# AITCS

# Development of Think & Go Road Safety Mobile Game using Gamification Approach

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**Abstract**: Road safety is considered as one of the most important topics for children's education at present due to the increased number of road incidents involving them every year. Think & Go is a road safety mobile game that is designed and developed in English language by using a 3D gamification approach on the Android platform for the target users aged 7 to 12 years old. Game Development Life Cycle (GDLC) model is adopted as the methodology model for the development process. On average, the proposed game received 77.8% of positive feedback for learning outcome acquisition, 73.33% for functionality of the game and 77.77% for user acceptance level of this game from the user testing. This can be concluded that the game provided positive learning outcome, functioning well, suitable for the target user to play and the game also will be monitored to improve in the future.

**Keywords**: Road Safety, Mobile Game

## 1. Introduction

According to the World Health Organization [1], road traffic accidents resulted in more than 260,000 deaths among children and young people aged 0-19 years in 2004. Children accounted for 21% of all deaths associated with road traffic accidents worldwide. Malaysia alone had recorded an average of 4% increment of road accidents a year since 2004. Fatal injury percentage in children under the age of 15 in Malaysia is amounted for 11% [2]. Additionally, more than 220 children aged under 14 years were injured every year on Malaysian roads during the past five years and between 1 to 3% of children were killed in road accidents [3]. These reports suggested that the awareness of road safety in children should be highly regarded not just by the parents, but also the society and the authority.

The problems that cause the number of fatal or non-fatal accidents that happened on the road increasing quite significantly, year on year are due to user carelessness and improper conduct to the road facilities. Other reason includes lack of awareness about the importance of road safety rules. As a road user, it is mandatory to learn and understand road safety rules since they can help keep us safe on the road. Further, there are only a few existing mobile games about road safety that can be found in the Google Play Store or Apple App Store. By taking some similar games as comparisons such as Crossing Fury and Road Cross Risky, these games are focused on the gameplay of road crossing with a lack emphasis on the road safety rule and do not provide clear instruction for the user before starting the game that can cause them cannot understanding gameplay easily.

The objectives of this project are to design a road safety mobile game using 3D gamification approach. Secondly, to develop a mobile game about road safety on the Android mobile platform. Lastly, to test the proposed "Think & Go" game to the target users.

"Think & Go" is an offline road safety mobile game that is aimed to assist the user in increasing awareness and the importance of road safety. It will be designed with a story about a road user named John as the main character. This game will be designed in 3 stages. These stages will be represented as "days" in the game by following the storyline. Each stage consists of a further 3 sub-stages, with increasing difficulty for each stage and sub-stage. Unity for Android platform will be used as the development platform, with English as the main language. This game will be implemented in a 3D approach and the target users are children aged 7 to 12 years old.

The related work such as technology used and comparison of the existing game applications, methodology used in the project which is Game Development Life Cycle (GDLC), and the result of alpha and beta testing that had been conducted will be discussed and explained further in the following section.

## 2.    Related Work

### 2.1    Technology Used

Unity Game Engine [4] with version 2014.4.12f1 is the software platform used to develop this game. The minimum system requirements for its development is via Windows 7 SP1+, 8 or 10, in a 64-bit version only. Additional platforms include Android SDK and Java Development Kit (JDK) for Android. Moreover, a minimum of Android operating system v4.4  or later versions is required to run this game on Android-based mobile devices. Other than that, a few more additional software such as Adobe Photoshop CS6 [5], Blender [6] and Adobe Illustrator CS6 [7] are also utilized for character, game buttons and background design of the game.

### 2.2    Comparision of Existing Game Applications

**Table 1: Comparative analysis on all three existing games and proposed game**

| Game Name | Traffic Rules And Street Safety For Kids [8] | Road Cross Risky [9] | Crossing Fury [10] | Think & Go |
|---|---|---|---|---|
| Developer | EnL Design Studio | Gravity Infosoft | Y310Games | Hong Liang Ni |
| Supported Platform | Android 4.4 and above | Android 4.0 and above | Android 5.0 and above | Android 4.4 and above |
| Category | Educational | Arcade | Action | -Role-playing game(RPG) -Educational |
| Language | English, Lithuanian | English | English | English |
| Game mode | Offline unless the player needs connect to his/her Facebook account | Offline | Offline | Offline |
| Background music | No | Yes | Yes | Yes |
| Sound Effect | Yes | Yes | Yes | Yes |
| Storyline | No | No | No | Yes |

**Table 1: (continued)**

| Game Name | Traffic Rules And Street Safety For Kids [8] | Road Cross Risky [9] | Crossing Fury [10] | Think & Go |
|---|---|---|---|---|
| Font | San Serif | San Serif | San Serif | San Serif |
| Strengths | -Easy to play<br>-Consistent button design<br>-Able to connect to Facebook account | -Consistent button design<br>-Provides camera view | - Provides various selection of options in setting | -Easy to play<br>-Provides clear instruction<br>-Consistent button design<br>- Contains with road safety material |
| Weaknesses | -Does not provide with clear instructions<br>- Does not contain road sign to guide the user in the game<br>-Does not comes with sound effect | -Does not provides with clear instructions<br>- Does not contain with road safety material<br>-Difficult to play | -Does not provides with clear instructions<br>- Does not contain with road safety material<br>-Difficult to play | -Design with 3 stages and each stages with 3 sub-stages only |

Based on Table 1, by comparing the three existing game applications which are Traffic Rules and Street Safety for Kids, Road Cross Risky, and Crossing Fury with the proposed game, "Think & Go", the strengths and weaknesses have been analyzed. The strengths of the proposed game are the game provides clear instruction, easy to play, consistent button design and contains road safety material. The weakness of the proposed game is the game will be designed with 3 stages and each stage with 3 sub-stages only.

## 3.  Methodology

Game Development Life Cycle (GDLC) model [11] is used for the development of the proposed game, "Think & Go". As the name suggests, there are six phases in this model, which are Initiation phase, Pre-Production phase, Production phase, Testing phase, Beta phase and Release phase.

### 3.1  Initiation Phase

This phase will create a rough idea of the game concept that will be designed. Besides, the introduction, the problem statement, objective, scope and expected result for the proposed game will be determined in this phase. The comparison and analysis of the weakness and strength between three existing or similar games or applications will also carry out. Furthermore, a Gantt chart is created for proper project organization.

