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Let's Learn Mandarin! : A Chinese Language Vocabulary Learning Mobile Application For 7 Years Old Children

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Abstract: The number of children enrolling in Chinese schools to learn the language increases year by year. Therefore, a Chinese vocabulary learning mobile application, Let's Learn Mandarin! will be developed by targeting 7-year-olds to learn Chinese language vocabulary to provide them an alternative approach to consolidate Chinese vocabulary. This application aims to address the shortcomings of some equivalent applications, such as the failure to implement attractive and interactive multimedia elements, boring learning content, and confusing navigational structure. This project aims to develop the proposed learning mobile application using 2D trivia gamification approach on Android using Unity. After completed the development of the application, user acceptance test is carried out among Year 1 students in S.J.K. (C) Saleng. The results test showed that the application received positive feedbacks from its target users. Therefore, it is said that the objectives of this project are achieved. Besides, the advantages, limitations, and future works of Let's Learn Mandarin! had also being identified in the end of the project.

Keywords: Chinese Vocabulary, Mobile Learning, Gamification, Android

1. Introduction

Recent years, there is an increasing number of children in Malaysia, including non-Chinese children, are attending Chinese schools and begin to learn Chinese [1]. To provide them an alternative approach to learn Chinese language vocabulary, Let's Learn Mandarin! is developed on the 2D Android mobile platform by using Unity. It is a Chinese vocabulary learning mobile application for children to learn Chinese vocabulary based on different categories. Any child who wants to learn some Chinese language vocabulary can utilize this mobile learning application in their spare time.

There is much evidence that children learn faster than adults. As a result, having a mobile learning application on their mobile device will help them learn new skills, such as learning a new language. However, many learning applications fail to provide appealing and engaging multimedia features that can entice children, resulting in them missing out on the opportunity to learn something new.

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During the processes of reviewing similar existing application, it is found that there are several language learning smartphone apps only offer boring instructional content. Since these mobile learning applications are similar with textbooks, children are more likely to spend time on other entertaining applications. Aside from that, issues such as failure to implement simple navigational elements and content that may be used to assess children's comprehension of the learning content are also faced by some of the review applications.

Therefore, the objective of this project is to develop Let's Learn Mandarin! learning mobile application using 2D trivia gamification approach on Android platform using Unity. The developed application will also be tested on target users, children aged seven years old. The subject matter expert for this project is Madam Kua Hwee Ting from SJK (C) Saleng. There are two types of modules in this mobile learning application: learning modules and trivia game modules. Each of these modules are consist of 4 categories. The learning module includes Chinese vocabulary from different categories, while the trivia game module offers a trivia game based on the categories available in the learning module. English and Mandarin will be the languages used in this application, and the application will be presented on a 2D Android mobile platform. The Unity 2020.3.0f1 version will be the software used to develop this mobile learning application with the assistance of the C# programming language. Multimedia Mobile Content Development (MMCD) will be the chosen development methodology for this project.

The five sections of this study are the introduction, relevant work, methodology, results and discussion, as well as conclusion. The second section will introduce the topic of Chinese language learning for children, the technologies that will be employed, and a comparison of similar existing Chinese language vocabulary learning applications with the proposed application. The third section presents the methodology chosen for this project, whereas the fourth section will be showing and analyzing the results of user acceptance test. The advantages, limitations, and future work of the application will also be included within the same section. Lastly, the summary of this article will be concluded in the fifth section.

2. Related Work

In this section, topic related to Chinese language learning for children as well as the technology used for it will be discussed. The comparison between the similar existing application for Chinese language vocabulary learning and the proposed application will also be discussed as well.

2.1 Chinese Language Learning for Children

The Chinese language is gradually becoming one of Malaysia's most in-demand languages. Many parents enrol their children in Chinese national primary schools to learn the language, whether they are native or non-native Chinese speakers [2]. One of the reasons this phenomenon is happening is because Chinese is one of the most spoken languages in the world. Chinese is not only spoken in China, but it is also spoken in Singapore, Taiwan and in our country, Malaysia. Hence, more and more parents decided to let their children learn Chinese so that they could communicate with more people around the world.

One of the ways for someone to master a language is by increasing their vocabulary in that language [3]. Therefore, children need to learn new Chinese language vocabulary from time to time to help them master the language in the future.

Suppose we wanted to make sure that children could memorize and understand the meaning of a particular vocabulary. In that case, patience and assistance should be given to them to quickly consolidate what they have learned. Children must also be provided appropriate encouragement and praise for them to sustain their enthusiasm in learning a new language's vocabulary while encountering difficulties [4].

2.2 Technologies Used for Chinese Language Learning

When it comes to applying technology in learning, interactive technology is one of the significant choices. Interactive technology is often described as a bidirectional flow of information between the technology and its users [5]. This often happens through a user interface in this type of technology.

Mobile applications are one example of interactive technology being used. It is also commonly referred to as a type of application software that is designed to run on a mobile device. Mobile applications often stand on the opposite side of desktop applications or web applications since a desktop application runs on a desktop computer. In contrast, a web application that runs on a mobile device's web browser is more like a mobile application that runs directly on a mobile device. The platform where this mobile learning application will be released is the Android mobile platform.

Many researchers have attempted to utilize the gamification approach in language studies to enhance language learners' motivation during learning [6]. Implementing appropriate gamification features such as game points, different levels, and practical challenges will allow students to stay motivated and engage themselves in the process of learning while also having fun.

Hence, a trivia game module, which is a module that asks the players questions related with different categories of Chinese language vocabulary, is implemented in this mobile learning application and provide the users with exciting features such as an attractive interface, different levels of a trivia game, and appropriate questions. This is to ensure children will engage themselves in learning the Chinese language vocabulary while enjoying the process of learning it.

2.3 Existing Applications

The three existing applications that are similar with the proposed application, Let's Learn Mandarin! for this project are Learn Chinese for Kids [7], Baby Chinese Language [8] and Learn Chinese Vocabulary [9]. Table 1 is created to compare the specifications of these three similar apps with the proposed application.

