

# Development of Mobile Application for Animal Conservation: Animal Rescue

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**Abstract:** Animal conservation approaches are fast evolving in response to rapidly growing changes in the environment as well as the integration of new modern technology. The present applications for kids to learn about animal conservation are less interesting and lack interactive features that can provide kids feedback and hold their interest. Therefore, the development of a mobile application that helps young children in learning conservation information and gets them to know animals with a gamification approach is recommended. The target users for this application project are children up to 5 and 6 years old. The Animal Rescue application was built using the Multimedia Mobile Content Development (MMCD) method. This project aims to help young people learn more about animal conservation. Respondents effectively learned conservation knowledge from Animal Rescue and applied it in their daily lives. The application received positive acceptance from users as an engaging learning tool for animal protection.

**Keywords:** Mobile Application, Animal Conservation, Gamification

## 1. Introduction

The community has learned that some animals are on the World Wild Life Organization's endangered species list. Today, more than 41, 000 species are listed as endangered on the red list by the International Union for Conservation of Nature. Human actions like illegal hunting, pollution, and logging pose the biggest threat to wildlife. The situation can only get better as more people become aware of it and adopt a more positive attitude by learning about wildlife in school and by organizing campaigns to increase public awareness [1]. Therefore, it is crucial to implement conservation education from preschool through university level and to encourage parents to send their kids to those facilities. However, formal education without a creative teaching method would make students uneasy while they were learning [2].

Gamification is incredibly popular in the education sector as it can provide a solution that makes learning more engaging and enjoyable while also improving outcomes [3]. Gamification is an approach that applies elements from games to non-gaming activities to boost motivation and engagement in them [4]. Leaderboards, game mechanics, design concepts, conceptual frameworks of game design, and gameplay methodologies are the five layers that may be used to describe gamification [5]. Gamification

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of learning can also be advantageous because games help players develop lifelong abilities like critical thinking, problem-solving, and awareness [6].

Moreover, the current applications that are available for children to learn about wildlife education are less engaging and lack interaction that can give feedback and attract their attention. Some of the applications lack interactive features and encourage less engagement, which causes the children to feel bored and cannot focus on the learning materials or the information [7]. In fact, enjoyable play is encouraged in the learning environments, alongside additional play-based activities that help to learn in certain topic areas [8].

The goals of the study are to design an "Animal Rescue" mobile application using a gamification approach, develop an "Animal Rescue" mobile application using Android technology and the Unity game engine, and test the functionality and user acceptance of the developed system on the target user. The target audience for the application is children ages of 5 and 6. Teacher Sylvia, a teacher at 3Q MRC Junior Sarikei, is the subject matter expert (SME) involved in this project. Additionally, the VARK model employed in this study will concentrate only on preferences for visual learning.

The remainder of the essay is structured as follows: Section 2 covers the domain of study, the technology used, and the result of the comparative analysis. Section 3 describes the Multimedia Mobile Content Development (MMCD) methodology and the output of each phase of this project. Furthermore, Section 4 presents the results and discussion, and Section 5 states the conclusion of the project.

## **2. Related Work**

This section explains the study domain, the technology applied, and the comparative analysis results.

### **2.1 Animal Conservation**

In addition to being valuable in and of themselves, flora and fauna are crucial components of a larger natural ecosystem that offers food, shelter, water, and other essential services to both other living things and humans [9]. To identify most of the current and exact status of the animals which is tigers nationally, the Department of Wildlife and National Parks, WWF-Malaysia, and other NGOs launched Malaysia's first National Tiger Survey from 2016 to 2020 [10]. Based on the survey's early findings, it was determined that there were now fewer than 150 wild tigers left so the Malayan tiger is listed as Critically Endangered on the IUCN Red List for Threatened Species and is totally protected by the Wildlife Conservation Act of 2010 [10]. The Malayan Tiger population has decreased from 3000 to less than 150 tigers as of 2022 because of habitat loss brought on by development, increased agricultural production, and widely spread hunting [12]. As an example, if deforestation continues at a level of 47 km<sup>2</sup> per year, the number of wild animals that tigers feed upon would be greatly decreased, resulting in a food shortage and a resulting decrease in the tiger population as the tigers have lost over 93% of their original habitat [11].

### **2.2 Interactive Technology**

Interactive technology enables a two-way flow of information between the user and the technology via an interface; the user typically sends a request for data or action to the technology, with the technology returning the required data or the outcome of the action to the user [12]. Interactive technology has been shown to improve learning outcomes, information retention, and student enthusiasm when compared to written content [13]. Example of interactive technology is mobile devices, computer, and tablets. The goal of utilizing touch screen techniques, one example of interactive technology, to enhance traditional teaching methods is to increase learner performance, which can raise the level of learning. As a result, there are generally more educational applications used in the educational process today. In research from Shakhnoza and Makhbuba (2021), the most basic requirement for the structure of modern

education is the opportunity to get positive outcomes in a short amount of time without using excessive physical and mental effort [14]. Mobile technology can influence the learning process through interactions with applications, according to research by Bernacki et al. [15]. Thus, the children can expose to animal conservation education via mobile technology throughout the application.

### 2.3 Comparative Analysis

In this section, the comparison between the three similar existing applications from Google Play Store with the proposed application is reviewed which are Baby Panda: Care for Animals [16], Little Panda’s Animal World [17], and Extinct animals, endangered sp [18].

Table 1 summarizes the key characteristics and limitations of the proposed application. First, the proposed application will be subjected to a quiz featuring multiple-choice questions. Second, the proposed application will be enriched by the addition of a sound button that the user may click to listen to the pronunciation audio. Third, the present applications do not give any conservation information. To promote the conservation idea with the suggested application, conservation-related material will be incorporated into the learning modules. This is due to the possibility that children may learn how to recognize animals while also learning additional protective measures. The proposed application, on the other hand, does not support iOS devices and only works with Android smartphones running version 4.0 and higher.