### 3.2  Pre-Production Phase

Pre-production is the most critical phase in the development of the game which involves the game design and game prototype. The 3D game character, game interface, gameplay, storyline, game assets of the proposed game will be designed in this phase. In addition, the user requirement will be defined such as the storyboard, the flow chart will be prepared, mainly for the game developer, to make a better understanding of the whole process of the game development. The storyboard, flowchart, content structure and navigation structure will show in Appendix A.

### 3.3  Production Phase

A much solid game prototype and game asset design from the previous phase will be further developed in Unity. Blender will be used mainly for 3D characters and assets creation and modeling. C# scripting will be designed for the character's movements and other features. A playable prototype of the proposed game should be available.
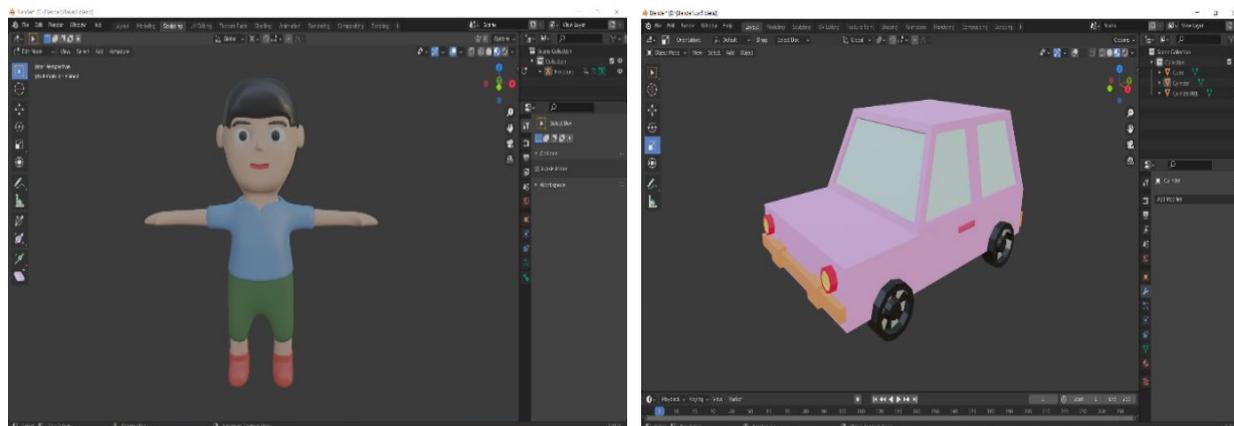


**Figure 1: 3D character and game asset modeling**

3.4     Testing Phase

Alpha testing will be used as one of the methods to conduct the game testing in this phase. The purpose of this testing is to identify the major bugs and features in the game before the game was completed and releasing to the target user. The functionality of the buttons of Think & Go are tested during alpha testing. The improvement will be amended once the errors are found during the testing. This is to ensure that the functionality of the buttons is the same as expected. The result of alpha testing of the functionality of the buttons is shown in Table 2.

**Table 2: Result of alpha testing**

| Button | Expected Result of the button | Actual Result of the button | Correction Action |
|---|---|---|---|
| Play Button | Navigates to Storyline Interface. | Function well | Not need |
| Quit Button | Open the Exit Panel when being clicked | Function well | Not need |
| Setting Button | Open the setting panel when being clicked | Function well | Not need |
| Home Button | Navigate to Main Interface | Function well | Not need |
| Skip Button | Navigate to Day Selection Interface | Function well | Not need |
| Day 1 Button | Navigate to the Pedestrian Safety Tip Interface | Function well | Not need |
| Day 2 Button | Navigate to the Cyclist Safety Tip Interface | Function well | Not need |
| Day 3 Button | Navigate to the Driver Safety Tip Interface | Function well | Not need |
| Next Button | Navigate to next Safety Tip Interface | Function well | Not need |

**Table 2: (continued)**

| Button | Expected Result of the button | Actual Result of the button | Correction Action |
|---|---|---|---|
| Start Button | Navigate to the Task Instruction Interface | Function well | Not need |
| OK Button | Navigate to Game Interface | Function well | Not need |
| Day Selection Button | Navigate back to Day Selection Interface | Function well | Not need |
| Replay Button | Navigate to current Game Interface | Function well | Not need |

### 3.5    Beta Phase

Beta phase is a testing of the proposed game to the target user after the development was completed. The purpose of this testing is to get sincere and constructive feedback and recommendations from the target user after playing this proposed Think & Go game.  For this testing, it will conduct with the target user by using Technology Acceptance Model (TAM) [12] to measure the user acceptance of the proposed game. A set of questionnaires on Google Form was prepared and distributed to the target user online. There have 15 target users during beta testing. The question will be divided into 4 sections which are Personal Detail, Learning Outcome Acquisition, Functionality of the game and User Acceptance Level. Each of the section consists of 3 questions. The result of beta testing will be discussed in Section 4.

### 3.6    Release Phase

Release phase involves the final product launching and project documentation. Once all of the process of well-defined planning and multiple tests to the target user is done, the Think & Go game could be considered as a refined or complete version and it can be released on the Android platform. The project documentation will also be released in PDF format in this phase.
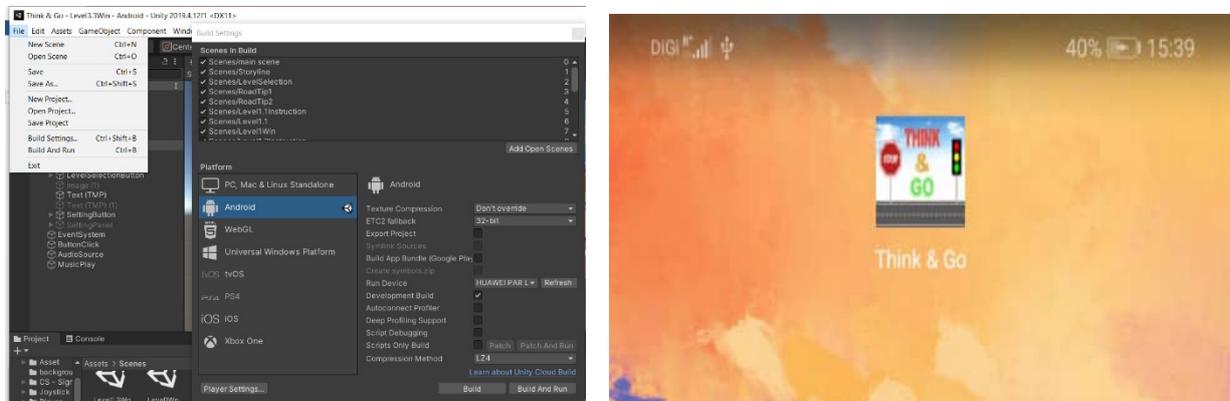


