



Manabu! Hiragana: A Japanese Hiragana Mobile Learning Application

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Abstract: Japanese language is the thirteenth most spoken language in the world. Due to the need for education, Japanese has become more popular and important. To learn the Japanese language, Hiragana is the most fundamental writing system and first to learn. However, there are many similar Hiragana learning software on the market, but each has its own characteristics and disadvantages. Therefore, this project aims to implement an interactive basic Hiragana mobile learning application for children based on a gamification approach and developed in Android platform by using Multimedia Mobile Content Development (MMCD) methodology. Utilizing the System Usability Scale (SUS), satisfactory results were obtained throughout the user acceptance and functionality testing, with a positive feedback of 90%. In short, it can be concluded that Manabu! Hiragana is suitable for learning Hiragana.

Keywords: Hiragana, Mobile learning application, MMCD

1. Introduction

The Japanese language is the thirteenth most spoken language in the world, with 126 million people speaking it as their native language in only two countries [1]. Japan towns can also be found in a number of countries. Therefore, there is no denying that Japanese culture is getting more and more expansion, and is also receiving attention from various cities. It is not easy to learn Japanese, as the pattern of the letter is different from the alphabet. There are four writing systems in Japanese which are Hiragana, Romanji, Kanji, and Katakana. Hiragana is the most basic writing system that can be used to communicate all Japanese words because there is a one-to-one correspondence between character and pronunciation in Hiragana, therefore predicting word pronunciation from spelling is simple.

On the other hand, there are plenty of Japanese learning applications that have been developed in the market today. Each application has its own strengths and features. However, weaknesses such as subscriptions for full tutorials, limited content and lack of interactive elements should not be ignored. Therefore, this project aims to develop an interactive offline Hiragana mobile learning application

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based on gamification approach by using Multimedia Mobile Content Development(MMCD) methodology. Multimedia elements are used to present the information in different ways which improve children's learning efficiency.

The objective of this project is to design Manabu! Hiragana mobile learning for Android that adopts the VARK model, to develop it by implementing gamification approach and to perform functional user acceptance testing to the target users. This project is an interactive mobile application for children seven to nine years old by using Unity3D as the domain software. There are five modules which are the Write module, Learn module, Quiz module, Game module, and References module. The application has several features including writing, clicking, and drag and drop function to better support the activity between user and the application. A functionality testing on the overall performance of the application has been performed with the target user, after the application is completed.

Next, this paper discusses the related work by explaining the domain study and reviewing similar existing applications, the methodology used to develop the application, the result and discussion, and the conclusion.

2. Related Work

The domain study of the project and reviewed similar existing applications will be discussed in this section.

2.1 VARK model

The VARK stands for visual, aural, read/write, and kinesthetic sensory[2], and it also represents the four main types of learner with each of these characteristics. A great teaching style presented that matches the learners' learning preferences will boost their learning efficiency. First of all, the visual learner will perform best when given visual media to understand a concept. These visual media may include charts, graphs, diagrams, illustrations, videos and also symbols. The symbols can be lines, arrows, or shapes presented for them to visualize the information. Next, the auditory learner will do their best when learning from audio sources, or reading out loud to help them in memorizing the information. In addition, for the reading and writing learners, this type of learner prefers information displayed in texts or words. They can do better by reading through text resources, and rewrite or jotting down the information. Lastly, the kinesthetic learners prefer to learn through physical movement or hand-on experience during activities. Therefore, the VARK model embedded in the application provides children with four different learning styles, which is vital to reinforcing their learning weaknesses and balance all aspects of their learning styles.

2.2 Mobile technology

Mobile technology such as the smartphone, tablets, and laptops have become a necessity in people's daily life. The users of mobile technology have been increasing in recent years [3]. Almost everyone owns a smartphone or mobile gadget these days, and even children have their mobile technology for education purposes. Undeniably, mobile technology allows the user to learn and other educational content anywhere and anytime, eliminating any geographical constraints and giving students more freedom [4]. Mobile technology is expanding rapidly, it has been improved from a simple communication device into a multi-tasking device which is able to video-conferencing, gaming, messaging etc. Thus it can be seen that the mobile technology is diverse these days, this is because of the introduction of various operating systems for mobile gadgets. Android is one of the operating systems that is generally designed for the smart device (touchscreen mobile device) and developed by Google [5]. Also, the Android system is the most used operating system nowadays, as it is open source and accessible to everyone[5]. It is also foreseeable that mobile learning systems based on Android technology will occupy a dominant position in the field of mobile learning, due to the

presence of rich and attractive multimedia elements, such as audio, video, and animation [6]. Therefore, the application of mobile learning in children's education will make a great contribution to the cultivation of children's personality, behavior and learning interest [7].

2.3 Review of three existing application

The reviewed existing similar Hiragana learning application will be discussed in this section. Applications such as Hiragana Pro, Fun! Hiragana, and Simple Hiragana have been competitively analyzed and compared with the proposed applications in tabular form, as shown in Table 1.