Table 1: Comparison of existing applications

Features	Learn Chinese for Kids	Baby Chinese Language	Learn Chinese Vocabulary	Let's Learn Mandarin!
Icon				
Platform	Android 4.0.3 or above	Android 4.0.3 or above	Android 4.1.0 or above	Android 4.0.3 or above
Pricing	Free	Free	Free, but contains in-app purchase	Free
Internet Connection	Required	Not require	Required	Not require
Number of modules	2	1	2	2
Learning module	Available	Available	Available	Available
Game module	Available	Not available	Available	Available
Background music	Not available	Not available	Not available	Gentle music

Table 1: (continued)

Features	Learn Chinese for Kids	Baby Chinese Language	Learn Chinese Vocabulary	Let's Learn Mandarin!
Main menu interface	Available	Not available	Not available	Available
Setting panel	Not available	Not available	Available	Available
Exit confirmation panel	Not available	Not available	Not available	Available
Module selection interface	Not available	Not available	Available	Available
Learning category selection interface	Available	Available	Available	Available
Learning content selection interface	Not available	Not available	Not available	Available
Learning content interface	Available	Available	Available	Available
Functional and navigational buttons	Return button is missing in some interface	Exist but small and inconsistent	Exist but small and inconsistent	Complete and fully functional
Overall color and design	Plain	Colorful	Plain	Colorful
Advertisement	Included	Not include	Included	Not include

Based on the comparison between all these mobile learning applications, it has been determined that Let's Learn Mandarin! which is an Android-based Chinese language vocabulary learning mobile application, will be developed with various multimedia elements and a clear navigational structure. The new application should also incorporate all the existing application's strengths while also addressing its flaws.

3. Methodology

Multimedia Mobile Content Development (MMCD) methodology has been tested and refined to develop some mobile content including mobile learning applications. In addition, this methodology can also help developers to speed up the application development process and at the same time optimize the use of mobile processing and data usage [10].

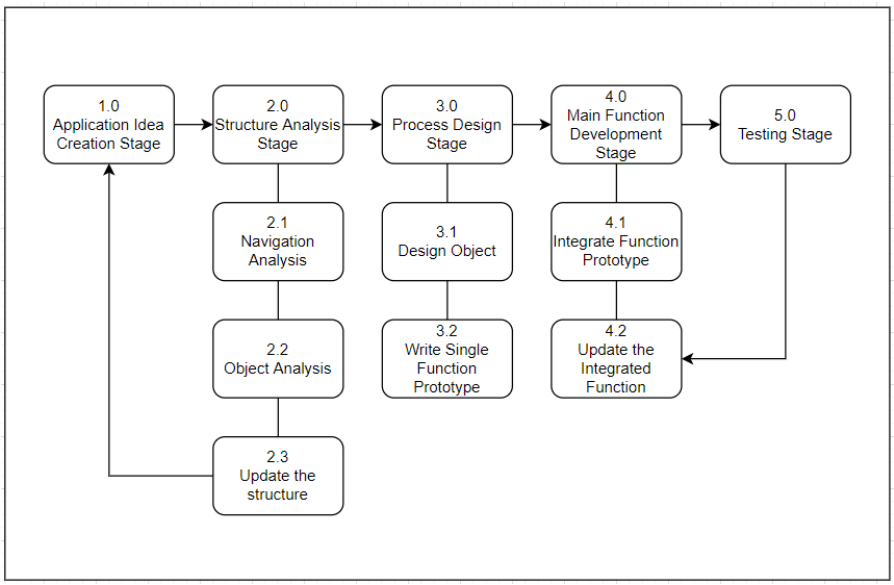


Figure 1: Stages of Multimedia Mobile Content Development (MMCD) [10]

Figure 1 shows the five main stages of MMCD methodology alongside with their respective substages, which are application idea creation stage, structure analysis stage, process design stage, main function development stage, and testing stage [10].

3.1 Application Idea Creation Stage

The first stage of MMCD methodology is application idea creation. In this stage, the project developer needs to prepare the information that are required for the development of the application before starting the actual design and development [10]. In this stage, the checklist for idea creation has been generated as shown in Table 2.

Table 2: Application idea creation checklist

Item	Note
Type of application	Learning application
Platform	Android mobile
Target users	7 years old child
Graphical user interface	Main interface, navigational interface learning interface, trivia game interface.
Image	Graphic for Chinese language vocabulary, button icons, images for trivia game.
Video	Video for trivia game.
Animation	Setting panel, exit confirmation panel, score animation, timer animation, remaining lives animation.
Audio	Background music, Chinese language vocabulary pronunciation.
Application summary	Let's Learn Mandarin! is a Chinese language vocabulary learning mobile application that developed for children that are 7 years old using 2D trivia gamification approach to help them learn Chinese language vocabulary.

3.2 Structure Analysis stage

The second stage of MMCD is structure analysis stage. In this stage, the navigation and object of the application are properly assessed in this stage to avoid them affecting the rest of the development stage. In addition to establishing the content structure check list, Madam Kua Hwee Ting, a Chinese subject teacher at S.J.K. (C) Saleng, Senai, Johor, was interviewed to establish the user analysis of the application. A set of questionnaires that are presented in Google Form had also been distributed online to 25 target users, which are children of 7 years old with the help of Madam Kua to come out with a complete structure of user analysis as showed in Table 3.

Table 3: User analysis of Let's Learn Mandarin!

Stakeholder Category	Role in Application	Design Implication	Action Needed
Subject Matter Expert	Consultant expert on content in related field	Simple while colorful user interface	• Prevent complicated design on interface while offering some colorful element to draw children attention. • The mapping of objects on interface should be simple to prevent children from confusion.
		Easy to navigate between interfaces	• Navigational and functional buttons provided should be as many as possible. • Use icon-based buttons instead of text-based for better understanding on function of buttons. • Navigational structure of application should be simple.
		Children-friendly learning	• Use simple word and graphic for learning module. • Use simple English and apply gameplay that is easy to understand.
		Simple but reliable content	• Include Chinese language vocabularies that are suitable for 7 years old children. • Avoid complicated words. • May refer to Year 1 Chinese syllabus.

