B – SIMPLE MODEL FLOWCHART ............................................................................. 31
1 Project Description

1.1 Problem Identification

1.1.1 Need of motivating study circumstance

In Hong Kong, the traditional teaching method is passive and unidirectional. Teacher and student lack of interaction during class. Usually, students just follow teachers’ instructions without critical thinking and they learn without the intention to ask more questions and investigate thoroughly. In view of this trend, current schools require a more positive and energetic learning circumstance. To break the tripped circles, we hope to find some ways to increase student participation in a lesson.

1.1.2 Need of efficient teaching tool

Enhancing the effectiveness of teaching is also one of the biggest problems for current teaching circumstance. The problem of excessive working hours of teachers has not been solved. Teachers are spending most of the time on marking and recording results in traditional class practices and quizzes. What they need is an effective teaching tool which helps to reduce the time of handling those repetitive work like marking and recording.

1.2 Project Introduction

To bring a new learning experience into classrooms, this project aims to apply gamification to design a game application for secondary schools. The application is called Plature that means “play in a lecture”. It is not an application for teaching course content. But students can practice what they have learned in the way of playing an interactive game during class, so as to increase their motivation of learning. Nowadays, teenagers are spending a lot of the time on playing mobile games. Technologies not only provide us a platform for entertainment and communication, and we believe it also provides a better learning platform for students.

In addition, we hope this platform can help teachers by establishing an efficient teaching process. A web panel was implemented for teachers to get the game result and analysis conveniently. Also, we hope most subjects can apply this application to assist learning. The teacher can input and manage customized questions as a quiz in multiple choices format which can be in the different subject. During lesson, they can manage their students to play the game by game room system and choose the imported quiz.

1.3 Project Objectives

1.3.1 Develop games for playing in real-time lecture

The major goal of this project is to develop some games for playing in lectures. Game elements like characters, competitive environment and game mechanics are included to provide a level up system and reward accomplishments such as getting points, badges, lives. Every student can get his/her own character to develop. Teachers can use different games to hold different purposes.

The games can utilize facilities inside a classroom including teacher’s computer, students’ smart phones or laptops and Wi-Fi infrastructure. With the use of this application, this can facilitate teachers in teaching new knowledge to students or helping students to revise what
they have learned.

In long term, the development of this project would aim at making the games to be general so that they can be used in different courses.

1.3.2 Break of tradition by lively and interactive lectures

In this project, changing current teaching style is one of the goals. This application can increase the interactivity and cooperation. When playing with the games, students need collaboration so as to win. Hence, this can promote team spirit. By grouping students into teams, they can collaborate to compete with other teams or earn rewards. In order to earn more points in the games, students are more willing to complete the tasks effectively. Throughout the process of playing games, the happiness of attending class will improve students’ intentions of learning.

1.3.3 Enhance teaching

In order to motivate student’s learning interest, teachers often have to design some games for playing during lectures. However, this is time-consuming in preparation and they may encounter problems when giving instructions to students to follow the steps. This application can act as a teaching tool, the question-based games can help teachers manage students and reduce their workload.

From the points of view of teachers, with using this application, they can know students’ weaknesses and strength by getting analysis from the game results. After the end of games in lessons, teachers can discuss with students which parts they are not doing well.

1.4 Case Study

Fortunately, different E-learning technology has gained popularity in the past two decades. With the development of technology, many applications were developed to improve learning circumstance and also enhance the effectiveness of teaching. Some case studies have been done on current popular e-learning applications.

1.4.1 Classcraft

![Figure 1 – Classcraft](image)
Classcraft is an online platform created by a high school physics teacher. Students can gain game experience (XP) by completing homework, tests or learning tasks. It uses game mechanics to engage students. Students aware of the rewards for their participation and hence, increase the motivation of learning. Classcraft has integrated with Google Classroom and is available to the classrooms around the world.

It is chosen for one of the case studies because it is popular around the world. However, it is not user-friendly on the design. The main screen is displaying character figure and its detail status. There are many other essential functions or setting hide on the menu with numberless options. Users may not find the function instantly by their intuitive sense. Also, RPG game design is complex. Characters belong to six groups of role. Each role contains different power and still set. Users require some time to pick up their RPG system, especially who are not familiar with RPG game.