Table 1: Comparison of related application

Application	Hiragana Pro [8]	Fun! Hiragana [9]	Simple Hiragana [10]	Manabu! Hiragana
Platform	Mobile android based	Mobile android and IOS based	Mobile android based	Mobile android based
Subscription	RM20.73	RM13.99	Free	Free
Number of module	Two	Two	Three	Four
Learning Module	Do not provide learning module	Learning module provided	Do not provide learning module	Learning module provided
Writing Module	Do not provide writing module	Learn the stroke order of letters from stroke to stroke	Learn by viewing at the image guides	Learn by viewing at the image and video guides
Quiz Module	Repeated multiple choice and typing quiz provided	No not provide quiz module	True false quiz provided	Multiple choice and typing quiz provided
Game Module	Do not provide game module	Dot-to-dot, catches letters, collects letters, and hide and seek game provided.	Do not provide game module	Collects letters and finds the object game.
Reference Module	Hiragana Charts with pronunciation are provided	Do not provide any chart for references	Hiragana Charts without pronunciation are provided	Hiragana Charts with pronunciation are provided
Content	46 Hiragana letters	20 out of 46 Hiragana letters and nouns are offered	46 Hiragana letters	46 Hiragana letters, greetings, numbers, body parts, and family members are provided.
VARK model	Visual, Auditory, and Read.	Visual, Auditory, Read/Write and Kinesthetic.	Visual and Read.	Visual, Auditory, Read/Write and Kinesthetic.
Navigation	Do not provide return button or home button	Do not provide return button or home button	Do not provide return button or home button	Provides return button and home button

Based on Table 1, Fun! Hiragana application is available on both Android and IOS platform while the others are only available in Android platform. For the application with subscription plan to access the full learning content which might interrupt the user's learning interest, thus a free application is proposed and developed that covers 46 Hiragana letters and which provides additional vocabulary. Additionally, the VARK model is used in the application to assist the learner while learning through

the application. In short, there are some improvements made to the proposed application to produce a more efficient and usable application for the user to learn the Hiragana.

3. Methodology

A methodology is a formal procedure approach towards the solution of a system problem. It outlines the steps to be followed in order to implement a complete system. Multimedia Mobile Content Development (MMCD) is chosen and applied to develop the project.

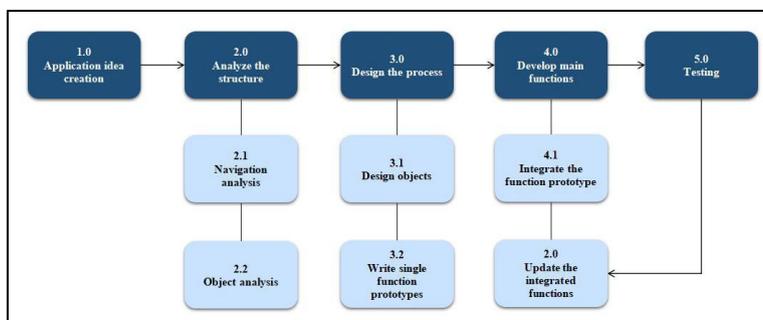


Figure 1 : Multimedia Mobile Content Development Model [11]

This framework is developed based on the Flash Light technique [11]. According to Figure 1, the MMCD framework is mainly to control the navigation, manage the contents and application logic in the early stage, which is suitable for multimedia mobile learning application development to keep track of the activities in application development and minimize the problem occurring during the process.

3.1 Application Idea Creation Checklist

This is the first phase of the MMCD framework, a process to figure out the project idea and produce a proposal including the introduction, objective, scope, expectations, and target user for the project. This is to ensure that the developer has a clear goal and direction towards the project. Table 2 shows the checklist for the idea creation of the project.

Table 2: Application idea creation checklist

Item	Note
Type of application	Mobile learning application
Target device	Android based
Target users	7 to 9 years old children
GUI	Background(main menu, write module, learn module, quiz module, and reference module)
Image	Icons, images in the write module, learn module, quiz module and reference module.
Animation	Intro video, game object and timer
Audio	Pronunciation, background music, narration and sound effects
Application synopsis	Manabu! Hiragana is a Japanese language mobile learning application. Some modules will be designed to enforce the user recognition on the hiragana, and simple greetings and nouns will be provided to enhance user knowledge of Japanese.

The items required to be considered before developing the project are tabulated to ensure that the developer has a direction when preparing the material in the early stage, and able to focus on the implementation phase once the design phase is complete.

3.2 Structure analysis stage

This is the second phase of the MMCD framework. Design structure such as navigation between the interfaces and each object, objects used in each scene, flowchart and content structure are main components to be analyzed in this phase. Content structure checklist is designed which consists of layer design, frame design, navigation, GUI, audio, video, script and storyboard, as shown in Table 3.