Table 3: (continued)

Stakeholder Category	Role in Application	Design Implication	Action Needed
General users	Target users of the application	Offline feature	The application should be able to access at anywhere, anytime on mobile device.
		Colorful interface	The interface should be filled with colorful elements instead of designing a plain interface.
		Usage of graphics	More graphics should be used instead of plain texts.

Based on the analysis made from the interview with the Subject Matter Expert, it was determined that the application should have a simple yet colorful user interface. The interfaces must also be easy to navigate to prevent confusion when using the application. The learning content of the application should be child-friendly and straightforward while ensuring the implemented content is reliable. From the standpoint of general users, the application should be able to be used offline, have a bright user interface (UI), and include more graphics. After the user analysis is completed, the next step is to continue analyzing more detailed information regarding the functions and structure of the application. Therefore, the content structure, navigational structure, and the application flowchart are created and attached in Appendix A. The functional and non-functional requirements of the application are tabulated in Table 4 and Table 4, respectively.

Table 3: Functional requirements of Let's Learn Mandarin!

Functional Requirement	Explanation
Supportive for User Interaction	• The application should allow users to give their inputs by touching the screen of mobile devices. • The application should allow users to navigate between different interfaces of the application by using suitable navigational buttons.
Provide Learning Module	• The application should allow users to recognize the word and graphic that is related to the Chinese language vocabulary. • The application should allow users to understand the meaning of the Chinese language vocabulary. • The application should allow users to recognize the pronunciation of the Chinese language vocabulary.
Autonomous Application Activities in Trivia Game Module	• While the trivia game is running, the app should be able to calculate the score earned each time they properly answer a question. • The application should be able to indicate the remaining time for users to answer all the questions while the trivia game is running. • While the trivia game is running, the app should be able to show how many lives players have left if they answer the questions incorrectly.

Table 3: (continued)

Functional Requirement	Explanation
Autonomous Application Activities in Trivia Game Module	• If users answer all the questions in given time limit and without using all the remaining lives, they will be navigated to the trivia game complete panel. • If users failed to answer all the questions in given time limit or finished using all the remaining lives, they will be navigated to the trivia game over panel.

Table 4: Non-functional requirement of Let's Learn Mandarin!

Non-functional Requirement	Explanation
Performance	• No internet connection is required for the application to operate. • The application should be able to operate at the fastest speed for most Android mobile that fulfils the application requirement.
Implementation	• The application should be able to operate on Android mobile device with an operating system of Android 4.1 or newer.
Usability	• Users of this application can access it at anywhere and anytime if they have the mobile device with this application installed. • Users should be able to use this application easily, learn the Chinese language vocabulary effectively, and gain satisfying user experience when using this application.
Legal	• Users of the application can only view but cannot modify the information that are displayed on the interfaces of the application.
Cultural	• The language used in this application will mainly be simple English language with some Chinese language as the learning content. • The application should provide content that is suitable for 7 years old children.
Graphical User Interface Support	• The application should support all essential elements, including graphics, animations, audio, and text for different sizes of display resolution on Android mobile.

3.3 Process Design Stage

Process design stage is the third stage for MMCD methodology. The main task in this stage is to prepare all the listed materials and assets that are listed in the content structure check list. The process design stage consists of two substages, which are design objects and write single function prototype.

In this case, Adobe Photoshop will be utilized to design the graphical elements that are required by the learning mobile application in this project. Unity will be used as well to compile all the assets alongside with the C# scripts. At the end of this process, a prototype should be completed from aspects of graphics and object designs, object placing on stage and single function prototype scripting that placed in each frame [10]. Since the scene navigation is one of the key functions in Let's Learn Mandarin! the C# script that contributes to the scene navigation of the prototype is attached in Appendix A.

3.4 Main Function Development Stage

For the fourth, which is main function development stage, the required main functions are the navigation between the user interfaces and modules, such as the main menu interface, module selection interface, different categories in learning module and different game levels in the trivia game module. The required navigational buttons, such as the return button, needs proper scripting to make sure that it works properly. For learning module, the most important navigational features will be navigating between different vocabulary. Therefore, it is important to make sure that the script is implemented properly to provide convenience for users when they wanted to navigate between different Chinese language vocabulary. The script is also implemented on the audio button that plays the pronunciation of the Chinese language vocabulary. For the trivia game module, the C# scripts will be focusing on the functionality of the features available in trivia game, such as the questions, the options, the score, timer, and the remaining lives for players. The scripts are also implemented to make sure that users can open the setting panel or to navigate out from the trivia game module.

3.5 Testing Stage

Testing stage is the last stage of MMCD development methodology. Two types of testing are going to be conducted in this stage, which are alpha and beta testing. The alpha testing was conducted by the application developer throughout the development process of the application until the project is completed whereas beta testing was carried out in the form of user acceptance test by distributing the learning mobile application alongside with questionnaire to 7 years old children through online method. The questionnaire is presented in Google Form to collect the target users' feedbacks regarding of their satisfaction towards the developed learning mobile application. After the data is collected in the form of target users' feedback, they are analyzed and taken into consideration as future improvement. Any mentioned problems regarding of the application will also be noted down and fix immediately. In this case, the result of alpha testing is tabulated in Table 5.

Table 5: Results of alpha testing for Let's Learn Mandarin!

Test	Expected Result	Actual Result	Corrective Action
Start button	Navigates to module selection interface.	Works well as planned.	Not required.
Option button	Shows option panel when clicked.	Works well as planned.	Not required.
Exit button	Shows exit confirmation panel when clicked.	Works well as planned.	Not required.
Mute button	Mute background music when clicked.	Works well as planned.	Not required.
Unmute button	Unmute background music when clicked.	Works well as planned.	Not required.