**Table 1: Comparison between existing application and proposed application**

Name	Baby Panda: Care for Animals	Little Panda’s Animal World	Extinct animals, endangered sp	Animal Rescue
Platform	Available for both Android and iOS systems		Only available for Android system	
Gamification	Provide the scenario game to the users	Provide puzzle, maze, and scenario game	Provide multiple-choice questions, time game, Yes/No game, and flashcards	Provide multiple choice questions in the quiz and match card memory game
Modules	The only module which is the game mode	Provide two modules which are learning and game with three conditions Desert, Jungle, Ocean	Provide two modules: Learning Game	Provide two modules which are learning and game with four conditions: Forest, Cave, Ocean, Wetland

Name	Baby Panda: Care for Animals	Little Panda's Animal World	Extinct animals, endangered sp	Animal Rescue
Special Effect	Provide sound effect and visual effect		Provide visual effect while the user answers the question wrongly	Provide sound effect and visual effect
Character	Panda who acts as an animal keeper	Panda acts as a doctor.	Does not provide any character in the application	Provide monkey acts as a helper.
Number of animals	15	20	230	20
Conservation information	Do not provide the conservation information			Provide the conservation information
Feature	Collection book with animal stickers	Provide the coins to continue to the next game if the user failed all the chances	Collection book with animal stickers	

### 3. Methodology/Framework

In this project, the Multimedia Mobile Content Development (MMCD) approach is used. The subphase "update the structure" under the structural analysis stages in Figure 1(b) has been excluded from the MMCD for this project. This is because it is not scheduled for this project to be changed and moved to the application idea creation phase after finishing the second phase. Instead, when the navigation and object analysis phases are completed, the project will move on to the process design stage. Following that, each phase of the MMCD is explained in the subsections that follow. Figure 1(a) illustrates each stage of Multimedia Mobile Content Development (MMCD).

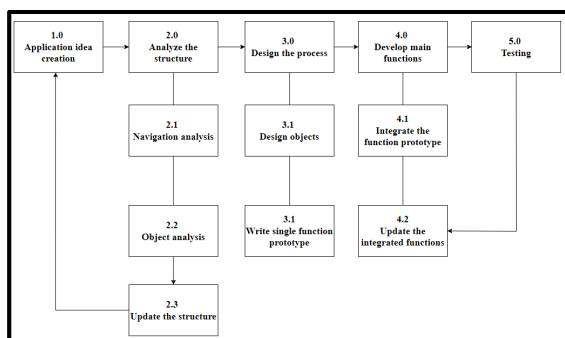


Figure 1(a): MMCD Methodology [19]

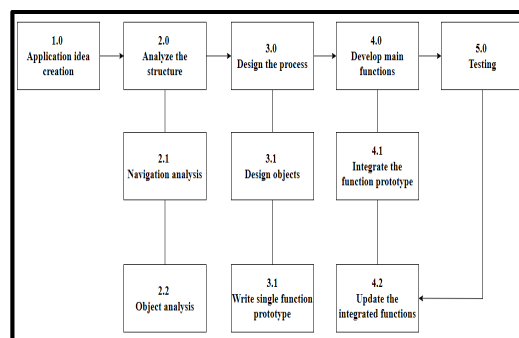


Figure 1(b): Modified MMCD Methodology

### 3.1 Application Idea Checklist

The first stage of the MMCD process is application concept generation. At this stage, the data required for the Animal Rescue's design and development is acquired. To identify user requirements, two strategies of information collection were applied. First, an interview with a Subject Matter Expert (SME) was done. Sylvia Anak Jarau is a teacher at the 3Q MRC Junior Sarikei. Appendix A has the transcript. Additionally, Google Forms is used to create and distribute several surveys to the target audience. Appendix B has a total of 20 responses from children aged 5 to 6 years collected with the assistance of their parents and SME. To summarize, 60% of respondents prefer to learn about animal conservation using mobile devices, 85% prefer to use pictures over text and 75% prefer to have an audio clip that pronounces the animals' names. Table 2 shows the results of the user analysis. The application idea creation checklist is shown in Table 3.

**Table 2: User Analysis**

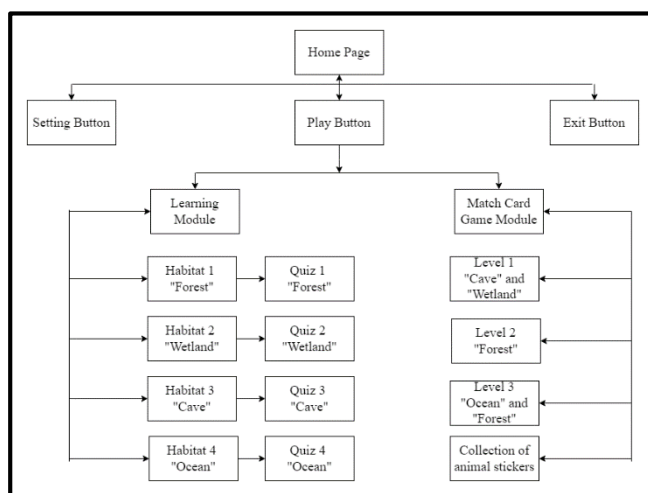
Stakeholder Category	Role in Application	Design Implication	Action Needed
Subject Matter Expert	Expert content consultant on a relevant topic	The user interface is simple but attractive.	<ul style="list-style-type: none"> <li>• Avoid complex interface and button design while including some colorful elements to attract children's attention.</li> </ul>
		Children-friendly learning	<ul style="list-style-type: none"> <li>• Use simple words and images for the learning module.</li> <li>• Use simple English as instruction.</li> <li>• Use gameplay that is easy to understand</li> </ul>
		Easy for navigation	<ul style="list-style-type: none"> <li>• Use icon-based for a better understanding of the function of the buttons.</li> <li>• Navigational structure of the application should be simple.</li> </ul>
General Users	Target users of the application	Usage of graphics	<ul style="list-style-type: none"> <li>• Provide a picture of the action to help explain the word.</li> </ul>
		Pronunciation of animal names	<ul style="list-style-type: none"> <li>• Provide a button to play the audio of the pronouns</li> </ul>