Therefore, our application will show all important and common functions in the main game screen. Such as gameplay rules and resume button. The user can always find the functions they need. Also, only 3 roles can be selected for the beginners. Different role will have only one feature so the user can get the difference between easily.

1.4.2 Quiz RPG: The Mystic World of Wiz

This is a quiz-based RPG mobile game for Android and iOS. Players can get fantasy characters to have battles with monsters by answering quizzes. The questions come from knowledge of any aspects and common sense but not only for academic and educational purpose.

There are only 2 type questions to answer. They are multiple choice and ordering question. The user can play without a game tutorial. Time limitation is set for each question. With optimizing use of the sound effect, the user play in a fast pace. However, questions come from knowledge of any aspects. The user may be annoyed by questions they do not interested in.

In our application, to stimulate students to answer questions, time limitation will be applied. Health point of user’s character will be deducted after a certain time. Also, teachers can input and control all questions to be answered by students. It solves the problem of getting confuse in random questions.
1.5 Proposed solution in this project

1.5.1 Gamification

Gamification is the main task of this project. It means applying game mechanics in non-game contexts. To increase student’s motivation, gamification of class’s practice will be a good solution. With the growth of technology such as increasing usage of mobile electronic devices and relevant applications, we got more choice and method to improve gamification in education.

According to the case studies, both Classcraft and The Mystic World of Wiz give rewards to players. When they win the game or finishing a task, players will have satisfaction on their face. In schools, students will be given rewards too if they have good performance. Therefore, the rewards obtained in the games will motivate them to study hard.

Another example of game elements is ranking. For example, Classcraft shows ranking among students which increase their desires to work hard and not fall below in the ranking. It can also from a group so as to give competition between each other. They willing to cooperate and particulate more in a team.

1.5.2 Big data analysis

As the increasing trend of applying big data analytics, this project will utilize big data analytics to improve Education. This analysis step including collecting data from the game result, then finding patterns and connections relating to human behavior, finally making new decisions depends on information.

For the first approach, the application will focus on collecting two kinds of data. The first one is the correctness, which indicates the percentage of different choices that student answered. The second one is how long they take to answer certain questions.

The overall goal should improve student results. We hope teachers can focus on weakness and strength of students so that they can gain a better understanding. Also, the data in real-time can deliver an optimal learning environment. Each individual student has different understanding on different subjects. In a traditional class, a teacher can only use a single way to teach the whole class. If this application could divide different kinds of student and give a more suitable strategy, this situation can be improved.

The web interface for teachers will be developed by D3.js. It helps to visualize the data so that teachers can easily focus on the results. In this web page, some pie charts will be used to display the correctness percentage and a timeline to show time used for answering.
2 Scope of Works

2.1 Project Scope

There are two servers, a Mongo database server and a Node.js server. As the core of this project, the game servers handle all request from users and pass the data access request to the database server. They are deployed in the cloud so that users in anywhere connected to the Internet can access the system.

For the client side, the mobile game application Plature will be developed in cross-platform game engine Unity. We will output the application in 4 platforms including Android, iPhone, MAC OS and Window Version. Users with different kinds of mobile devices or personal computer can also use the service. A web control panel is developed for teachers to manage and view the application data. It can be accessed by devices with browser and support Google Chrome for best performance.

The details of function design are mentioned in Game server part under Project Methodology.

![Diagram of project scope](image-url)
2.2 Project Deliverables

The final product and deliverables for this project are as follow:

1. A cross-platform game application called Plature, which can support both Android and Apple iOS devices. It contains a competitive game, Four Kingdoms and 2 mini games, Apple Tree and Cloud in Sky.

2. A web panel for teacher users, which is supported in most browser like Google Chrome.

3. An Interim Report and an interim presentation

4. A final report and a final presentation

2.3 Schedule and Milestones

There are four big milestones. Firstly, we implemented a minimum viable product which built the core of the system. In the second milestone, we design and develop the logic of the game. Then, implementation of teacher web panel is another milestone. Finally, we test and optimize the final product.

3 Project Methodology

3.1 Main Project Flow

Before starting the implementation of the whole application, the project was broken down into some smaller parts as a milestone to build. Our first stage was constructing a minimum viable product which includes a collection of the absolute minimum set of features. In the end of December, the minimum viable product was built with a game server, database server, login system and a simple multiple choice game application. The flow chart of the minimum viable product can be found in Appendix B.