Table 3: Content structure checklist

Item	Note
Layers design	<ul style="list-style-type: none"> • Layer 3: Scripts • Layer 2: Content (Texts and objects) • Layer 1: Background images
Scene design	<ul style="list-style-type: none"> • Scene 1: Main Menu • Scene 2: Writing topic list • Scene 3: Writing info • Scene 4: Learning topic list • Scene 5: Learning greeting info • Scene 6: Learning number info • Scene 7: Learning body info • Scene 8: Learning family info • Scene 9: Multiple quiz • Scene 10: Typing quiz • Scene 11: Find object game • Scene 12: Collect items game • Scene 13: Reference info
Menu and Navigation	<ul style="list-style-type: none"> • Button navigation
Number of main GUI	<ul style="list-style-type: none"> • Application logo • Hiragana stroke order (46 letters) • Greeting learning (8 letters) • Body parts learning (7 letters) • Numbers learning (10 letters) • Family member learning (8 letters) • Quiz (2 types of quiz) • Game (2 types of games) • Reference (3 charts)
Sub GUI	none
Images	<ul style="list-style-type: none"> • Background images (jpg or png) • Learning info images (jpg or png)
Placing audio	<ul style="list-style-type: none"> • Pronunciation • Background music • Narration • Button sound effects
Placing video	Hiragana stroke order video (46 letters)
C# script Draft	SceneManager.LoadScene(sceneIndex); to redirect to another scene

Moreover, this phase considers the navigation structure, which illustrates the navigation between the scenes as shown in Figure 2. Also, storyboards are created in this phase to demonstrate the idea of interface design of the application. In addition, for the design of content structure for the application as shown in Figure 3, an interview session was conducted with Puan Siti Hajah Binti Bidin, a Japanese language lecturer who teaches in University Tun Hussien Onn (UTHM), who is also the Subject Matter Expert for the project, to gather the information and user requirement for the project design.