**Table 3: Application idea checklist**

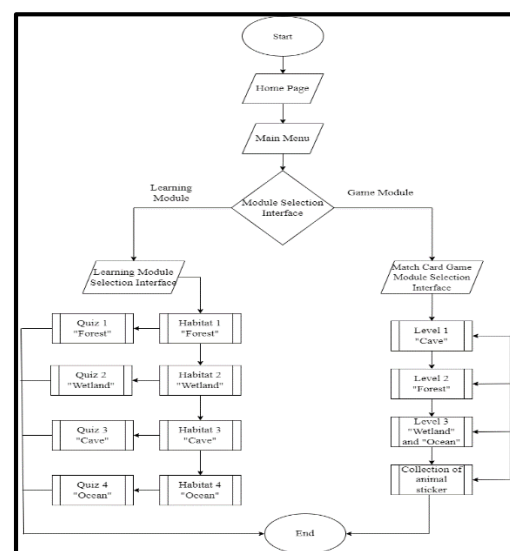
Item	Description
Type of application	Mobile application
Target device	Android-based smartphone
Target users	Children aged between 5 to 6 years old
Graphic User Interface (GUI)	Background of the main menu, learning module, and game module
Images	Icons, buttons, animals, animals' stickers, and backgrounds
Audio	Pronunciation of animals' names, and background music
Animation	Game module
Application synopsis	Animal Rescue is a mobile application in which users can learn the conservation information of the animals and recognize 20 types of animals that live in different types of habitats. The application provided audio and image to deliver the learning content.

### 3.2 Analyze the structure

The structure of the application to be created is studied in the second stage of the MMCD method. The object and navigation analysis are performed. The navigation structure is illustrated in Figure 2. Figure 3 displays the system flowcharts. Meanwhile, Appendix B contains the remaining flowcharts for the modules. Appendix C has a breakdown of the content structure. Tables 4 and 5 list the functional and non-functional criteria.



**Figure 2: Navigation Structure**



**Figure 3: System flowchart**

**Table 4: Functional requirements**

Functional Requirement	Explanation
User Interaction Friendly	<ul style="list-style-type: none"> <li>• The application should load and display the application's component on the screen.</li> <li>• The application should allow the user to navigate through the application's buttons.</li> </ul>
Provide Learning Module	<ul style="list-style-type: none"> <li>• The application should allow the user to acknowledge the name and image corresponding with the animals and their habitats.</li> <li>• The application should allow the user to recognize the pronunciation of the animals' names.</li> <li>• While the quiz is operating, the application should be able to show how many chances the user has left if they answer the question incorrectly.</li> <li>• The application should be able to indicate the remaining time for the user to answer all the questions while the quiz is operating.</li> <li>• The application should be able to generate the user's score for each successfully answered question while the quiz is still executing.</li> </ul>
Provide Learning Module	<ul style="list-style-type: none"> <li>• If the user answers all the questions within the time limit without using up all of the user's chances, the user will be sent to the quiz passed the screen.</li> <li>• If the user does not answer all the questions within the time limit or uses all of the user's chances, the user will be presented with the quiz failed screen.</li> </ul>
Autonomous Application Activities in Match Card Game Module	<ul style="list-style-type: none"> <li>• While playing the match card game, the application should be able to display the animation of the card flashing once the user clicks on it.</li> <li>• If the user successfully matches all the cards, the app should be able to display the level finished panel.</li> <li>• If the user fails to correctly match all the cards, the application should be able to display the level failed panel.</li> <li>• The application should be able to display the collection panel when the user has completed all the levels.</li> </ul>











**Table 5: Non-functional requirements**











Non-functional Requirement	Explanation
Performance	<ul style="list-style-type: none"> <li>The application should be able to run at the fastest and most efficient speed on the majority of Android devices that satisfy the application's requirements.</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>The application should be compatible with Android mobile devices running Android 4.1 or higher.</li> </ul>
Usability	<ul style="list-style-type: none"> <li>The application's buttons should be able to work properly by navigating the other interfaces after the user has clicked on it.</li> <li>The learning information should be delivered in simple English.</li> </ul>
Legal	<ul style="list-style-type: none"> <li>Users of the application can only see but not alter the information shown on the app's interfaces.</li> </ul>
Support for Graphical User Interfaces	<ul style="list-style-type: none"> <li>The application should enable all vital aspects, such as visuals, animations, music, and text, for varying sizes of display resolution on Android mobile.</li> </ul>

### 3.3 Design the process




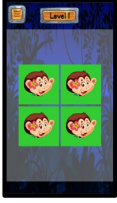
The third component of the MMCD technique involves process design. This stage's two subphases are object design and single-function prototype scripting. At the end of this stage, the prototype for the learning module and game module will be created. Authoring tools such as Adobe Photoshop and Canva are applied in this project to generate pictures, 2D animations, and storyboards. Meanwhile, Unity software is utilized to develop the scripting assets. Table 6 illustrates the button design, while Table 7 displays the interface design.

**Table 6: Button design**

Button	Description	Button	Description
	This is Start Button.		This is the Back Button.
	This is the Setting Button.		This is the Home Button.
	This is the Mute Button.		This is the Next Button.
	This is the Unmute Button.		This is the Narrator Button.
	This is the Close Button.		This is the Collection Button.

Button	Description	Button	Description
	This is the Info Button.		This is the Learn Button.
	This is the Yes Button.		This is the Game Button.
	This is the No Button.		This is the Level Selection Button.
	This is the Cave Button.		This is the Quiz Button.
	This is the Forest Button.		This is the Level Button.
	This is the Ocean Button.		This is the Wetland Button.