In next stage, detailed game flow and game interface was designed. The detail of mini-games with apple tree and Cloud in Sky designed by Holly and the competitive game designed by me. A better user experience would be required in order to achieve our second objective, break
of tradition by lively and interactive lectures. We also implemented the game logic. In order to get rid of traditional passive lectures, interactive game elements will be applied.

In stage 3, the development is focused on the perspective of teachers to fulfill the third project objective, enhance teaching. A web panel was implemented for teachers to import their quizzes and questions. We have considered what kind of game result analysis teachers may need and how to display these results visually.

Finally, the whole application was tested to ensure the application can be launched smoothly and it is a fair game for the players. Through the final testing and optimizing part, the Node.js server and Mongo database server were deployed in Google Cloud. Therefore, users can simply access to use our application and web service. This final stage accomplishes our first objective, developing games for playing in real-time lecture.

### 3.2 System Architecture Design

In this project, three layers’ architectural pattern is used. The top level is an application developed by Unity and a Web panel implemented by EJS templating language of Node.js. These 2 client-side products help to pass the input from user to next layer. The second layer is a server developed by Node.js which being a communication medium between client and database. It acts as the backend to handle all requests from users. These requests are not only the static login request by using sample HTTP method, but also apply the socket.io to transmit messages during the game. The last level is a Mongo database which store user information and game related data as well as quizzes and game result. With the help of database, the game server can extract and manage the data efficiently.

Among the 3 layers, each layer can only access the level below but not cross or above. This design prevents client-side access the database directly to collect data. Therefore, the strategy is implementing from the lowest level to upper level.

![Figure 5 – System architecture](image-url)
## 3.3 Database design

As MongoDB is a NoSQL database and it contains no schema by nature. There are 4 main objects, User, Quiz, Game, Answer. User object contains the basic information of a user. The type of user indicates he or she is a teacher or student.

For teachers, their prepared questions and quizzes are stored in Quiz object. When student join in the room and particular quiz would be requested by searching quiz name and teacher’s username. A game object would be generating when the teacher starts a game.

For students, his answer during game is stored. After a game, the result can be obtained through a query of room ID of Answer objects.

A UML diagram shows the relation of different objects:

![UML Diagram]

**Figure 6 – Database Design**

## 3.4 Server system design

The server is consisted of 3 main part. They are socket part, API part and teacher web panel HTML part.
3.4.1 Socket for game play

The socket connect server with teacher and student client in the game application to handle message immediately.

**Table of socket function received from teacher client**

<table>
<thead>
<tr>
<th>Socket function</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>teacher_connection</td>
<td>TCP handshake process for teacher client.</td>
</tr>
<tr>
<td>Create_game_room</td>
<td>Server receives this message when a teacher is trying to create a game room. Then, server returns a random room key. The teacher should show this room key for students to join.</td>
</tr>
<tr>
<td>start</td>
<td>When a teacher starts a game in waiting room scene, server receives the game room key and send back the start message to students in that game room for loading specified game scene. A new game object is created in database with game data like quiz id and student name list etc.</td>
</tr>
</tbody>
</table>

**Table of socket function received from student client**

<table>
<thead>
<tr>
<th>Socket function</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>student_connect</td>
<td>TCP handshake process for student client.</td>
</tr>
<tr>
<td>join</td>
<td>Server receives the message when a student enters a room key and join a game room. Then, server response whether that student can join. If yes, the student can get quiz content from response data.</td>
</tr>
<tr>
<td>answer</td>
<td>Each time student answering a question, server will receive this answer message. Based on the data received, server creates an answer object to store in database.</td>
</tr>
<tr>
<td>answer4king</td>
<td>It is the similar function of “answer” designed for Four Kingdoms. As the special game logic of Four Kingdoms, server requires to set a winner and store who can defense in each round.</td>
</tr>
</tbody>
</table>

3.4.2 Application program interface (API)

As there are 2 final products, game application and teacher web panel, some common request are implemented as API in api.js. Those API can handle requests from different clients in both products.
# Table of all API request