Table 5: (continued)

Test	Expected Result	Actual Result	Corrective Action
Learning Module button	Navigate to vocabulary category selection interface when clicked.	Works well as planned.	Not required.
Trivia Game Module button	Navigate to trivia game selection interface when clicked.	Works well as planned.	Not required.
Back button	Return to previous interface when clicked.	Works well as planned.	Not required.
Vocabulary Category Selection button	Navigate to corresponding vocabulary category when clicked.	Works well as planned.	Not required.
Vocabulary Content Selection button	Navigate to corresponding vocabulary content when clicked.	Works well as planned.	Not required.
Pronunciation Audio Play button	Plays pronunciation audio of corresponding vocabulary when clicked.	Pronunciation audio overlapped when button is clicked multiple times.	Ensure only one instance of audio is played when being clicked.
Next Vocabulary button	Navigate to next vocabulary when clicked.	Works well as planned.	Not required.
Previous Vocabulary button	Navigate to previous vocabulary when clicked.	Works well as planned.	Not required.
Trivia Game Selection button	Navigate to corresponding trivia game when clicked.	Works well as planned.	Not required.
Correct Answer button	Invoke function in script for increment of score when clicked.	Works well as planned.	Not required.
Wrong Answer button	Invoke function in script for deduction of life when clicked.	Works well as planned.	Not required.
Retry button	Retry current trivia game when clicked.	Works well as planned.	Not required.
Home button	Return to main menu when clicked.	Works well as planned.	Not required.
Game Selection button	Return to trivia game selection	Works well as planned.	Not required.

4. Results and Discussion

In this part, the result of beta testing for the proposed learning mobile application, Let's Learn Mandarin! will be discussed. In this case, a set of questionnaires were presented on Google Form and distributed to the testing subjects alongside the apk file of the application. The number of participants for user acceptance test is 25 person and all of them are Year 1 student from SJK (C) Saleng, Senai, Johor. Apart from asking the SME's help to distribute the materials for beta testing, a discussion session was also held with her to explain all the questions in the Google Form for clarification. The parents of these students are also being informed, and they verbally administer the questionnaire to assist their children when they fail to understand the question. The questions of questionnaire and the result of the beta testing is being displayed in Appendix C and Appendix D correspondingly. The questions in Google Form that focus on the application's features are mainly divided into three sections: learning outcome acquisition, user acceptance level, and application functionality.

From the results of Google Form, we can see that there are five questions in Section 1, which is the learning outcome acquisition. All the questions under this section were answered with a positive answer from the chart shown. However, we can still see that a few respondents provided negative or ambiguous answers to different questions. For the first question, there are 84% of the respondents answered "Yes", 4% of the respondents answered "No", and 12% of the respondents answered "Maybe" for the first question. For the second question, 72% of respondents answered "Yes", 12% of respondents answered "No", and 16% of respondents answered "Maybe". For the third question, 80% of the respondents had given a positive answer, and 8% had given a negative answer. 16% of the respondents had ambiguous answers to the same question. As for the fourth and the fifth question, both have the same results, where 76% of the respondents answered "Yes", 8% of the respondents answered "No", and 16% of the respondents answered "Maybe". Overall, most of the respondents had given a positive response in this section, which means that the application had provided a positive learning outcome for the target users, since the application provides graphic and audio elements within the learning module, making it easier for the users to recall what they learnt by relating the vocabulary to its pronunciation and the image that represents the vocabulary itself.

For the section of user acceptance level, 76% of the respondents think that the proposed application is attractive and colorful, which means that they are satisfied with the graphics used within the application. However, 8% of the respondents had given the opposite answer, and 16% were not sure whether the application was attractive and colorful or not. For the second question, 84% of respondents reflected that they enjoyed both learning and trivia game module in Let's Learn Mandarin! whereas only 4% of the respondents gave the opposite response. On top of that, 12% of the respondents had given an unsure answer. This shows that the target users satisfy the content implemented in both modules. For the third question, 80% of the respondents answered "Yes," 8% of the respondents answered "No," and 12% of respondents answered "Maybe." This question proved that most of the target users think that the application is user-friendly. From the analyzed result, we can say that the target users had given positive feedback regarding the user acceptance level of the application. The reasons for obtaining positive user acceptance feedback might be due to various multimedia elements implemented within the application, making the interface look colorful and attractive. Apart from that, the application also provides satisfying user experiences, such as by implementing complete sets of functional buttons that enable users to use the application easily, resulting in positive user acceptance feedback.

For the last section that asks for users' opinion on the functionality of the application, , there are 80% of the respondents think that it is easy to navigate through all scenes in the proposed application while 4% of them think otherwise. For the remaining 16%, they had given an ambiguous answer for the question. The result of this questions proves that with the action of implementing full sets of functional buttons, such as return button, home button, and retry button, it makes the users feel that it is easy to

navigate between different scenes. On top of that, there are 84% of the respondents had given a positive answer for the second question and none of the respondents had given a negative answer. This proves that the graphics and texts that are implemented into the application is being display properly. However, there are 16% of the respondents are not sure about the answer. Lastly, there are 88% of the respondents reflected that they did not encounter any errors while using the application and none of the respondents reflected that they had encounter any errors while using the application. However, there are 12% of the respondents are not sure about their answers. Overall, the functionality of Let's Learn Mandarin! is in the range from above average to high. This might be due to the application works completely fine, as there are no bugs or any issues that results in bad user experience.

After analyzing the results obtained from the 3 sections, which are learning outcome acquisition, user acceptance level, and functionality of application, it is concluded that positive feedbacks and acceptable results had been given from the respondents for all these sections. All 25 respondents are satisfied with the proposed application and thus, proving that the application had fulfill the users' requirement in general. Therefore, it is concluded that the application has advantages as following:

i. Let's Learn Mandarin! provided a positive result from the aspect of learning outcome acquisition. It can help seven-year-old children learn, consolidate, and revise Chinese language vocabulary from different basic categories.

ii. Let's Learn Mandarin! has a high level of user acceptance since its target users enjoy it due to its attractive and colourful user interface.

iii. The functionality of features in Let's Learn Mandarin! is complete as all texts, buttons, and graphics are displayed correctly, and the background music and sound effects are played sequentially.

iv. Trivia game module in Let's Learn Mandarin! provides a simple and fun game for children to revise and consolidate the Chinese language vocabulary they learnt from the learning module.

v. Since the application is built on the Android mobile platform, it can be used as a home-based revision tool when children want to learn, revise, or consolidate the Chinese language vocabularies implemented within this application's learning module.