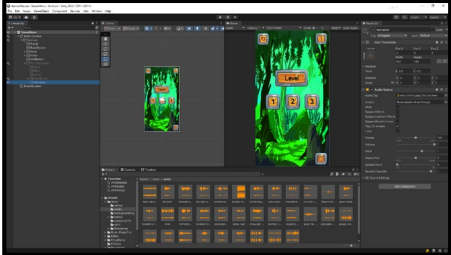
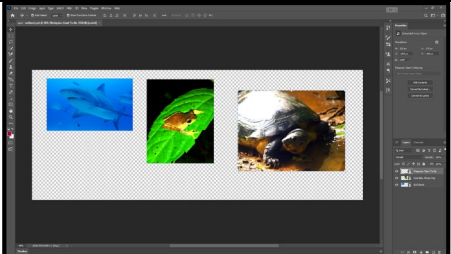
**Table 7: Interface design**

Interfaces	Description
	This is the startup interface of the proposed application. The user clicks the start button to go to the main menu.
	This is the main menu interface of the proposed application. The user clicks the learn button to go to the learning module while the game button goes to the game module.
	The learning module interfaces. There are four types of habitats. To listen to the audio, click on the narrator buttons next to the names of the animals.
	The game module interfaces. There are three levels in the game. As a reward for completing each level, users will receive an animal sticker.

### 3.4 Develop the Main Function

The key features of the suggested application are put into place at this phase. It required building application assets, integrating the assets into the application, and integrating application assets. Table 8 summarizes its components, which include audio recordings, and graphics.

**Table 8: Application assets development**

Assets	Development	Description
Audio		The audio files within the Animal Rescue application employ the Moving Picture Experts Group Layer-3 Audio (MP3) format, meticulously recorded by the author to guarantee the preservation of copyright protection.
Graphics		Adobe Photoshop is used to edit the components like buttons, photos, and application icons, while their backgrounds or illustrations are transparent.

The C# scripts are also created to enable the application's key features. Implementing a sceneries switcher, game manager, and quiz manager are some examples of such functionalities. In Table 9, those actions are described. The created application's interfaces are shown in Table 10 in the meanwhile.

**Table 9: Integration in Unity**

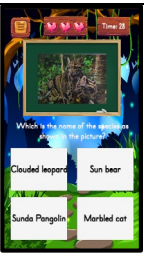

Functions	C# Scripts	Description
Quiz Manager (Learning module)	<pre> void SelectQuestion() {     if (currentQuestionIndex &gt;= shuffledQuestions.Count)     {         // No questions remaining, game over         gameStatus = GameStatus.Next;         quizUI.GameWinPanel.SetActive(true);         return;     }     selectedQuestion = shuffledQuestions[currentQuestionIndex];     currentQuestionIndex++;     quizUI.SetQuestion(selectedQuestion); }                 </pre> <pre> private void OnClick(Button btn) {     if(quizManager.GameStatus == GameStatus.Playing)     {         if (lanswered)         {             answered = true;             bool val = quizManager.Answer(btn.name);             if (val)             {                 btn.image.color = correctCol;             }             else             {                 btn.image.color = wrongCol;             }         }     } }                 </pre>	The next question in the quiz is chosen by the SelectQuestion method, which is also in charge of presenting it. By invoking this method, the code picks the next question, refreshes the UI, and goes through the quiz until there are no more questions left.. The OnClick method handles the button click event. It is triggered when an answer choice button in the quiz UI is pressed. It also changes the color of the button to indicate whether the selected response is accurate.

Functions	C# Scripts	Description
<p>Life system (Learning module)</p>	<pre data-bbox="379 241 807 736"> public void ReduceLife(int index) {     lifeImageList[index].color = darkCol; }  public bool Answer(string answered) {     bool correctAns = false;     if (answered == selectedQuestion.correctAns)     {         correctAns = true;         correctSound.Play();     }     else     {         lifeRemaining--;         wrongSound.Play();         quizUI.ReduceLife(lifeRemaining);     }     if (lifeRemaining == 0)     {         gameStatus = GameStatus.Next;         quizUI.GameOverPanel.SetActive(true);     } }                 </pre>	<p>Upon the selection of an erroneous answer by the player, the invocation of the ReduceLife method ensues. This method facilitates a reduction in the visibility of one of the life images by altering its color to a darker hue. The life system is involved in the Answer function in which the user answer incorrectly, it reduces the remaining lives. If there are no lives left, the game status is set to Next, and the game over panel is displayed.</p>
<p>Timer system (Learning module)</p>	<pre data-bbox="379 810 807 1079"> private void SetTimer(float value) {     TimeSpan time = TimeSpan.FromSeconds(value);     quizUI.TimerText.text = "Time: " + time.ToString("ss");      if (currentTime &lt;= 0)     {         gameStatus = GameStatus.Next;         quizUI.GameOverPanel.SetActive(true);     } }                 </pre>	<p>By employing the SetTimer method, the timer UI is dynamically updated according to the provided time value. Once the timer reaches zero, the game status transitions to "Next," triggering the display of the game over the panel. The system has applied in the Answer function as if the time reaches zero, the game status is set to Next, and the game over panel is displayed.</p>
<p>Game Manager (Game module)</p>	<pre data-bbox="379 1270 775 1635"> public void PickAPuzzle() {     string name =         UnityEngine.EventSystems.EventSystem.current.currentSelectedGameObjectName;     if(!firstGuess)     {         firstGuess = true;         firstGuessIndex = int.Parse             (UnityEngine.EventSystems.EventSystem.current.currentSelectedGameObjectName);         firstGuessPuzzle = gamePuzzles[firstGuessIndex].name;         btns[firstGuessIndex].image.sprite = gamePuzzles[firstGuessIndex];     }     else if(!secondGuess)     {         secondGuess = true;         secondGuessIndex = int.Parse             (UnityEngine.EventSystems.EventSystem.current.currentSelectedGameObjectName);         secondGuessPuzzle = gamePuzzles[secondGuessIndex].name;         btns[secondGuessIndex].image.sprite = gamePuzzles[secondGuessIndex];         StartCoroutine(CheckIfThePuzzlesMatch());     }     flipSound.Play(); }                 </pre>	<p>The script controls the gameplay logic for a puzzle-matching game, such as processing user input, searching for matches, and determining when the game is complete. The PickAPuzzle method is called as it requires storing the index and name, displays the sprite, and runs the CheckIfThePuzzlesMatch function again.</p>