<table>
<thead>
<tr>
<th>Request</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>register</td>
<td>Handle register request in both products.</td>
</tr>
<tr>
<td>login</td>
<td>Handle login request in both products.</td>
</tr>
<tr>
<td>logout</td>
<td>Handle logout request in both products.</td>
</tr>
<tr>
<td>quiz_list</td>
<td>Server receives a GET parameter created_by and then makes a query on database to search a quiz list created by that teacher. It finally returns the query result to clients.</td>
</tr>
<tr>
<td></td>
<td>Game application:</td>
</tr>
<tr>
<td></td>
<td>When teacher creates a game room, application gets the quiz list and output as a dropdown selection menu.</td>
</tr>
<tr>
<td></td>
<td>Teacher Web panel:</td>
</tr>
<tr>
<td></td>
<td>In View Quiz page, the web gets the quiz list and display all quizzes’ content.</td>
</tr>
<tr>
<td>get_quiz</td>
<td>Server receive 2 GET parameters created_by and quizName then makes a query on database to search a quiz list created by that teacher and have certain quiz name. It finally returns the query result to client.</td>
</tr>
<tr>
<td></td>
<td>Game application:</td>
</tr>
<tr>
<td></td>
<td>When students join a game room, application will get the quiz content and then store it in the temporary memory. When the application loads a game scene, the question and choice will be displayed.</td>
</tr>
<tr>
<td></td>
<td>Teacher Web panel:</td>
</tr>
<tr>
<td></td>
<td>Display the certain quiz content when teacher have just successfully imported a quiz.</td>
</tr>
<tr>
<td>deleteQuiz</td>
<td>Handle the ajax request from teacher panel to delete specific quiz. By passing the quiz id from web, server send a remove command to database.</td>
</tr>
</tbody>
</table>
3.4.3 Basic routing for teacher web panel

Server handle different request from teacher web panel.

Table of main HTML request from teacher web panel

<table>
<thead>
<tr>
<th>Request</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET result /</td>
<td>Server check if the user session exists. Then pass the username to database to search the games created by this user. A list of Game object will be return to result.ejs template to render the data.</td>
</tr>
<tr>
<td>GET result/PieChart/</td>
<td>By passing the game id and total number of questions, server send them to database and return a list of answer object to render a pie chart page. It is implemented with D3.js.</td>
</tr>
<tr>
<td>GET result/TimeLine/</td>
<td>By passing the game id, server send them to database and return a list of answer object and a game object to render a timeline page. It is implemented with D3.js.</td>
</tr>
<tr>
<td>GET result/allresult/</td>
<td>It is a similar request as TimeLine that it passes the game id and server send them to database and return a list of answer object and a game object. But then server process the data into an accepting JSON format which can render a result table effortlessly.</td>
</tr>
<tr>
<td>GET input_quiz</td>
<td>Server check if the user session exists. An input quiz page is rendered with the instruction of importing quiz and the excel upload from.</td>
</tr>
<tr>
<td>GET view_quiz</td>
<td>Server check if the user session exists. A query is made by username in session to get a list of quiz objects. It is used for rendering view / edit page that each quiz content is displayed by a table.</td>
</tr>
<tr>
<td>POST input_quiz/upload/</td>
<td>An excel file is uploaded to server. It will be converted into JSON data so server can send it to database so as to create a new quiz object. At the same time, the JSON data is used to render the preview page with successful message.</td>
</tr>
</tbody>
</table>

3.5 Application design

3.5.1 Game controller

Each game scene haves their own game controller which control the specific game logic. The three game controllers, Apple Tree, Cloud in Sky and Four Kingdoms, are developed from the same game controller of minimum viable product so that they share a similar structure. It manages all game elements in that game. Once start, ShowQuestion function will display question and choices. When a player triggers the answer object, the controller sends the answer to server. Then the game elements will be resettled and question index is increased by
1. This process repeats until finishing all questions.

3.5.2 Network controller

Student and teacher have their own network controller. It groups all function to emit or receive respective socket message. The network controller will be created after login and it would not be destroyed between scene. All scenes can commutate with the server by calling functions from the network controller.

3.5.3 Audio controller

There is an audio controller with a sound manager script which would not be destroyed when change scenes. It contains three Audio Source Component which represents background music, sound effect and button clicked sound effect respectively. By calling the public function from sound manager script, all music or sound effect can be played in all scene.

3.6 Development Tools

After the implementation of project, some advantages and disadvantages of development tools are captured.