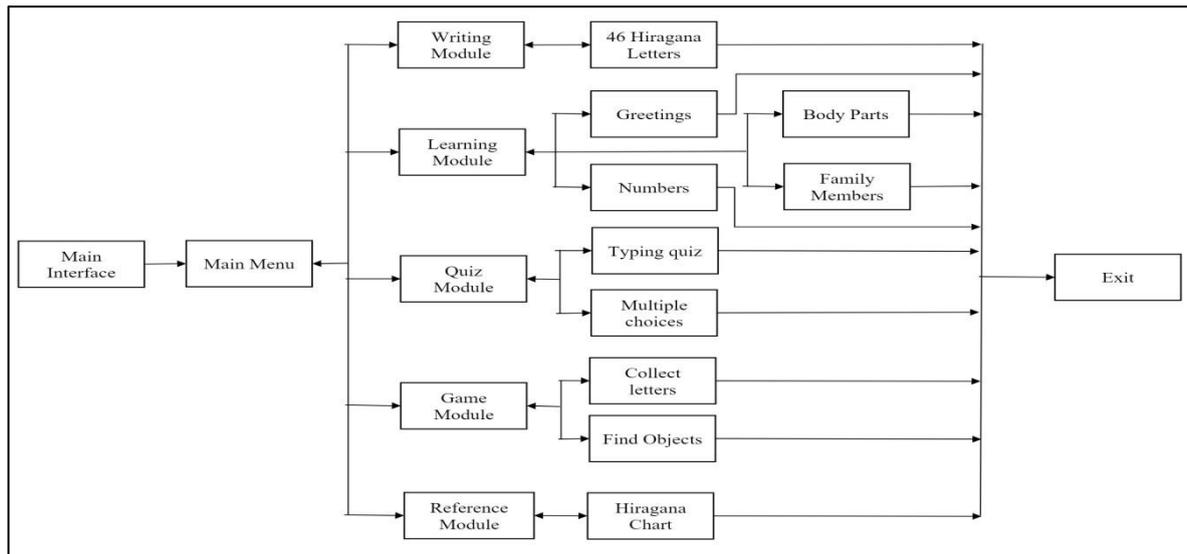


Figure 2 : Navigation Structure

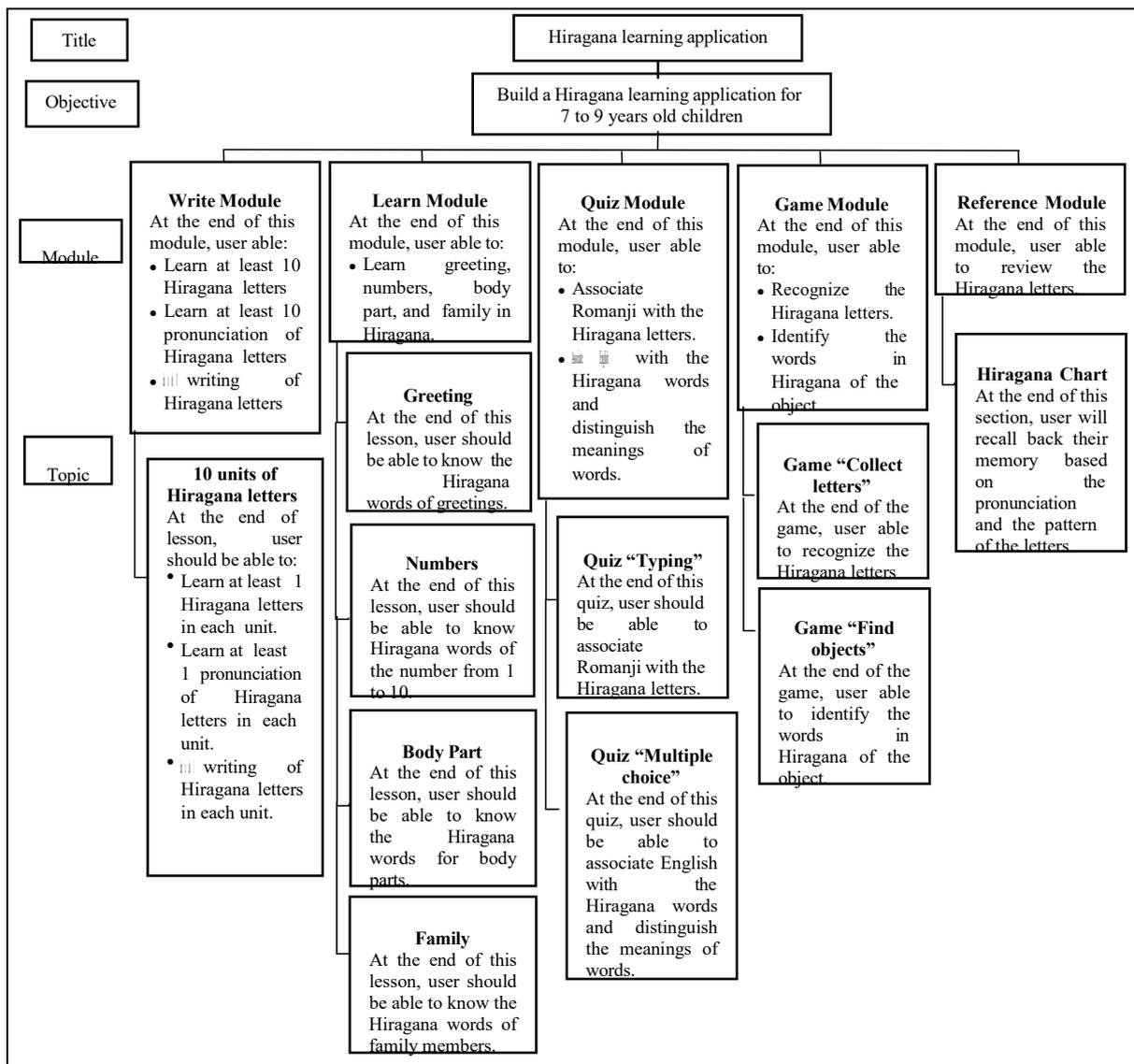


Figure 3 : Content Structure

Besides, other components need to be considered in this phase, such as functional and non-functional requirements of the application that have been tabulated in Table 4 and 5, and the hardware and software requirement for application development as shown in Table 6 and 7.

Table 4: Functional requirement

Functional requirement	Description
Operation	<ul style="list-style-type: none"> • If users completed a writing unit, the application shall be able to unlock the next unit. • If the time is reached in find object game, the application shall be able to activate the tips function. • If users answered a quiz question correctly, the application shall be able to add the mark.
User Interaction	<ul style="list-style-type: none"> • If users press the play button, the application shall provide the user with the ability to play video. • If users drag the object, the application shall enable the object to move. • If users answered a quiz question, the application shall be able to display the next question. • If users press the eraser button in the writing module, the application shall be able to clear all the writing. • If users press the navigation buttons, the application shall provide the user with the ability to navigate through the application. • If users swipe on the writing module, the application shall be able to show the writing. • If users press the sound button, the application shall provide the user with the ability to pronounce the letters.

Table 5: Non-functional requirement

Non-Functional requirement	Description
Availability	<ul style="list-style-type: none"> • The application shall be able to access anytime after installed the application
Usability	<ul style="list-style-type: none"> • The application of the button size is easy to tap • The user should be able to reach their desired page within three clicks.
Operational	<ul style="list-style-type: none"> • The application shall be able to operate on android devices. • The application shall operate offline.
Performance	<ul style="list-style-type: none"> • The response time of the button should not be more than 2 seconds.
Culture	<ul style="list-style-type: none"> • The application uses the English language as the base language and Hiragana as learning content.
Legal	<ul style="list-style-type: none"> • The application shall not allow the user to modify the information of the application.