Functions	C# Scripts	Description
	<pre>IEnumerator CheckIfThePuzzlesMatch() {     yield return new WaitForSeconds(1f);     if(firstGuessPuzzle == secondGuessPuzzle)     {         yield return new WaitForSeconds(.5f);          btns[firstGuessIndex].interactable = false;         btns[secondGuessIndex].interactable = false;          btns[firstGuessIndex].image.color = new Color(0, 0, 0, 0);         btns[secondGuessIndex].image.color = new Color(0, 0, 0, 0);          correctSound.Play();          CheckIfTheGameIsFinished();     }     else     {         btns[firstGuessIndex].image.sprite = bgImage;         btns[secondGuessIndex].image.sprite = bgImage;          wrongSound.Play();     }      yield return new WaitForSeconds(.5f);     firstGuess = secondGuess = false; }  void CheckIfTheGameIsFinished() {     countCorrectGuesses++;      if (countCorrectGuesses == gameGuesses)     {         Debug.Log("Game Finished");         GameWinPop.SetActive(true);         gamewin.Play();     } }</pre>	<p>Moreover, the coroutine <code>CheckIfThePuzzlesMatch</code> checks if the first and second guesses match. If they do, it disables the buttons, hides their sprites and checks to see if the game is done. If they do not match, the sprites are reset to the background picture and the guesses are reset after a wait. When every accurate match is made, the <code>CheckIfTheGameIsFinished</code> method is called. If it matches the total number of game guesses, it increases the <code>countCorrectGuesses</code> variable and activates a game win popup with a victory sound.</p>

**Table 10: Interfaces of the developed application**

Module	Interfaces	Module	Interfaces
Startup interface		Main Menu	
Learning menu		Game menu	
Learning module		Game module	

Module	Interfaces	Module	Interfaces
Quiz interface		Book sticker interface	

### 3.5 Testing

Two types of testing will be done in the final step of the MMCD methodology: functional testing as shown in Table 11 and user acceptability testing. If errors are found, the project will go back to the previous phase and update the combined functionality to fix the errors.

**Table 11: Functional Testing**

Test	Expected Result	Actual Result	Corrective Action
Back button	Navigate to the previous page	Works well as planned.	Not needed
Audio button	Play the audio	Works well as planned.	Not needed
Close button	Close the pop-up panel	Works well as planned.	Not needed
Retry button	Retry the quiz and game level	Works well as planned.	Not needed
Life system	Track the answer from the user and reduce the life when the answer is wrong	Works well as planned.	Not needed
Game Selection button	Return to game selection	Works well as planned.	Not needed

The results of the functional testing are shown in Table 11. The buttons in Animal Rescue functioned as expected, however, there was an issue in the quiz section. The problem is that the questions loop indefinitely until the time limit is arrived. The solution is to add a 'ShuffleQuestions' function to shuffle the questions while also stopping the looping and displaying the questions on the screen. Aside from that, the Fisher-Yates method was used by iterating from the last entry in the list to the first element using the while loop. Within the loop, it creates an inclusive random index k between 0 and n. The question at index k is then swapped with the question at number n, essentially rearranging their places in the list. The loop continues until it has iterated over all the entries in the list, resulting in a fully shuffled shuffledQuestions list. The Fisher-Yates algorithm is a well-known technique for rearranging elements in an array or list. It ensures that the distribution is uniform, and that each element has an equal chance of being in any place. The quiz game may present the questions in a random sequence by shuffling them, creating diversity, and avoiding predictability.

#### 4. Results and Discussion

This section presents statistics and analysis obtained from user acceptability testing. The purpose of the testing was to assess the level of acceptance among users towards the developed application. In this scenario, a set of questions was displayed on Google Form and delivered alongside the application's apk file to the target users. The questionnaire focused on evaluating three aspects: Learning Outcome Achievement, Application Functionality, and User Acceptance. A total of thirty responses were collected and subsequently analyzed.

Based on Figure 4(a), it was observed that 80% of the respondents agreed that the information provided in the learning module was understandable, while 10% of the respondents disagreed with this statement. Additionally, 10% of the respondents expressed uncertainty, as they found certain words in the application difficult to comprehend due to unfamiliarity. Furthermore, approximately 83.30% of the respondents agreed that the learning module facilitated the correct pronunciation of animal names, while 10% remained unsure, and 6.7% disagreed. The longer length of certain animal names was cited as the reason for the difficulty in learning. In terms of the quiz section, around 76.7% of users agreed that they could understand the information presented, while 13.3% were uncertain, and 10% disagreed. The difficulty stemmed from the challenging words presented as options, which made it hard for the target users to select the correct answers. For the fourth statement, 76.7% of the respondents agreed, 13.3% disagreed, and 10% were uncertain. This was attributed to the difficulty children faced in memorizing the words used in the quiz and applying the methods in their daily lives.

Regarding functionality analysis based on Figure 4(b), approximately 83.3% of respondents agreed that the text, images, and audio in the application were clear, while 10% disagreed, and 6.7% were unsure. Lengthy audio content posed challenges in understanding. Furthermore, 83.3% of respondents found the application easy to use, while 10% disagreed, and 6.7% remained uncertain. The difficulty of the game completion was cited as a reason for disagreement. In relation to the last statement in this section, 90% of respondents agreed that the buttons were user-friendly, 6.7% were uncertain, and only 3.3% disagreed. Uncertainty arose from the lack of clarity regarding the destination of the "done" button when clicked.