Even though Let's Learn Mandarin! had shown its advantages, it also has some limitations which are found after analysing the results of user testing. The limitation of this application is listed as follows:

i. There are only 5 categories of Chinese language vocabulary implemented within the learning module, which provide less choices for the target users to choose what kind of Chinese language vocabulary they wanted to learn.

ii. Even though the questions in trivia game is being shuffled every time, the questions presented in it remained the same when each time the users play the trivia game.

iii. The resolution of the application might be inconsistent for newer Android mobile devices, especially for those who have higher resolution from the aspect of height.

In this case, some enhancements that can be implemented in the future of Let's Learn Mandarin! to solve its current limitations are also suggested at the end of this project. The suggested future works are as follows:

i. Provide update for learning module by implementing more categories of Chinese language vocabulary.

ii. Provide update for trivia game module by implementing more questions into existing question list of trivia game.

iii. Fix the resolution issue of the application by adjusting the application to fix various Android mobile devices' resolution.

5. Conclusion

In conclusion, Let's Learn Mandarin! is a Chinese language vocabulary learning mobile application developed according to each development stage in the chosen development methodology, Multimedia Mobile Content Development (MMCD), using software such as Unity, Visual Studio Code, and Adobe Photoshop. This mobile learning application is an interactive application that allows children of 7 years old to learn and consolidate Chinese language vocabulary by accessing the learning module and trivia game module provided in this application. After finishing the main function development stage as well as the testing stage, it is said that the project's objectives had been achieved, which are to design the Let's Learn Mandarin! learning mobile application using a 2D trivia gamification approach, develop the proposed learning mobile application on the Android platform using Unity, and test the developed application on target users, who are children that are seven years old. The advantages and limitations of the application were also identified after analyzing the results of the user acceptance test during beta testing. On top of that, some improvements to the application have been suggested in future work to enhance Let's Learn Mandarin!. It is hoped that the application will improve in the future.

Acknowledgment

The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support.

Appendix A

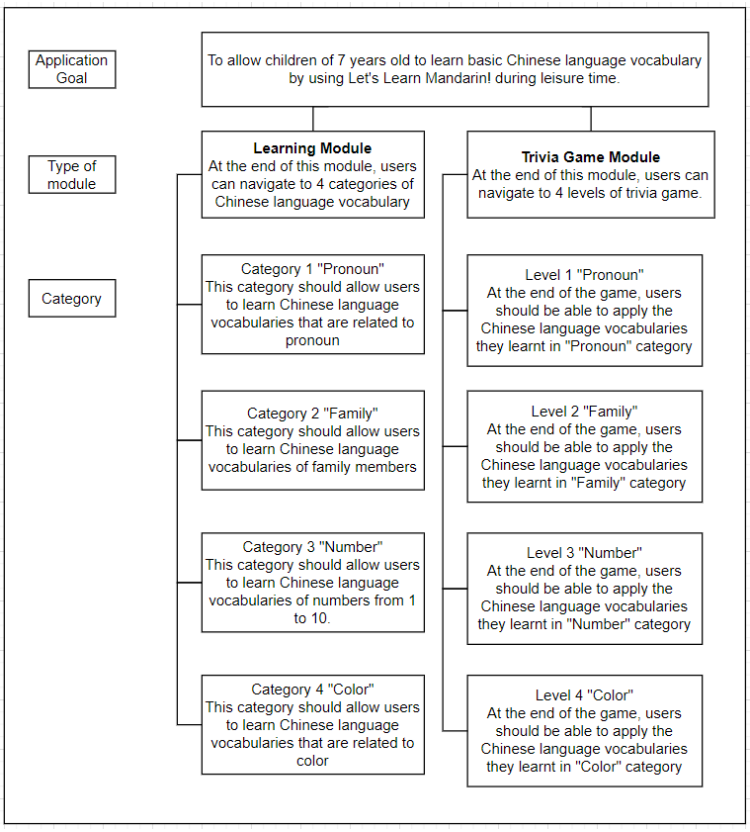


Figure 2: Content structure of Let's Learn Mandarin!

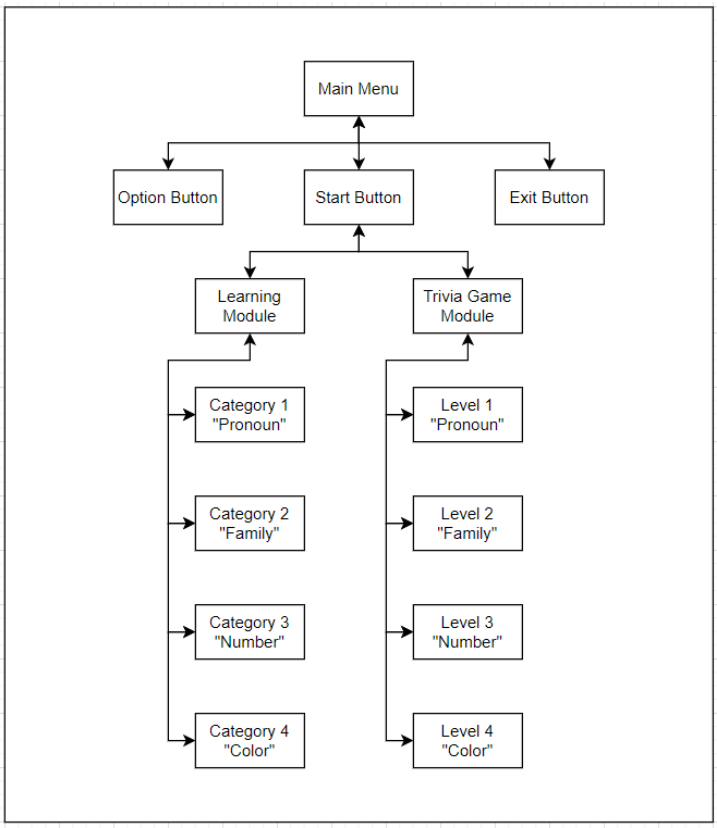


Figure 3: Navigational structure of Let's Learn Mandarin!