Table 6: Hardware requirement

Hardware	Requirement
Processor	Intel(R) Core(TM) i5-9300H CPU @ 2.40GHz 2.40 GHz
RAM	12GB RAM DDR4
Operating system	Windows 7 (SP1+) and Windows 10, 64-bit versions only.
System Type	64-bit Operating System
Graphic card	GeForce® GTX 1660Ti

Table 7: Software requirement

Software	Purpose
Unity 2020.3.6f1	Used to integrate the assets such as UI buttons, sprite, and canvas to create the interface of the application and run the application..
Microsoft Visual Studio 2019	Used to write C# scripts for the application.
Adobe Photoshop CC 2019	Used to create and edit the assets.
Adobe Premiere-Pro	Used to edit the audio clip recorded and create launching scene.

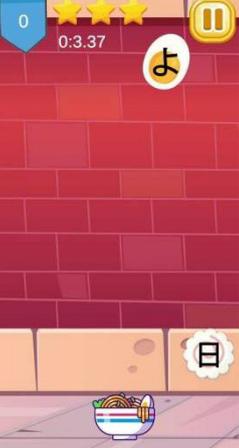
3.3 Process design stage

Design the process is the third phase in this framework. In this phase, two components are discussed which are the design object and the scripting of each function. The object design is the creation of the GUI such as the interface of the application, and buttons, as shown in Table 8. The scripting for single-function prototypes is important such as writing the instructions for each button and scene that needed to be executed. To execute this phase, the material and objects required such as the items listed in Table 3 should be prepared. Adobe Photoshop software is used to design the objects and images used, including the charts in the reference module, the buttons style for each scene, and the images required in the learning module.

Table 8: Main interface of the application

Object	Design		
Buttons			
Interface	<p>Main Menu</p>	<p>Write Menu interface</p>	<p>Learn Interface</p>
Description	<ul style="list-style-type: none"> Consist of four main buttons that navigate users to Write Module, Learn Module, Quiz Module, Game Module, and Reference Module. Setting button, Exit button, and Card button is provided. 	<ul style="list-style-type: none"> A list of buttons provided that navigate users to the corresponding unit. Only the yellow button is activated and clickable. 	<ul style="list-style-type: none"> Three writing systems are provided which are Hiragana, Romanji, and English. Speaker button allows the user to listen to the pronunciation of the letter.

Table 8: (continued)

Object Interface	Design		
 <p data-bbox="448 719 679 752">Reference interface</p>	 <p data-bbox="448 719 783 752">Card interface</p>	 <p data-bbox="783 719 1406 752">Game Menu Interface</p>	
<p data-bbox="217 775 352 808">Description</p> <ul data-bbox="400 775 711 976" style="list-style-type: none"> • Pronunciation of the characters provided. • Light bulb button will show the information about the characters shown on screen. 	<ul data-bbox="759 775 1070 999" style="list-style-type: none"> • Users can press on these unlocked buttons to view the flash card of the object. • Light bulb button will show the tips to the user. 	<ul data-bbox="1118 775 1398 976" style="list-style-type: none"> • There are two games provided in Game Module, such as Collect Letter, and Find Object game. 	
<p data-bbox="233 1021 336 1055">Interface</p>  <p data-bbox="440 1514 695 1547">Multiple Choice Quiz</p>	 <p data-bbox="448 1514 783 1547">Collect Letter Game</p>	 <p data-bbox="783 1514 1406 1547">Write-Unit 1</p>	
<p data-bbox="217 1581 352 1615">Description</p> <ul data-bbox="400 1581 711 1917" style="list-style-type: none"> • In this page, users need to choose the correct answer based on the question given in English. • There will be marks incremented if the answer is correct, otherwise marks will not be given. 	<ul data-bbox="759 1581 1070 1939" style="list-style-type: none"> • In this game, users need to collect the Hiragana letter that falls from the top of the screen. • The ramen object can be dragged horizontally to collide with the Hiragana objects to get 2 marks for each. 	<ul data-bbox="1118 1581 1398 1984" style="list-style-type: none"> • Users can write the letter by tracing on the screen. • Eraser button will clear all the writing of the user. • Audio and video is provided to assist user learning 	

3.4 Develop main functions

Developing the main function process is about the writing scripting of the main function, to make the application functional. There are three main functions implemented in this application which are tracing feature, clicking based feature, and dragging feature. These features are planned to be implemented in the modules of the application to support the VARK learning model. For example, the tracing feature implemented in the write module allows the user to have a writing practice on the Hiragana words, which also achieves and supports the reading and writing learning style. The clicking-based feature is implemented in each of the modules which allow the user to interact with the buttons to perform specific action by executing certain scripts behind the buttons, such as switching the learning content, or pronunciation, which can also support learners of both visual and auditory learning style. Also, the dragging feature which is implemented in the collect letters game section, allows the user to drag the object and collect the correct letters by performing kinesthetic activity.