**Figure 2: Building Think & Go on Android platform**

## 4.    Results and Discussion

For beta testing, it was conducted by using Technology Acceptance Model (TAM) to the target user. The questionnaire that prepared for the 15 target users was measured by using "Yes", "No" and "Not Sure" to scale the questions asked. The measured items were listed in Table 3 and the result of beta testing was shown in Figure 3 to Figure 8.

**Table 3: Measured items**

| Construct | Evaluation variables | Measured Items |
| --- | --- | --- |
| Perceived of usefulness (PU) | Learning Outcome Acquisition | Question 1: I can recognize all the road sign in this game.<br>Question 2: I know what is the use and meaning of the road sign.<br>Question 3: I know the road safety rules that need to follow as a road user (pedestrian, cyclist and driver). |
| Attitude Toward Using (ATU) | Functionality of the game | Question 1: I know all the use and function of the buttons in the game.<br>Question 2: I can hear the instructions given in the game clearly.<br>Question 3: I can control the character by using the virtual joystick |
| Perceived ease of use (PEOU) | User acceptance level | Question 1: I think Think & Go is easy to play.<br>Question 2: I think the instructions are simple and easy to understand.<br>Question 3: I like the interface design in the game. |
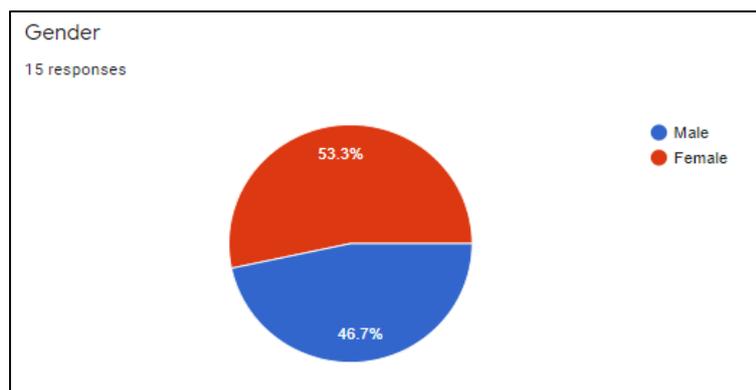


**Figure 3: Gender**

Based on Figure 3, there are 8 out of 15 of respondents (53.3%) are female while 7 of them (46.7%) are male.
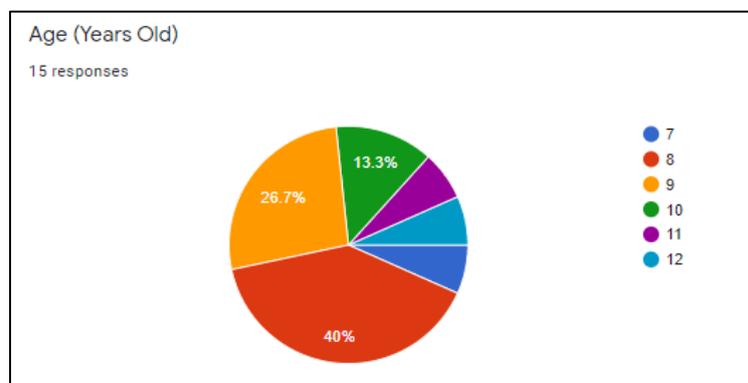


**Figure 4: Age**

Figure 4 shows the age of the respondents. There are 6 out of 25 respondents (40%) are 8 years old, 4 of them (26.7%) are 9 years old. 2 out of 25 (13.3%) of them are 10 years old and only 1 of them (6.7%) is 7, 11 and 12 years old respectively.
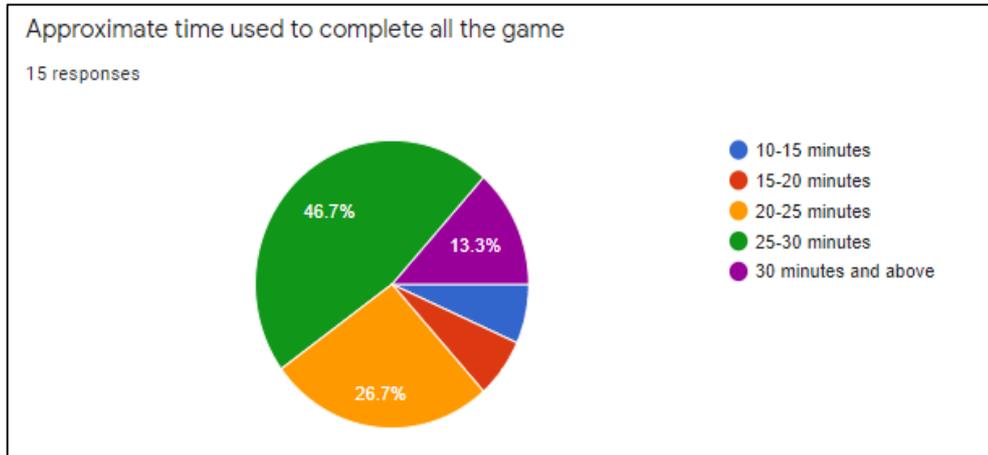