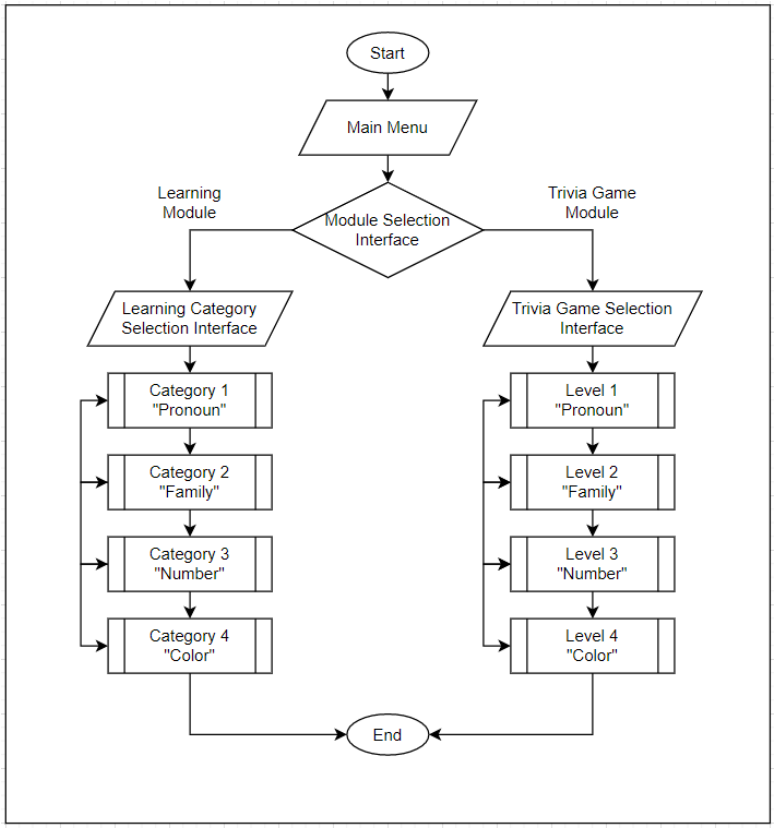


Figure 4: Main flowchart of Let's Learn Mandarin!

SceneControl.cs

D: > Unity Projects > ChineseVocab > Assets > Scripts > SceneControl.cs

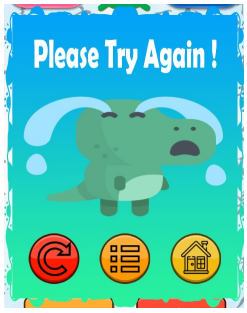
```
1   using System.Collections;
2   using System.Collections.Generic;
3   using UnityEngine;
4   using UnityEngine.SceneManagement;
5
6   public class SceneControl : MonoBehaviour
7   {
8       public void LoadScene(string sceneName)
9       {
10          SceneManager.LoadScene(sceneName);
11      }
12  }
13
```

Figure 5: Code snippets responsible for scene navigation in single function prototype

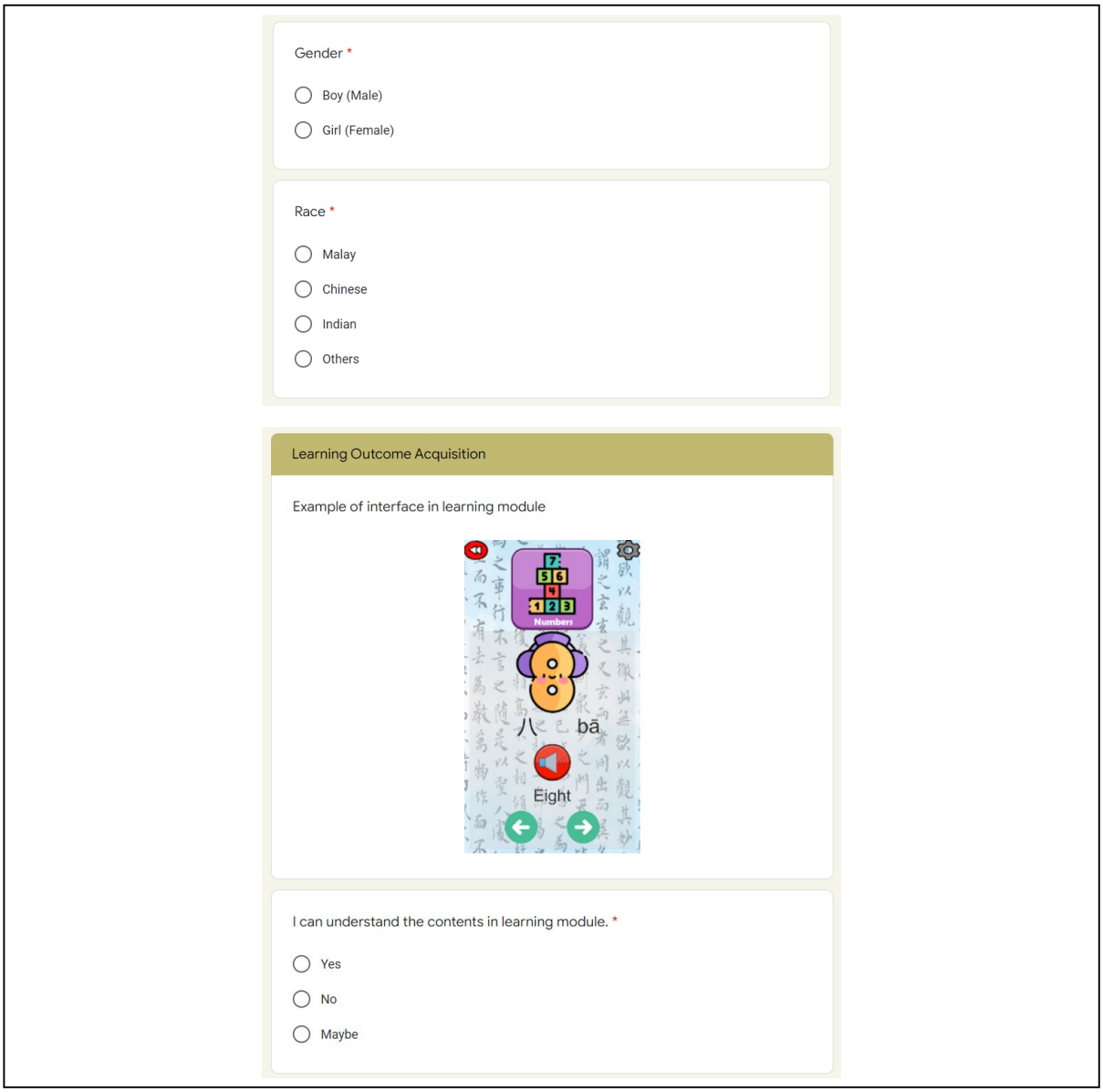
Appendix B

Interface	Main Menu	Setting Panel	Exit Confirmation Panel	Module Selection
Output				