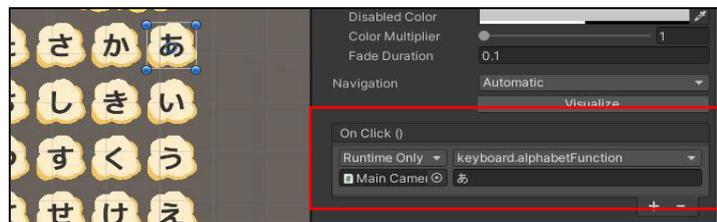


Figure 4 : Clickable object invokes function

The clicking based function is implemented in all the buttons of the application, to perform tasks once it is clicked. Based on Figure 4, the clicking function is attached to the keyboard button which allows the user to insert or input a letter once the corresponding button is clicked.

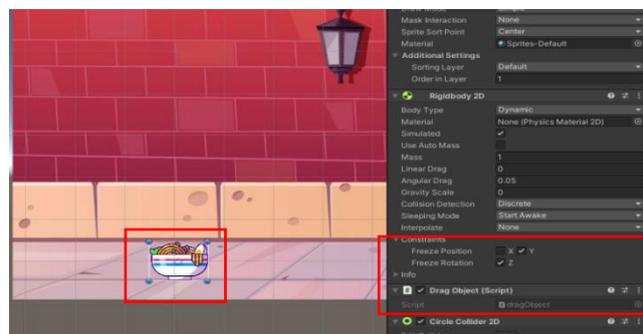


Figure 5 : Drag feature in the collect letters game module

Based on Figure 5, the dragging feature is attached to the ramen object, which allow the object draggable and moveable horizontally to collect the falling object.



Figure 6 : Writing features in write module

Based on Figure 6, the writing feature is implemented in the write module. Users are allowed to trace on the screen of the application to learn and write the letter.

3.5 Testing

The functional tests are carried out in which the complete script for main functions is run to test the functional performance of the application. Errors will be fixed, if there are any errors or bugs involved in the application. In addition, a beta test will be carried out by distributing a Google form to 15 users from 7 to 9 years old children who have learned Hiragana language, to test the user acceptance on effectiveness and performance of the Manabu! Hiragana application.

3.5.1 Alpha testing

In alpha testing, functional testing is performed to test the functionality of the application and whether the button of the application is working. This is carried out throughout the development process until the project is completed. A functional testing result shown in Table 9 is created to check if the function of each button works, if there is any error or unable to perform the task, it will be discovered during this testing process, and the debug or improvement will be done to solve the problem and ensure the button functions as intended.

Table 9: Result table of Functional Testing

Test	Expected Result	Actual Result	Corrective Action
Write Button	Navigates to Write Menu	Works well as expected	Not needed.
Unit Buttons	Navigates to corresponding unit	Works well as expected.	Not needed.
Learn Button	Navigates to Learn Module	Works well as expected.	Not needed.
Quiz Button	Navigates to Quiz Module	Works well as expected.	Not needed.
Game Button	Navigates to Game Module	Works well as expected.	Not needed.
Reference Button	Navigates to Quiz Module	Works well as expected	Not needed.
Card Button	Navigates to Card Module	Works well as expected	Not needed.
Setting Button	Shows setting panel when clicked.	Works well as expected.	Not needed.
Reset Button	Clear all the write module progress	The module is not reset at once.	Make sure the module is reset at once.
Exit Button	Shows exit confirmation panel when clicked	Works well as expected.	Not needed.
Clear Writing Button	Clears all writing.	Works well as expected.	Not needed.
Pause Button	Shows pause panel and stops the counting time when clicked.	The time is still moving after button is clicked	Setting the game time scale to zero.
Tips Button	Shows tip panel when clicked.	Works well as expected.	Not needed.
Audio Button	Plays associated audio clips when clicked.	Works well as expected.	Not needed.
Video Button	Plays associated video clips when clicked.	Works well as expected.	Not needed.
Start Game Button	Invoke time countdown script to start the game.	Works well as expected.	Not needed.

4. Results and Discussion

In this section, the application is fully completed and prepared for user testing. The beta testing result of the application is collected and analyzed from the target user and will be discussed as follows.

4.1 Beta testing

In beta testing, the user acceptance test will be performed by involving the targeted user. System Usability Scale (SUS) is adopted to measure user acceptance and usability towards the application. There are 15 targeted users who have or possess the knowledge of the Hiragana language involved in this testing to obtain their acceptance level towards the application. The acceptance level of the user toward the application is collected by distributing a set of the questionnaire in Google form. The questionnaire covers three sections, which are the demographic, learning outcome acquisition, and user acceptance level. Figure 7 shows the gender analysis of the respondent.