3.6.1 Game development: Unity

In this project, Unity is used as the game engine. The greatest virtue of Unity is the cross-platform product output with a built-in integrated development environment (IDE). We will output the product with some common platforms such as Android, iOS of iPhone or IPad and computer version. The users can play games without broader of devices.

Unity is easy to implement as well. The integrated development environment enables simplified, rapid development of games. So that game elements and scene can be created comfortably by putting graphics, sounds, animations together. Many tutorial or books can be found which give many references for our project.

There are many plugins in Unity’s Asset Store. The most important plugin for our project is the socket.io which provides networking application programming interface. As the result, our application can enable to communicate with the server. We have also applied some free plugins such as the explosion animation and Interface images.

3.6.2 Server development: Node.js

Among many server-side languages, Node.js was most suitable for developing the game server. It uses an event-based server execution procedure rather than the multi-thread management overhead languages. By implementing event-based asynchronous instead of waiting for I/O operations, Node.js is faster compare with other server-side languages such as PHP.

The second advantage is that Node.js scalable to millions of concurrent connections. It meets our need because our application demands many connections from students. A class around 28 students would play the game together. In fact, some cloud network for game development such as photon only allows 20 persons. That is the reason for developing our own server.
3.6.3 Server-Client Communication: Socket.io

As the game in this project is a server-client based game, it will require to handle real-time multi-player game requests. Therefore, a reliable server-client communication tool is needed for guarantee the connectivity and networking performance.

Socket.io is an application enables real-time bidirectional event-based communication. It is designed for web communication originally. In fact, the nature of Socket.io is suitable for every platform, browser, or device. As the result, it is suitable for our application as well.

It has a simple and user-friendly user interface. We can easily understand the function from the official document. Such as the Emit function with message name and content as parameter. Also, Socket.io provide some functions to make the game implementation convenient. We can simply create a room by a key and broadcast the messages to all user inside that game room.

However, Socket.io is designed for implementing a simple chatting room. Its API is not perfectly fit for our requirement of game room logic. We need to restructure the room system because two separated type of user, teacher and student. If they are in the same game room, teacher may receive some message that generates during student’s game. In order to prevent this unnecessary usage, teacher will not join the game room and his / her data will be temporarily stored in the server.

3.6.4 Database management system - MongoDB

MongoDB is a non-relational database with query language support. It stores data in JSON format so the complex structure of data can be stored easily as it uses dynamic schemas with variation in structure. As the system in this project will create large amounts of data transaction, especially during the playing of games. MongoDB can support high transaction rate by rapid read-write operations. It is much faster than MySQL because efficient data structure JSON reducing time needed per request. It meets the need of the project.

Although JSON support a nested structure, it is difficult to make a query or edit for inner content. For example, we fail to save the game result in a nested structure so that each student’s result is under a certain quiz. The operation is too complex to created and insert the object to specific value. It will increase the burden of database server as well. The solution is putting all necessary data into a result object and make a list of objects instead of using nest structure.
4 Product Design

In order to provide a satisfactory user experience, some strategies and factors are considered for the design of front-end product including game application and teacher Web panel. There are mainly 2 type of users, teacher and student. They may get different interest and requirement in the Interface design.

4.1 Use Case

4.1.1 Start a game

Primary actor: Teacher

Basic flow of events:

1. A teacher registers a teacher account and login to teacher panel.
2. Teacher import a quiz by an Excel file.
3. Teacher go to View/Edit Quiz page to confirm whether that quiz is imported.
4. Teacher registers and logins to the application.
5. Teacher enter the necessary information and create a game room.
6. The application shows the room key.
7. Students join a game room with the room key.
8. When all students have joined, teacher start a game.

4.1.2 Play a game

Primary actor: Student

Preconditions: Teacher have created a game room.

Basic flow of events:

1. Students registry and login to the application.
2. Students join the game room with room key.
3. Wait for all student join to the game room.
4. Teacher start a game.
5. The application change scene to the game selected by teacher.
6. Students play the game by answering teacher’s customized questions.
7. The game end until all questions are completed.
4.1.3 View the game result

Primary actor: Teacher

Preconditions: Students have completed an entire game.

Basic flow of events:

1. A teacher login to teacher panel.
2. Teacher go to the Result page.
3. Web panel show information of all created games.
4. Teacher can see the pie chart and timeline by clicking the Analysis button.