Regarding user acceptance analysis based on Figure 4(c), approximately 80% of respondents found the application fascinating and visually engaging, while 16.7% disagreed, and only 3.3% were uncertain. The lack of interesting elements was identified as the reason for disagreement. Additionally, around 86.7% of respondents accepted the match-card game and the learning module, while 10% could not accept them, and only 3.3% remained unsure. The game was perceived as highly challenging by the respondents. Lastly, approximately 76.7% of respondents expressed willingness to recommend the application to family members and friends, while 16.7% disagreed, and only 6.7% were uncertain. The inability of some family members to understand English was cited as a reason for disagreement.

In conclusion, most respondents were able to learn about conservation knowledge from the Animal Rescue application and implement the acquired knowledge in their daily lives. The application was generally accepted by the target users as a means of engaging and learning about animals and their protection.

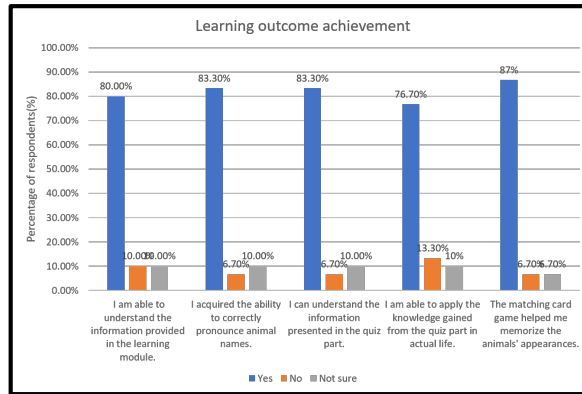


Figure 4(a): Analysis of learning outcome achievement

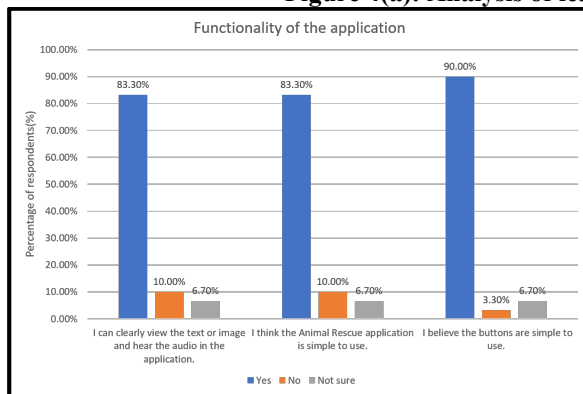


Figure 4(b): Analysis of functionality of Animal Rescue

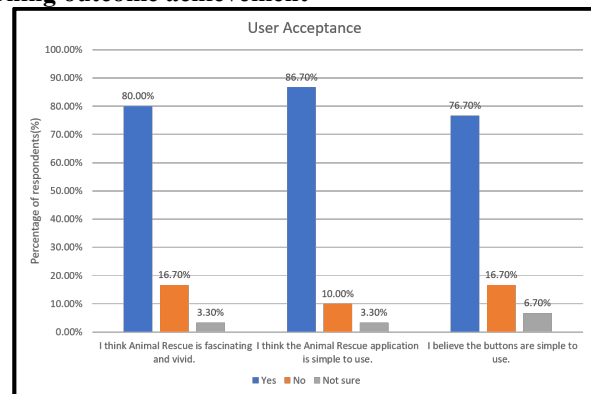


Figure 4(c): Analysis of user acceptance

## 5. Conclusion

Based on the analysis of the testing phase results, it has been determined that the Animal Rescue application is suitable for the target users to learn about conservation knowledge. The project's three objectives were successfully achieved. Firstly, a match card memory game was implemented to enhance the gamification aspect. Secondly, the application was developed using Android technology and the Unity game engine. Lastly, functional and user acceptance testing were conducted following the completion of the development phase. The project adhered to the Multimedia Mobile Content Development (MMCD) methodology, ensuring timely completion. The advantages and limitations of the Animal Rescue application are summarized in Table 12. In terms of future work, it is recommended to include all endangered animals in the Learning module and expand the quiz section with additional question sets. Furthermore, the application should incorporate Chinese, Tamil, and Malay languages.

Table 12: Advantages and limitations of the Animal Rescue application

Advantages	Limitations
<ul style="list-style-type: none"> <li>• Provide conservation knowledge for the target user to learn and practice</li> <li>• Provide pronunciation audio for the target user to learn</li> <li>• Provide match card memory game to train the memory skill of the target user</li> </ul>	<ul style="list-style-type: none"> <li>• Does not include all the endangered animals</li> <li>• Does not provide multiple languages</li> <li>• Provide a list of words or terms that may be difficult for the intended user to understand.</li> </ul>