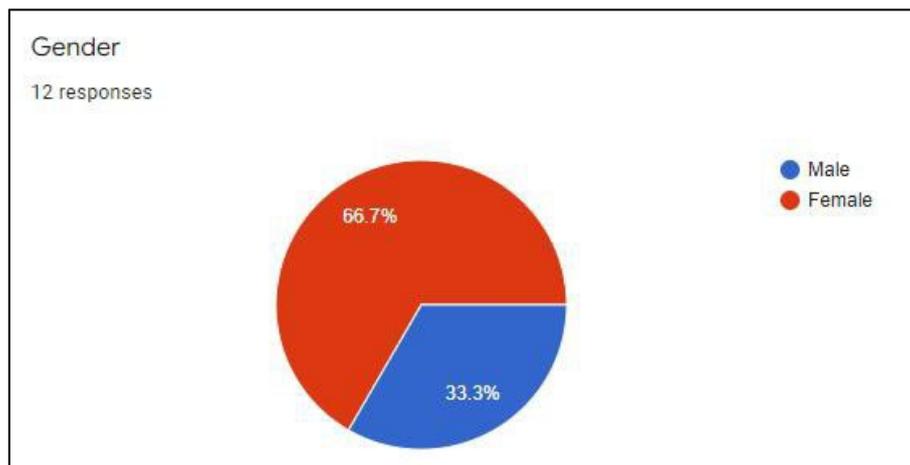


Figure 7 : Gender analysis of respondent

As shown in Figure 7, nine out of fifteen respondents (60%) are female and six of them (40%) are male respondents. Figure 8 shows the age analysis of the respondents which is divided into three categories: aged seven, eight and nine. The major age group of respondents are nine-year-old children with eight out of 15 respondents (53.3%), followed by eight-year-old children, accounting for 33.3% of the total (five), and finally seven-year-old children, accounting for 13.3% of the total (two).

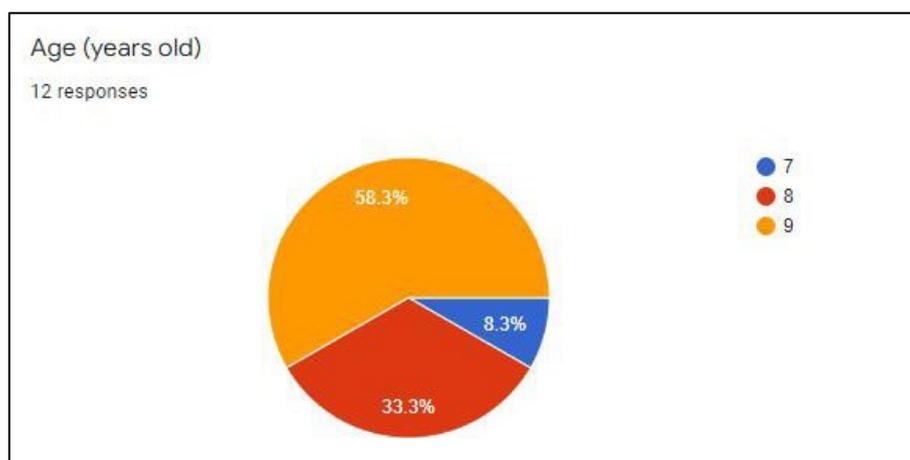


Figure 8 : Age analysis of respondent

Figure 9 shows the race analysis of respondents, Chinese is the major category involved in this testing, which is 14 out of 15 respondents with 93.3%. The percentage of Indian respondents is 6.7% involved in this testing.

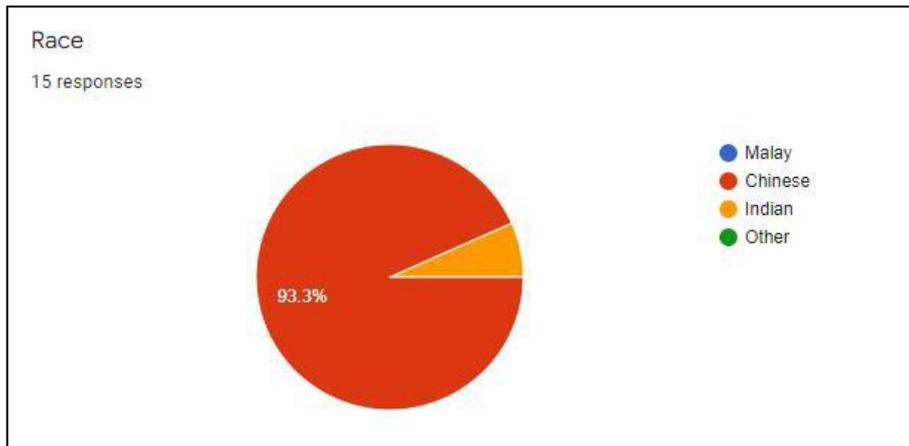


Figure 9 : Race of respondent

Figure 10 shows the experience analysis of respondent’s experience in using learning applications. The figure stated that most of the respondents (86.7%) with the number of 13 respondents have the experience in using the learning application, whereas there are only 13.3% of which two respondents have no experience in using the learning application.