4.2 Login System

Login system will be used to manage the user accounts. The system would identify whether a user is a student or teacher. Each username can only determine one role. The Users who want both teacher and student role are required to register two different accounts – a student account and a teacher account. Different interface would be displayed for different role. Students are allowed to get their character's data after login and join in an opening game room.

Plasure’s Register scene:

![Register]

Figure 7 – Application Register
Plature’s Login scene:

![Login screenshot](image)

**Figure 8 – Application Login**

### 4.3 Game room system design

#### 4.3.1 Teacher

After login, teachers can create a game room by selecting the quiz and fill in the game room name. Three game can be chosen.

![Create Game Room screenshot](image)

**Figure 9 – Application Create Game Room**
When server receive this request, a random room key is generated and send back to teacher’s application.

![Room Key: 777](image)

**Figure 10 – Application Waiting Room**

When all students join the game room by using that room key, teacher can start a game.

### 4.3.2 Student

After login, Students can join a certain game room by inputting specific key.

![Game Menu](image)

**Figure 11 – Application Game Menu**
A model with successful message will be displayed if server accept the joining request.

![Application Waiting for start](image)

**Figure 12 – Application Waiting for start**

### 4.4 Game design

#### 4.4.1 Mini games

The mini games aim to know each student’s strength and weakness in around 15 minutes. The most likely scenario would be giving a small quiz to check whether students understand the concept or topic in that lesson. Students have to answer the questions by collecting correct items.

There are two mini-games, Apple Tree and Cloud in Sky. The detail game design can refer to Holly’s report. Here is the basic game flow:

For Apple Tree, students have to collect the apple with the correct answer. There is a few second to show the question and choices before starting to answer. Then, multiple apples with different alphabet letters will flow from a tree. The apples drop with random speed and students need to rotate their devices to move the basket right under the apples with the correct answer. If a student can the correct apple, he or she can earn points.

For Cloud in Sky, students have to collect the cloud with the correct answer. It is similar to Apple Tree that questions will show from a few seconds. After that, multiple clouds with different answer will appear. Students have to control the rod in the underground with a good timer so as to collect the cloud with the correct answer and earn points.

#### 4.4.2 Competitive game: Four Kingdoms

The second game is a competitive answering game called Four Kingdoms. This is a medium-scale game which take about 30 to 60 minutes. As the average class size of secondary school is around 28, students will be divided into four groups. With a competitive behavior, each group requires to answer questions as fast as possible in order to attack and win the war.
The objective of game aims at cooperative training. Students can review what they have learnt in a whole subject or big section. As only four devices are required, it is suitable to play in classroom.

Game Flow

When the game begins, there are 4 kingdoms with their own castle and power bar to show how many health point they have. To let the cannon get enough power to attack others, players required to answer questions.
All players will get the same question at the same time. Player who answer correctly and be the fastest one will get the priority to attack.

![Figure 15 – Four Kingdoms correct answer](image)

After one of the kingdoms answer correctly, the game will show a timer represent the time before attack. If other kingdoms can answer correctly during this short time, a shield will be provided, so as to defense from this term. However, once the kingdoms answering wrong or time up, they will get damage.

![Figure 16 – Four Kingdoms Attack](image)

Four Kingdoms game will end when 3 of the kingdoms lose all health point or the kingdom with highest HP when all questions are finished.
4.5 Teacher Panel

If a teacher doesn't register an account, she/he can do it in the register page:

![Teacher Please Sign Up](image1.png)

**Figure 17 – Teacher web panel Register page**

The login page:

![Plature Teacher Web Panel](image2.png)

**Figure 18 – Teacher web panel Login page**
The Home page:

It is a responsive website so that UI will change according to the window size of browser.

When it is the first login, that teacher doesn't get any quiz. In order to use a quiz to start a game, he/she needs to import an Excel file in the Input Quiz page. There are some instructions about the usage of template Excel file and its restricted format.

Guidance
1. You should download the template Excel file.
2. Add questions and choices to the template file.
3. Don't modify the field titles in the first row.
4. For the answer column, please fill with Income: A = 0, B = 1, C = 2, D = 3
5. Submit the completed Excel file and click the upload button.
When teacher complete the importing, a successful page would show the quiz content:

The View/Edit Quiz Page show all imported quiz. Teacher can simply delete the quiz by clicking the delete button:
After playing some games, the Result page showing the game information created by that logged teacher. It contains data of each game including game room name, applied quiz name, players list and game type. There are Pie Chart, Timeline and All Result button which link to respective analysis or result pages.