Interface	Learning Category Selection	Learning Content Selection	Learning Content	Trivia Game Selection
Output				

Interface	Trivia Game	Game Complete Panel	Game Lose Panel	In-game Setting Panel
Output				

Appendix C



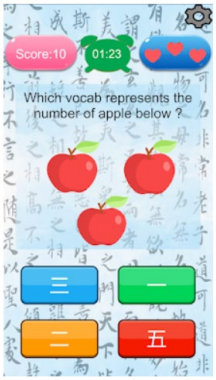
I can understand the Chinese language vocabulary and use it. *

- Yes
- No
- Maybe

I learnt how to pronounce the Chinese language vocabulary showed in this application. *

- Yes
- No
- Maybe

Example of interface in trivia game module

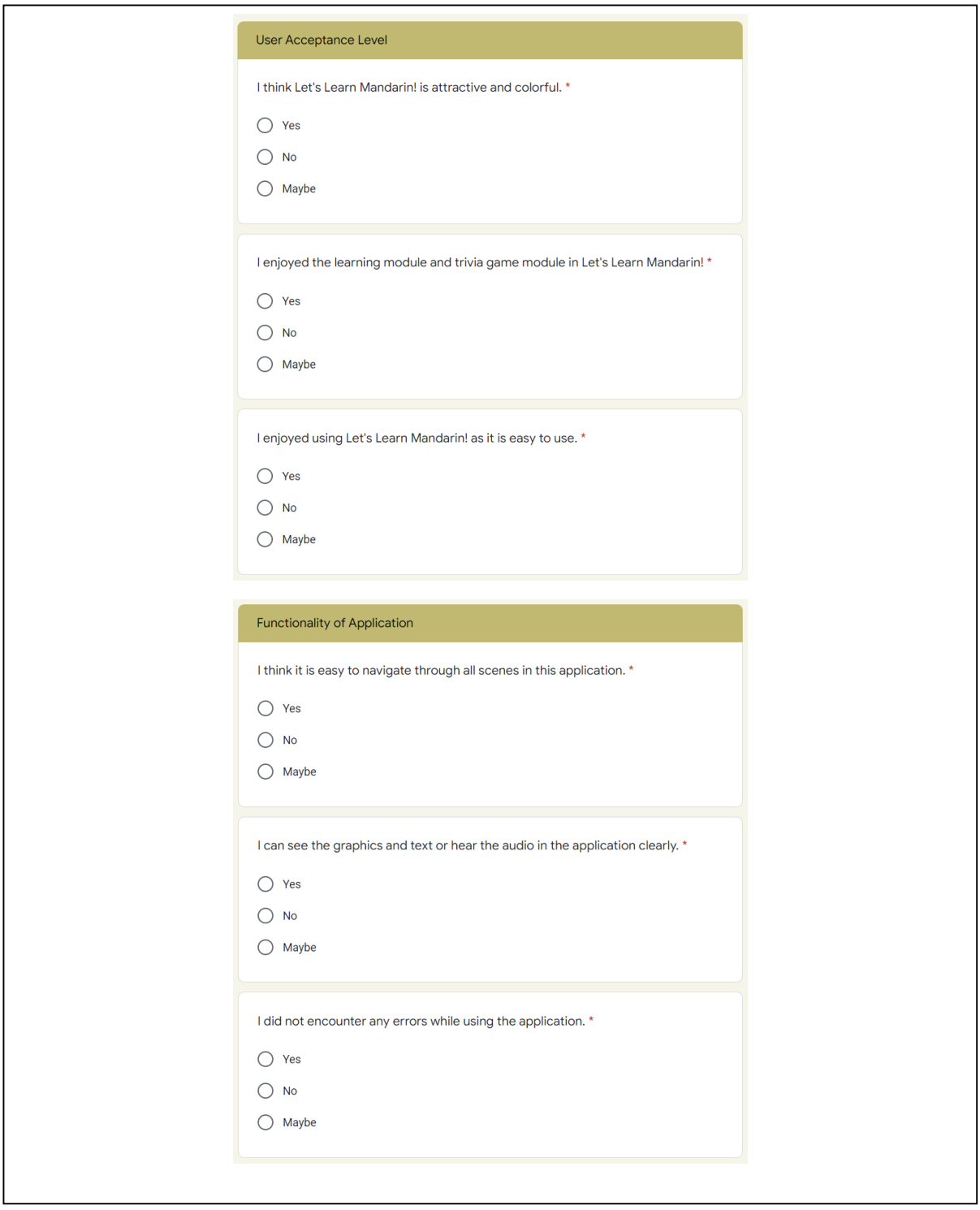


I can understand the contents in trivia game module. *

- Yes
- No
- Maybe

The trivia game helped me revise the Chinese language vocabulary. *

- Yes
- No
- Maybe



User Acceptance Level

I think Let's Learn Mandarin! is attractive and colorful. *

- Yes
- No
- Maybe