**Figure 5: Approximate time used to complete all the game analysis of target users**

Figure 5 shows the approximate time used for the respondents to complete all the game. There are 7 out of 15 (46.7%) of them completed the game within 25 to 35 minutes and 4 of them (26.7%) completed the game within 20 to 25 minutes. Then, 2 of them (13.3%) finished more than 30 minutes. Only 1 target user (6.7%) completed the game within 10 to 15 minutes and 15 to 20 minutes respectively.
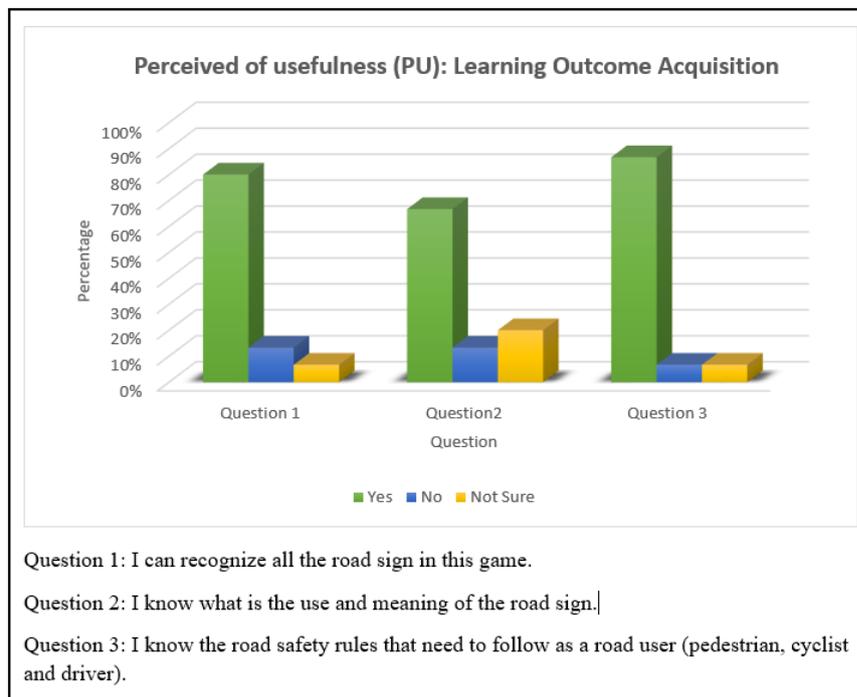


**Figure 6: Analysis of learning outcome acquisition**

Figure 6 shows the result analysis of Learning Outcome Acquisition. For Question 1, there are 80% of respondents can recognize all the road signs in the game while 13.30% of them cannot, and another 6.70% not sure about it. There are 66.70% of them knew the use and meaning of the road sign, 13.30% thought otherwise and 20% unsure about the answer for question 2. As for Question 3, 86.70% of them knew the road safety rules that needed to follow as a road user, 6.70% of them did not know and not

sure respectively. From the overall result, most of the target users answered positively for these 3 questions. It can be concluded that Think & Go game provided them positive learning outcomes.
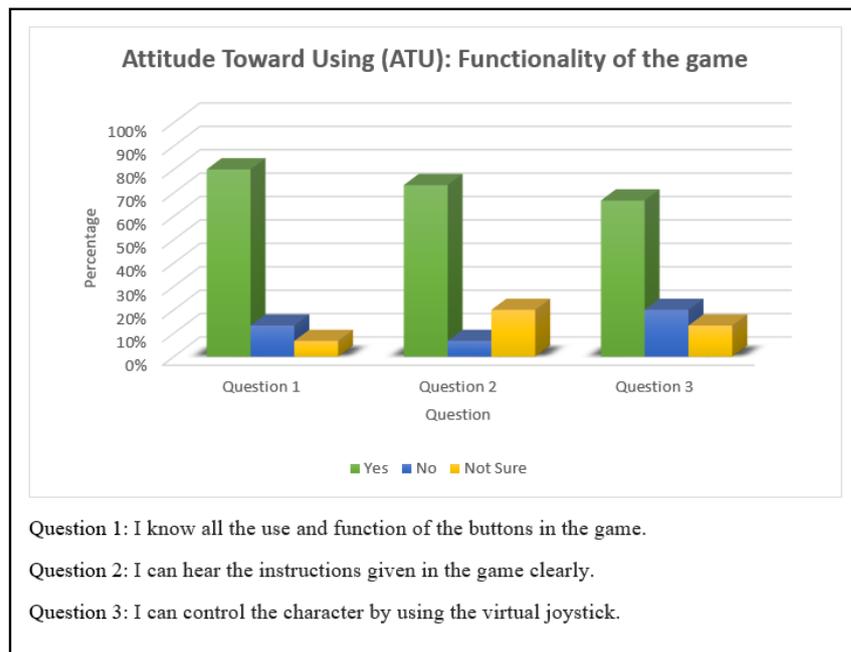


**Attitude Toward Using (ATU): Functionality of the game**

Question 1: I know all the use and function of the buttons in the game.

Question 2: I can hear the instructions given in the game clearly.

Question 3: I can control the character by using the virtual joystick.

**Figure 7: Analysis of functionality of the game**

Figure 7 shows the result of the analysis of the functionality of the game. The result shows that 80% of respondents knew how to use and the function of all the buttons in the game, 13.30% of them did not agree with it and 6.70% are unsured about the answer for Question 1. As for Question 2, 73.30% of them can hear the instruction given in the game clearly, 6.70% of them thought otherwise and 20 % was not sure about the answer. For the last question, there are 66.70% of them can use the virtual joystick to control the character in the game while 20% of them cannot and 13.30% are unsure of the answer. Overall, it can be concluded that the functionality of Think & Go was functioning well since the positive answer was higher than the negative answer.
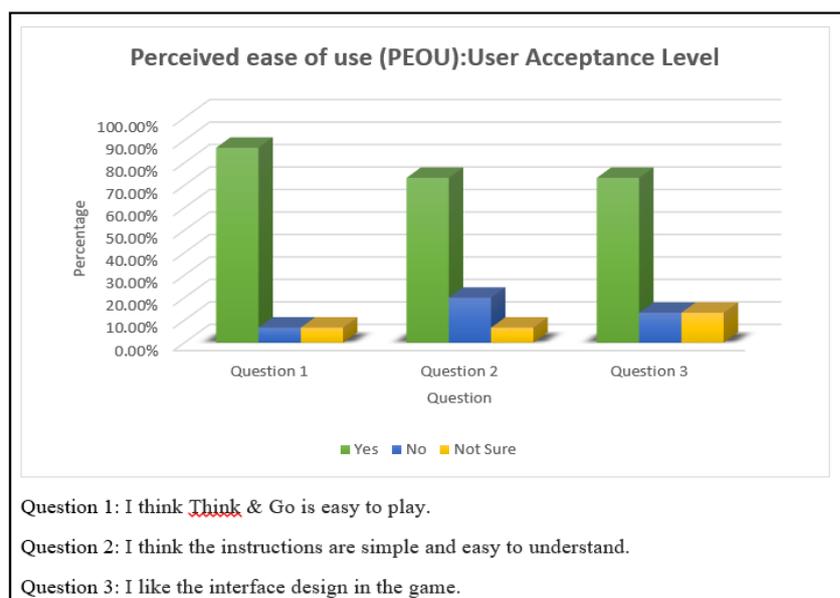


**Perceived ease of use (PEOU): User Acceptance Level**

Question 1: I think Think & Go is easy to play.