## Acknowledgment

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

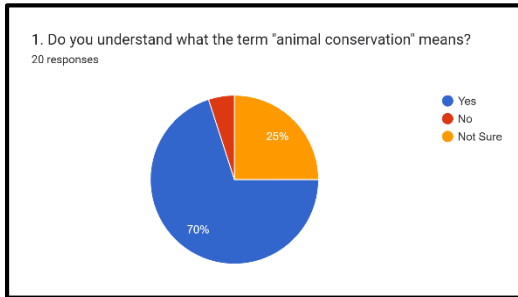
## Appendix A

**Table 13: Transcripts of the user analysis**

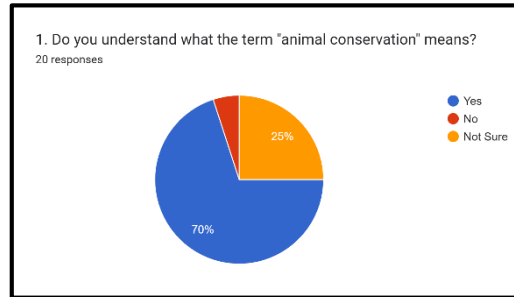
Lok Yi	:	Good morning! Madam, my name is Chan Lok Yi and I am a UTHM degree student. I am now working on my final year project. In this assignment, I need to create a gamified mobile learning application for animal conservation. I am here to invite you to take part in this interview session so that we can finish this project. Could you kindly introduce yourself before we begin?
Sylvia	:	Good morning. My name is Sylvia Anak Jarau, and I teach at 3Q MRC Junior Sarikei in Sarawak.
Lok Yi	:	I appreciate the introduction from Madam. I am curious if kindergarten students have learned about any animals in their textbooks.
Sylvia	:	Yes, kids have learned about animals, but they have learned about domesticated animals like cats, dogs, and ducks. However, the youngsters learned very little about wild animals from their textbooks.
Lok Yi	:	Okay. Do the youngsters understand why the number of animals is decreasing?
Sylvia	:	The children have not been taught about this. They must first learn before going on a zoo visitation program. However, the younger children are unable to participate in such activities because they are unable to follow the teachers' instructions.
Lok Yi	:	Really. Is it appropriate for younger children to be exposed to animal conservation knowledge via a mobile device application?
Sylvia	:	Yes.
Lok Yi	:	For the requirement, what is your view on the application's design and how it should look?
Sylvia	:	The application, in my opinion, should be in accordance with the concept, and another important element is the text, which should begin with capital letters and should apply to the names of the animals.
Lok Yi	:	Understandable. Are there any concerns about the features and navigation of this mobile application?
Sylvia	:	It is critical that the applications are simple to use. Therefore, I advise adding significant buttons to the application so users can use it only by clicking. The button is better created with an icon so that youngsters can understand how the buttons operate.
Lok Yi	:	Are there any suggestions about the contents of the learning modules?
Sylvia	:	Since the youngsters only learned basic English vocabulary, try to avoid using difficult vocabulary in the contents and instead use pictures to explain the word.
Lok Yi	:	I understand what you meant. Do you consider that adding gamification to the application is effective?
Sylvia	:	Of course. Children prefer to play games over learning.
Lok Yi	:	Great. Do you think it is effective to add a match card memory game to the game module while adding a quiz with multiple choice questions to the learning module?
Sylvia	:	Absolutely. However, the game must be simple for youngsters to play.
Lok Yi	:	Good, Madam. I will try to improve it. Do you have something to add?
Sylvia	:	That is basically everything that I have to say.
Lok Yi	:	Thank you for your time, Madam. I believe we can call the interview to an end.

## Appendix B

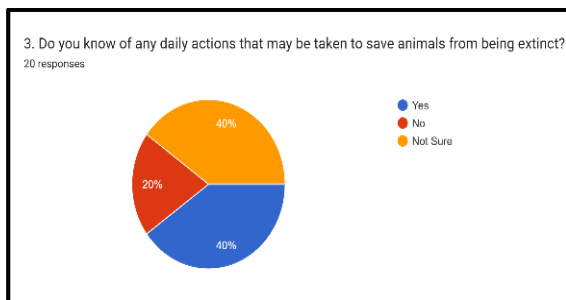
This section displays the findings of the questionnaires used for user analysis. Twenty feedbacks are gathered from individuals aged three to five years old. Figures 4(a) and 4(b) illustrate the highlighted concerns.



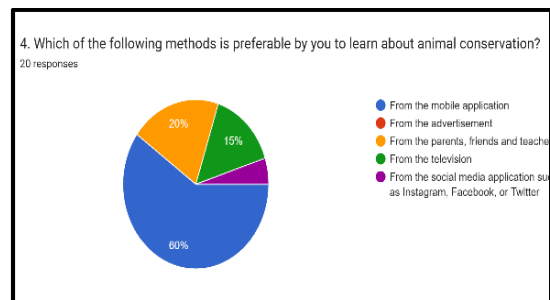
**Figure 5(a): User Experience**



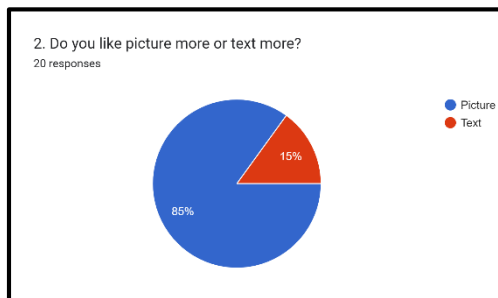
**Figure 5(b): User Experience**



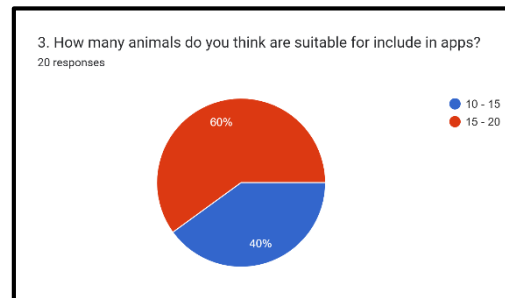
**Figure 5(c): User Experience**



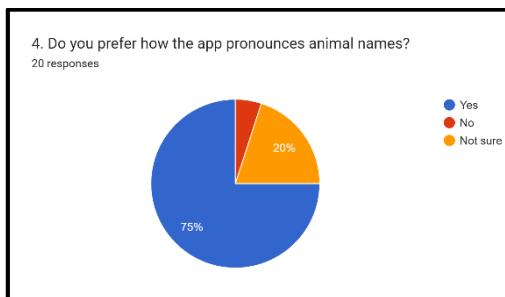
**Figure 5(d): User Experience**



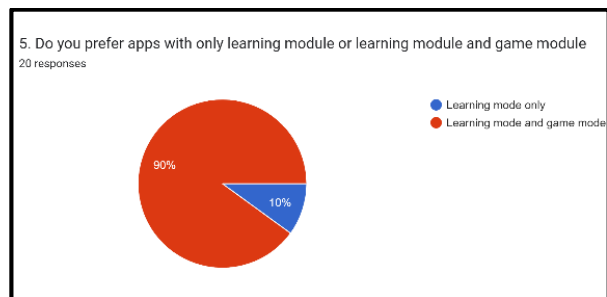
**Figure 5(e): Preferable analysis**



**Figure 5(f): Preferable analysis**



**Figure 5(g): Preferable analysis**



**Figure 5(h): Preferable analysis**

## Appendix C

This section presents the content structure mentioned in Section 3.2.