I enjoyed the learning module and trivia game module in Let's Learn Mandarin! *

- Yes
- No
- Maybe

I enjoyed using Let's Learn Mandarin! as it is easy to use. *

- Yes
- No
- Maybe

Functionality of Application

I think it is easy to navigate through all scenes in this application. *

- Yes
- No
- Maybe

I can see the graphics and text or hear the audio in the application clearly. *

- Yes
- No
- Maybe

I did not encounter any errors while using the application. *

- Yes
- No
- Maybe

Appendix D

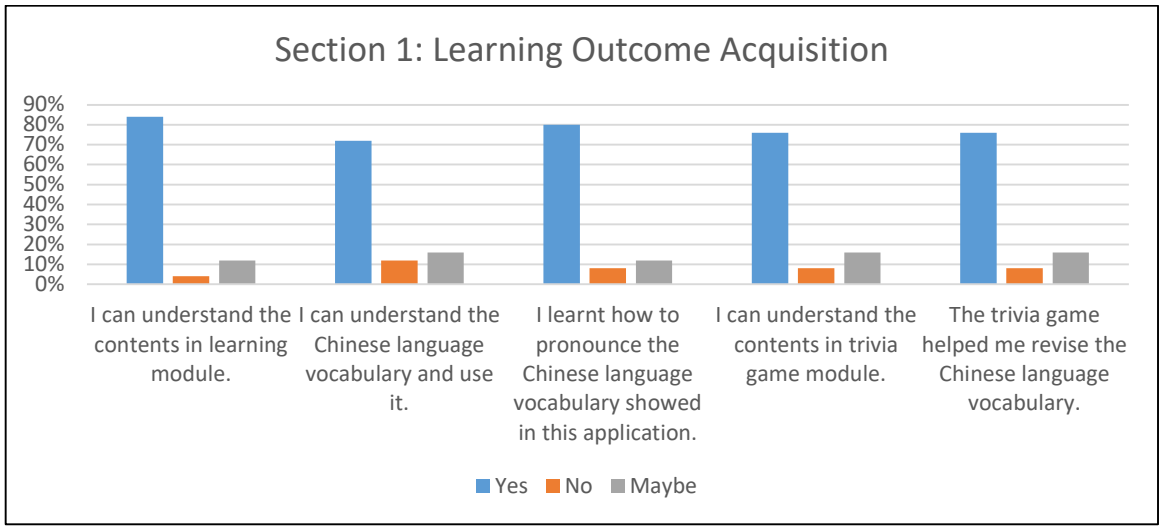


Figure 1: Results of questionnaire for section 1

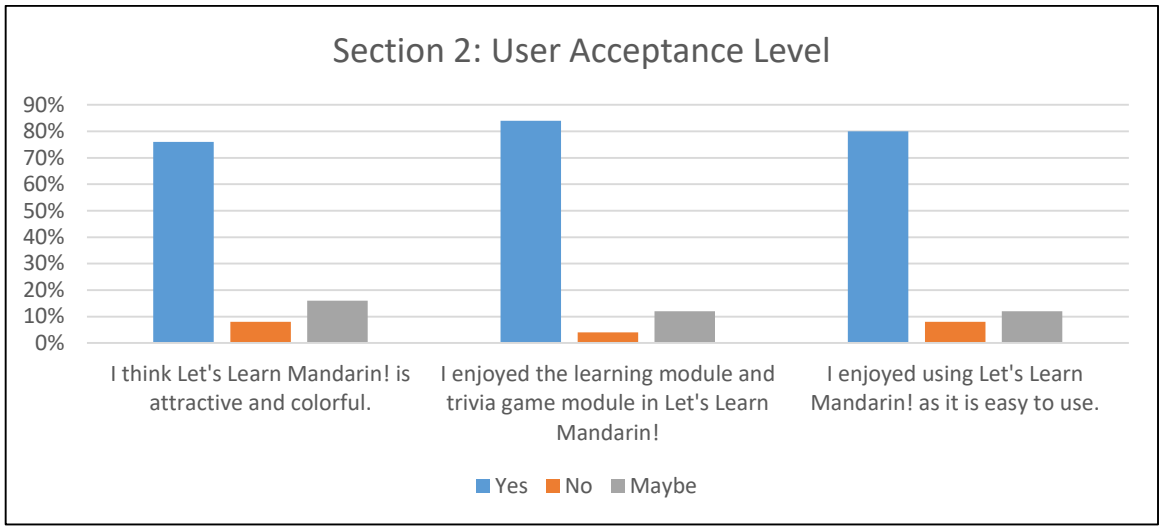


Figure 2: Results of questionnaire for section 2

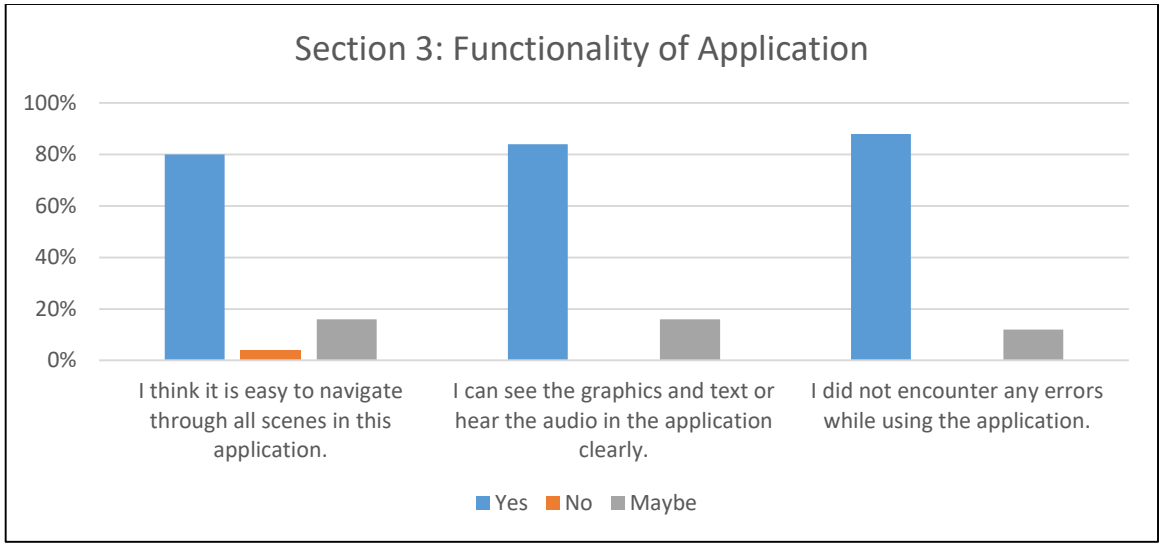


Figure 3: Results of questionnaire for section 3

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