Question 2: I think the instructions are simple and easy to understand.

Question 3: I like the interface design in the game.

**Figure 8: Analysis of user acceptance level**

According to Figure 8, there are 86.7% of respondents that thought of this Think & Go game was easy to play while 6.70% of them thought otherwise and not sure of the answer respectively. As for Question 2, 73.30% of them thought the instructions given in the game were simple and easy to understand. There are 20% of them who thought it was difficult to understand and 6.70% unsured about the answer. 73.30% of them liked the interface in the game while 13.30% of them did not like the interface design and not sure of the answer respectively. As for the overall result analysis, it can be concluded that the user acceptance level of the game was still acceptable and had positive feedback from the target users.

## 5.    Conclusion

In conclusion, the knowledge of road safety are vital, especially for road user. The developed mobile game is believed to acknowledge the users and increased their awareness, in a casual and fun way. Game Development Life Cycle (GDLC) model is used as the methodology model in developing this game. Furthermore, all three objectives of this project have been achieved as Think & Go had received positive feedbacks from the respondents, with a few suggestions for future work also have been outlined to improve this game.

**Acknowledgement**

**Appendix A**



(a)                                                    (b)

**Figure 1: (a) Main interface (b) Exit panel**



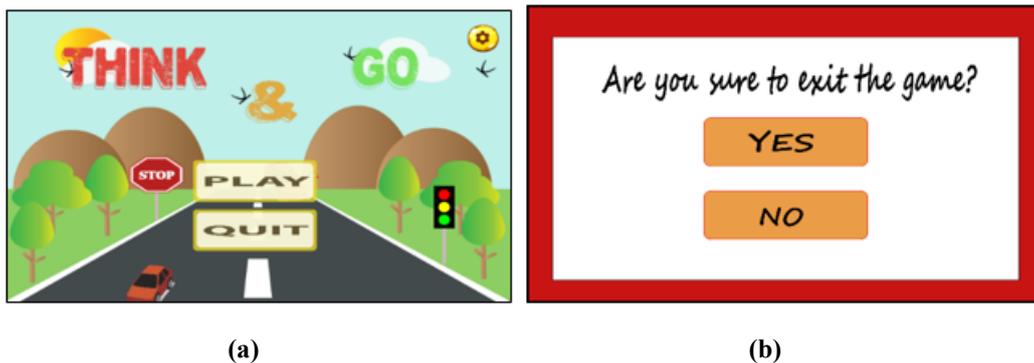(a)                                                    (b)

**Figure 2: (a) Setting panel (b) Storyline interface**

(a)                                                                (b)
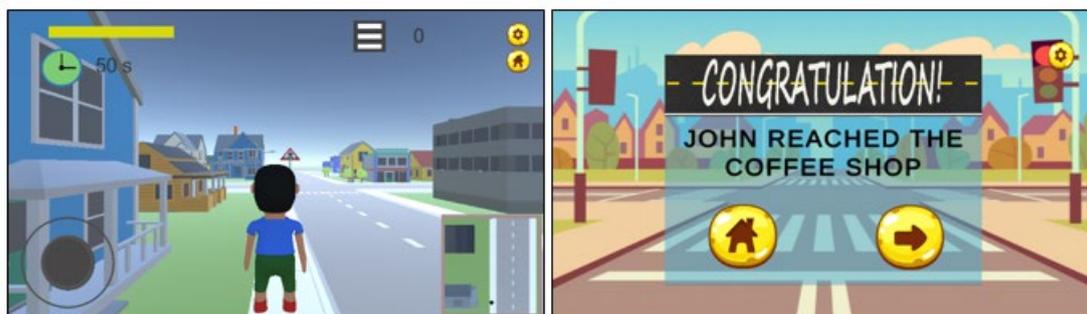
**Figure 3: (a) Day selection  (b) Pedestrian safety tip 1**



(a)                                                                (b)

**Figure 4: (a) Pedestrian safety tip 2 (b) Day 1 task 1 instruction**



(a)                                                                (b)

**Figure 5: (a) Day 1 task 1 game interface (b) Win interface**



(a)                                                                (b)

**Figure 6: (a) Cyclist safety tip 1  (b) Cyclist safety tip 2**

(a)                                                        (b)

**Figure 7: (a) Day 2 task 1 instruction (b) Day 2 task 1 game interface**



(a)                                                        (b)

**Figure 8: (a) Driver safety tip 1 (b) Driver safety tip 2**



(a)                                                        (b)