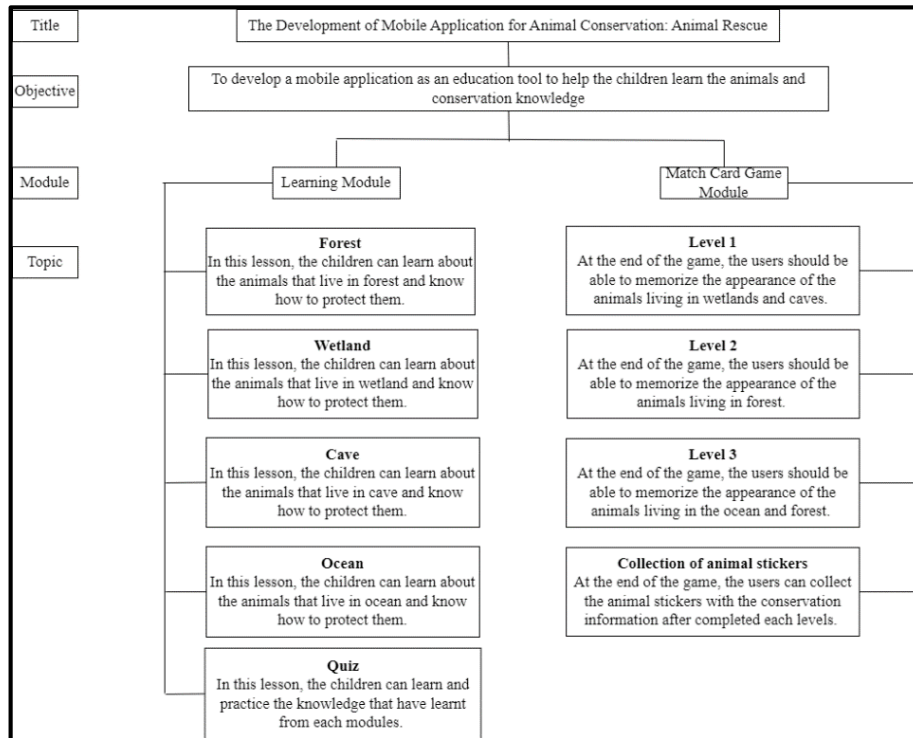


Figure 6: Content Structure

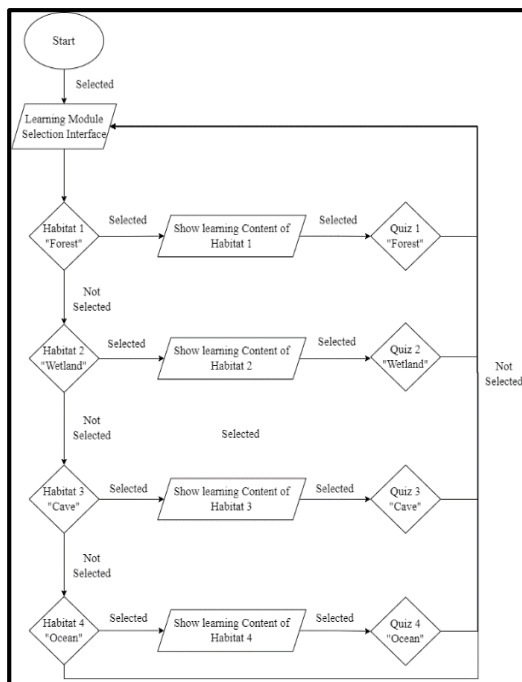


Figure 7(a): Flowchart of learning for Animal Rescue

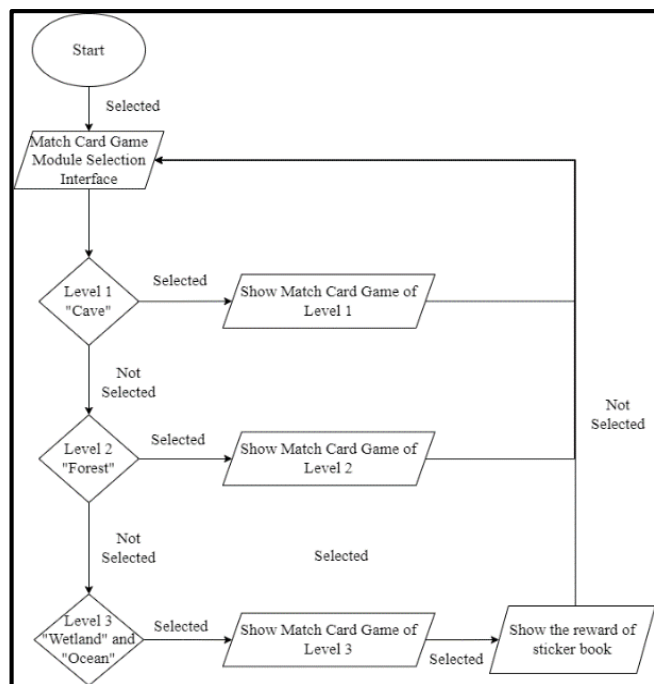


Figure 7(b): Flowchart of game module for Animal Rescue

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