![Figure 24 – Teacher web panel Login](image)

The pie chart shows the correctness. The correct answer is in green color, all other colors represent the wrong answer.

![Figure 25 – Teacher web Pie Chart](image)
The Timeline graph show how many time used for each student to answer that question. When a mouse is pointing into the bar area, the actual time in seconds will be displayed.

![Timeline Graph]

Figure 26 – Teacher web Timeline

The All Result page show a table with all participated student and their result.

<table>
<thead>
<tr>
<th>Student name</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>test1</td>
<td>✔️</td>
<td>✔️</td>
<td>✘️</td>
<td>✘️</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>test2</td>
<td>✔️</td>
<td>✔️</td>
<td>✘️</td>
<td>✔️</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 27 – Teacher web All Result

4.6 Testing

In the final milestone, black-box testing was applied for the final product. The application was tested in Android Phone (LG G3), IPad, Mac OS and Window. The teacher panel was tested in different browser as well. The test cases are designed for standard scenario. Some criteria are observed to check whether the loading time and transition time is acceptable.

To test the user acceptance, we have invited friends to test the application and give feedback. Sometimes, developers may miss the experience of user. Testing by other users help us to find bugs and improve the application to become more user-friendly. Also, more people involve in testing can simulate the lecture scenario. Many students will play the game together during lecture.
5 Future Development

5.1 Type of question

At the beginning of planning phase, we have designed 2 more type of question involving fill in the blank and ordering question. However, during the implementation, it is known as a big workload that can’t be developed feasibly by 2 men power. We have given up this plan.

Besides, we have put efforts in getting images as a question source too. Because it is common usage for some Mathematic problem such as solving the geometric question. But the result is not ideal as expected.

In order to provide more choice of question type, the rebuild of database is required. Thanks to the feasible nature of Mongodb with JSON format, it is more convenient than using database with table structure.

5.2 Implementation of games

In the game design stage, we planned to have integration between 2 games, Four Kingdoms and mini games. The game result of mini-game involving the number of collected apples and clouds could have a further usage to buy powerful weapon and tools in Four Kingdoms. This plan is canceled as the developing process is too slow. Also, the current database structure is not allowed to reuse the result because there is none of identify and pair up between teacher and student. It requires a modify on database structure too. In order to have an on time schedule, this design is discarded at the end.

From a feedback of testing user, a scene can be implemented for students to access their game result after finishing a game. Because students may want to review the questions and have a revision on the question answered wrong.

5.3 Self-learning tool

With some edits from the server and application, Plature can be converted to a self-learning tool as well. As the high feasibility of this project, it can simply be done by adding a user type “self-learning”. In the application, the scenes from both teacher and student can be merged so that self-learning users can create a game and play it by themselves. They can therefore have a test by themselves. By allowing the access to teacher web panel, self-learning users can import their own customized quiz and know the weaknesses and strength by viewing the test result.

5.4 Security

Security is one of future development. The login system of application and teacher web panel can apply the SSL to tighten security. As the deploy of server to Google Cloud is quite late, there is a risk that we have no enough time to test all service of application and teacher web panel. Since some adjustment is needed by raising the security level.
Appendix A – Project Team Details

Project Team

Two team members including design and implement. Project Manager and Design Architect are coordinated and work together on this project.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Duty</th>
</tr>
</thead>
</table>
| Kwok On Ki     | Project Manager     | • Project leader and coordinator responsible for overall planning and development of the project  
                  |                     | • System Development                                                |
| Sham Cheuk Yee | Design Architect    | • Database management and enhance                                    
                  |                     | • Game design                                                       
                  |                     | • Interface design                                                  
                  |                     | • Testing                                                           |
Appendix B – Simple model Flowchart

1. Enter game interface
2. Get into the room by particular key
3. Download questions created by that teacher
4. Get signal from game server to start game
5. Current answer?
   - Yes: Save result and character gain rewards (Exp)
   - No: Save result and character lost HP
6. Finish all questions
7. Send result to game server for analysis
8. Student can review their result
9. Teacher get the result and display to students
10. Communicate results