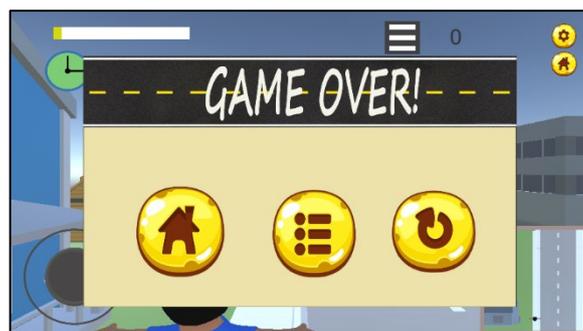**Figure 9: (a) Day 3 task 1 instruction (b) Day 3 task 1 game interface**
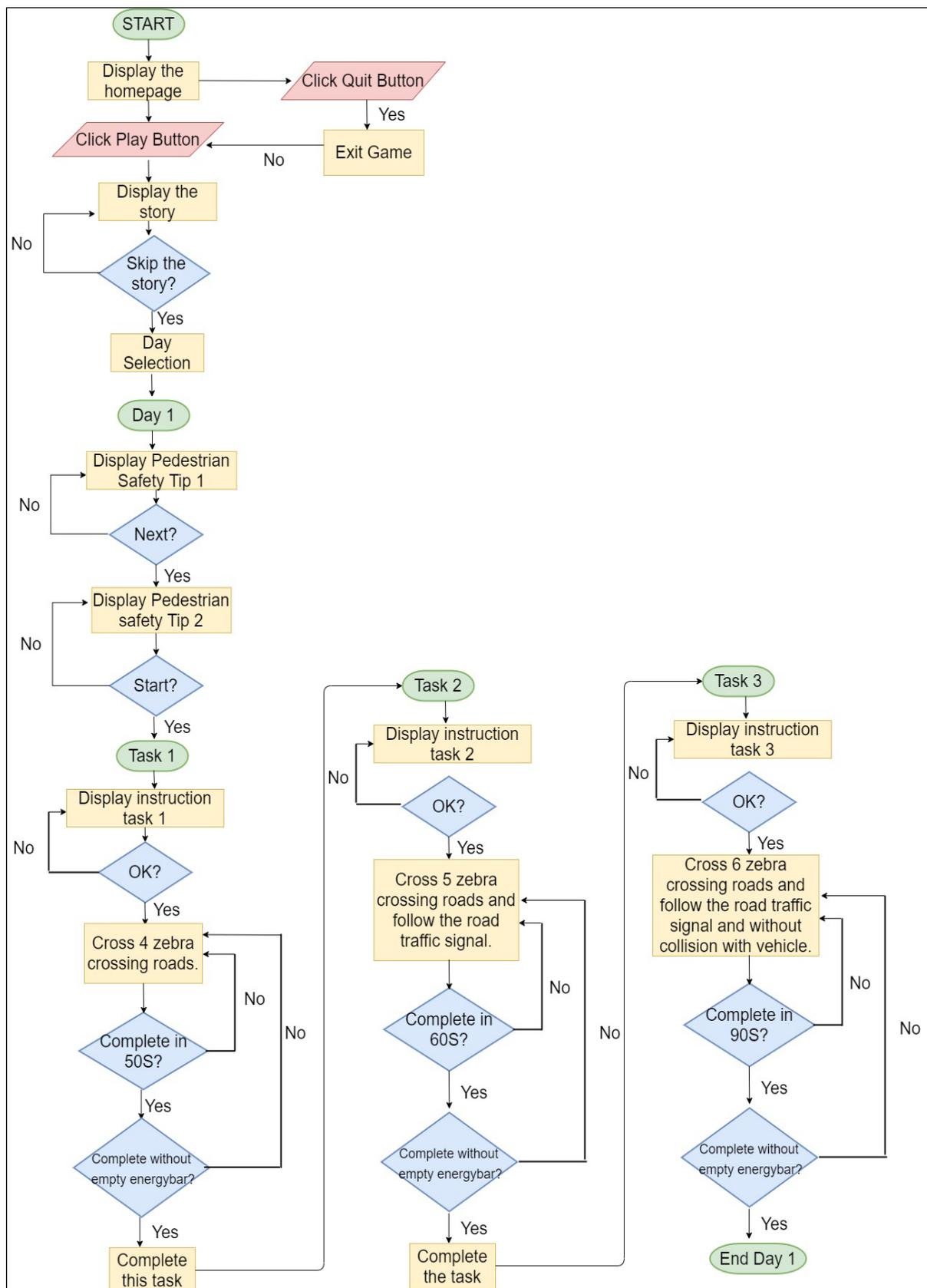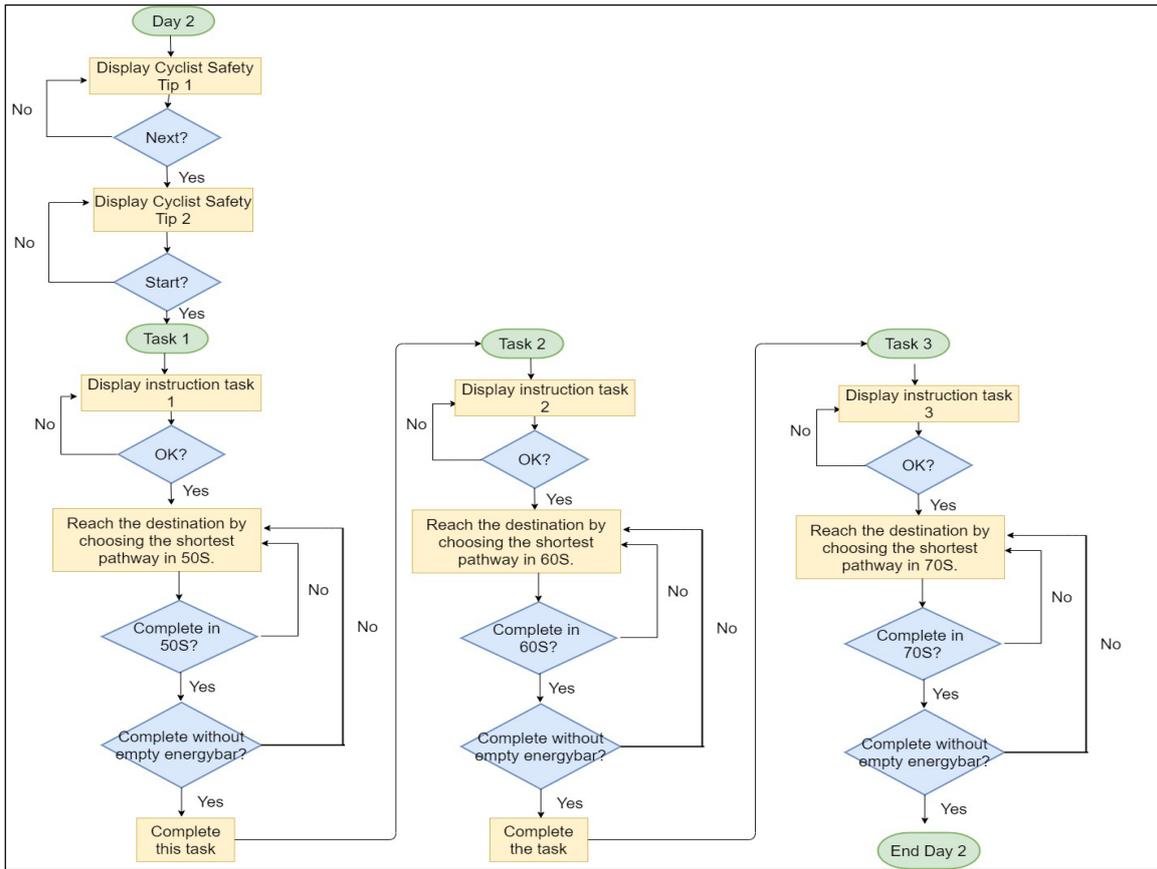


**Figure 10: Game over panel**

**Figure 11: Flowchart**

**Figure 11: (continued)**



**Figure 11: (continued)**

| GOAL | To enhance the awareness and knowledge of children about road safety by playing Think & Go |
|---|---|

**Game Module**

- At the end of this module, the user should be able to complete all 3 stages (Day) and 3 substages (Task) in each stage.

MODULE

LESSON

**DAY 1 (Pedestrian)**

- Users should be able to recognize different road signs.
- Users should be able to know the road safety tips and how to behave properly as a pedestrian.

**DAY 2 (Cyclist)**

- Users should be able to recognize different road signs.
- Users should be able to know the road safety tips and how to behave properly as a cyclist.

**DAY 3 ( Driver)**

- Users should be able to recognize different road signs.
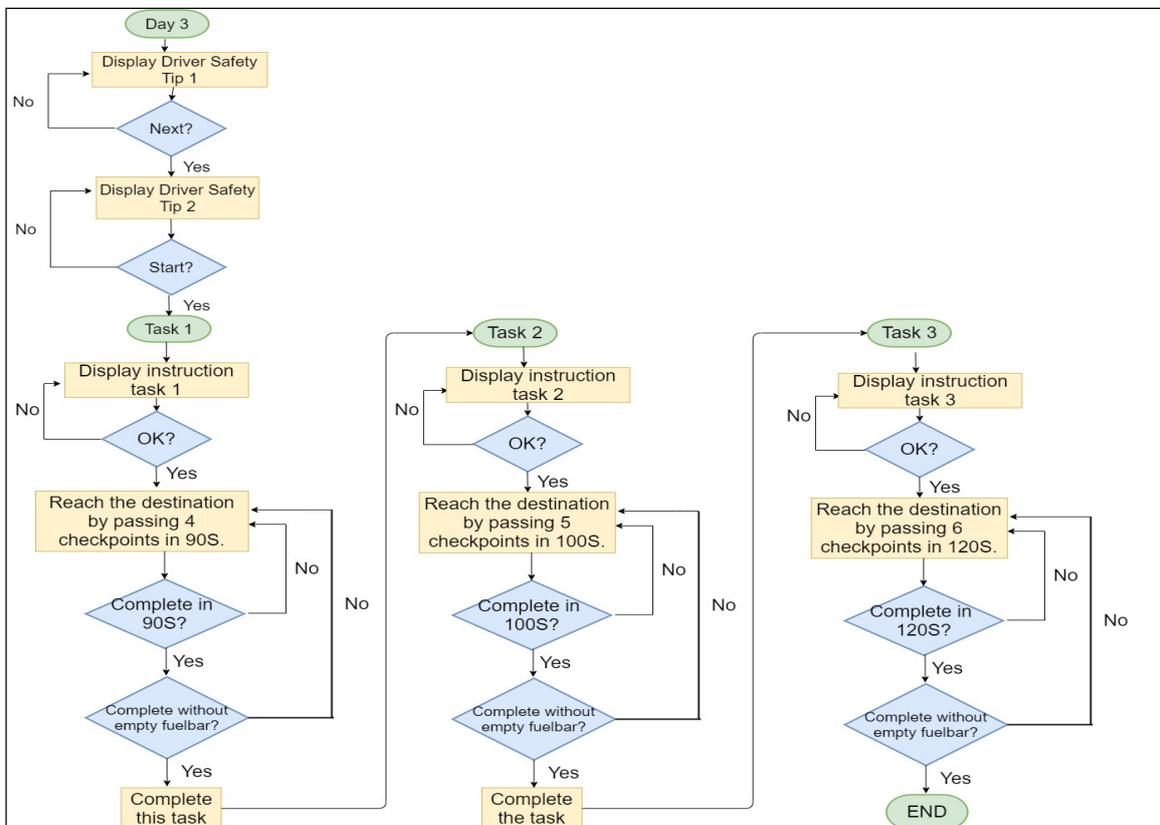- Users should be able to know the road safety tips and how to behave properly as a driver.
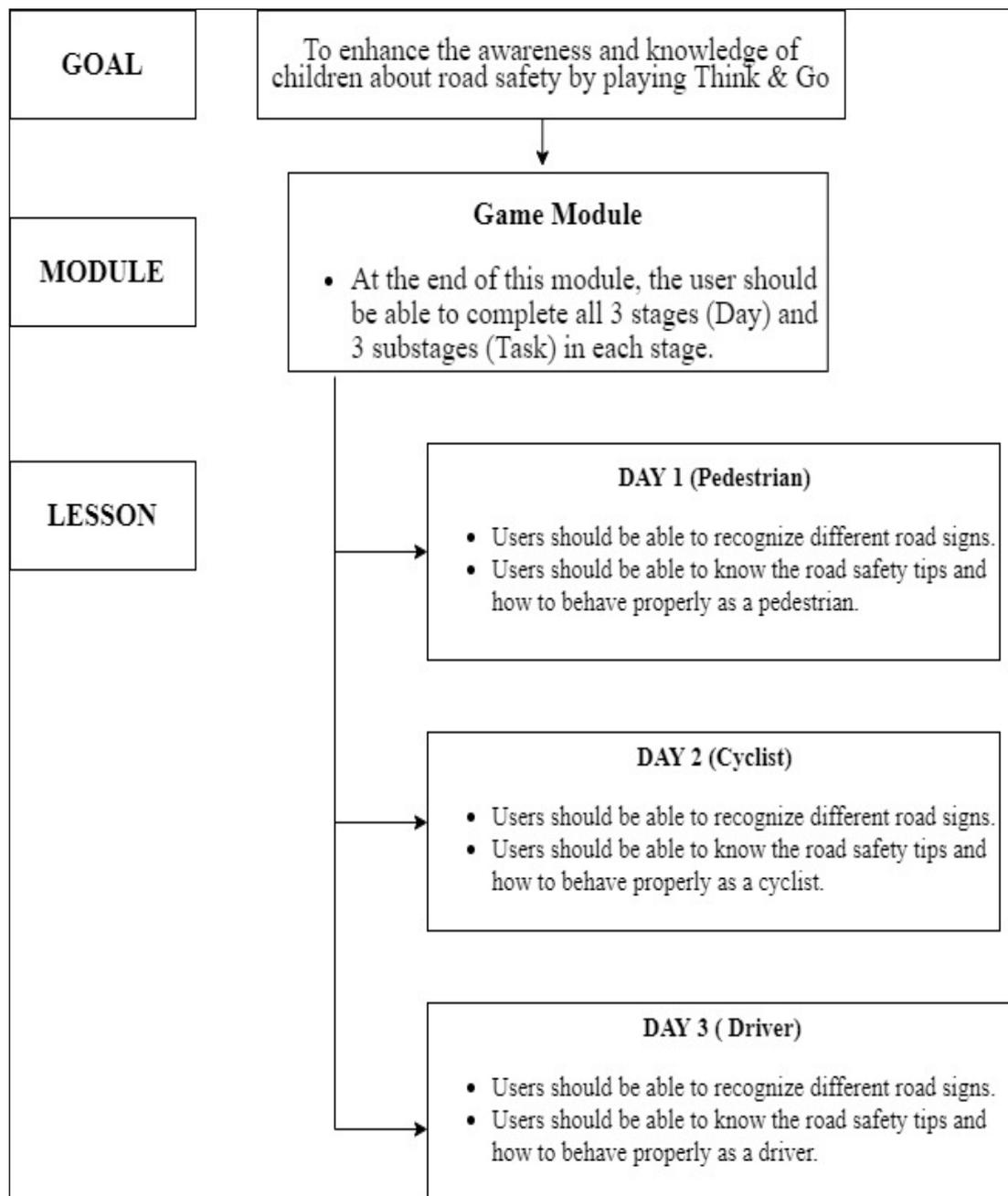
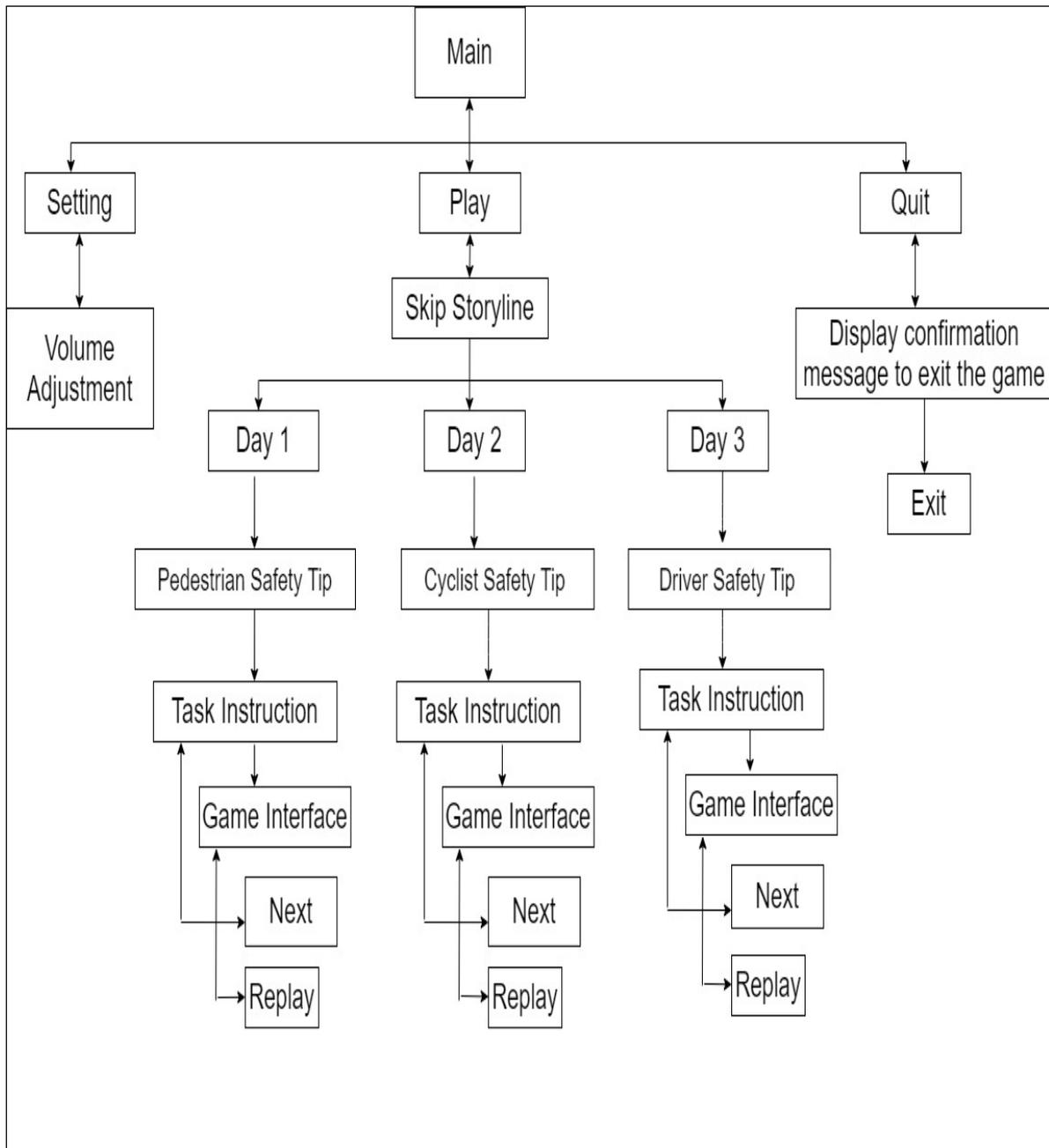**Figure 12: Content structure**

**Figure 13: Navigation structure**

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