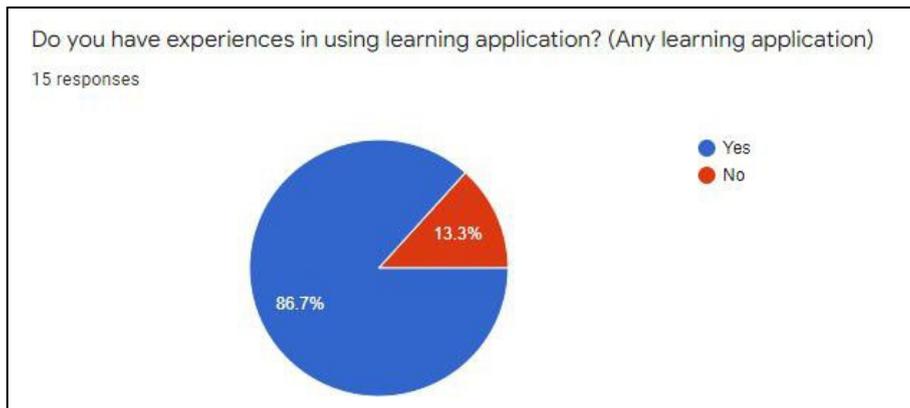


Figure 10 : The analysis of respondent’s experience in using learning application

The following section will discuss about the result of learning outcome acquisition that was collected from the respondent. Figure 11 shows the analysis of learning outcome acquisition. There are five questions designed in the learning outcome section which are related to the learning outcome of the write, game, and quiz module. For question one to question four, a positive result is that all of the respondents can pronounce the sound of the Hiragana letters, write the Hiragana character, associate Romanji and English with the Hiragana letter. Furthermore, for question five, most of the respondent give a positive feedback, which are 12 respondents (80%) answered ‘Yes’ that they can identify the character of Hiragana between Kanji and Katakana, while three respondents (25%) unable to identify the Hiragana character. In general, since the majority of the respondents give positive feedback from the questionnaire, thus the application has the ability to provide a positive learning outcome.

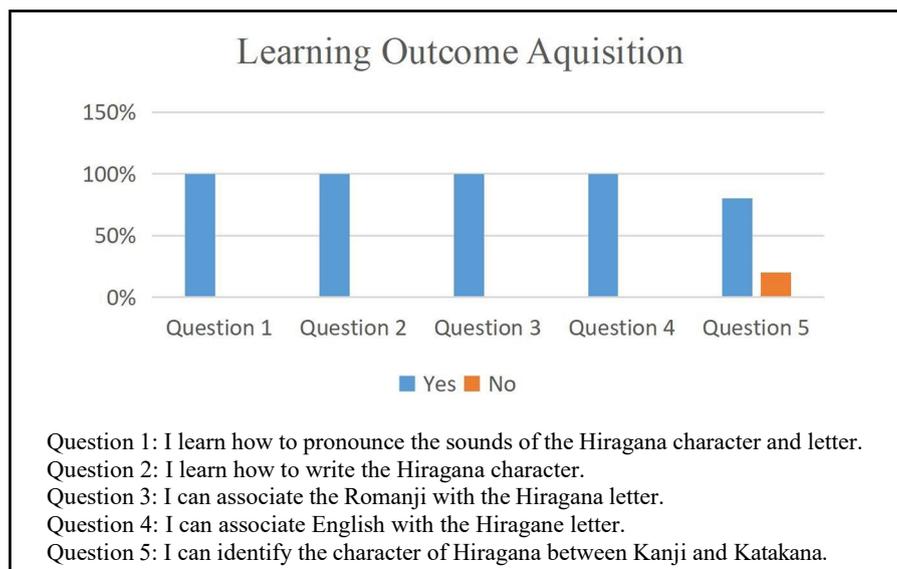


Figure 11 : The Learning Outcome Acquisition analysis of respondent

On the other hand, this section will discuss the user acceptance level towards the application. There are 11 questions designed in this section mainly to gather and analyze the level of user acceptance or attitude toward the application. Based on Figure 12, 46.7% of respondents strongly agreed and agreed that the interface of the application is colourful and joyful and 6.7% of respondents answered ‘Neutral’. Next, for question two, 46.7% of respondents (seven) strongly agree that the content provided is useful, 40% of respondents (six) agree with this statement, and only 13.3% which is two out of 15 respondents remain neutral to this statement. Moreover, most of the respondents (66.7%) strongly agree that the navigation of the application was easy and simple to understand, followed by 33.3% of respondents choosing the agreed option. For question four, there are nine respondents (60%) who strongly agreed that the instruction given was easy to understand, while there are three respondents (20%) respectively agreed and remained neutral to this statement.

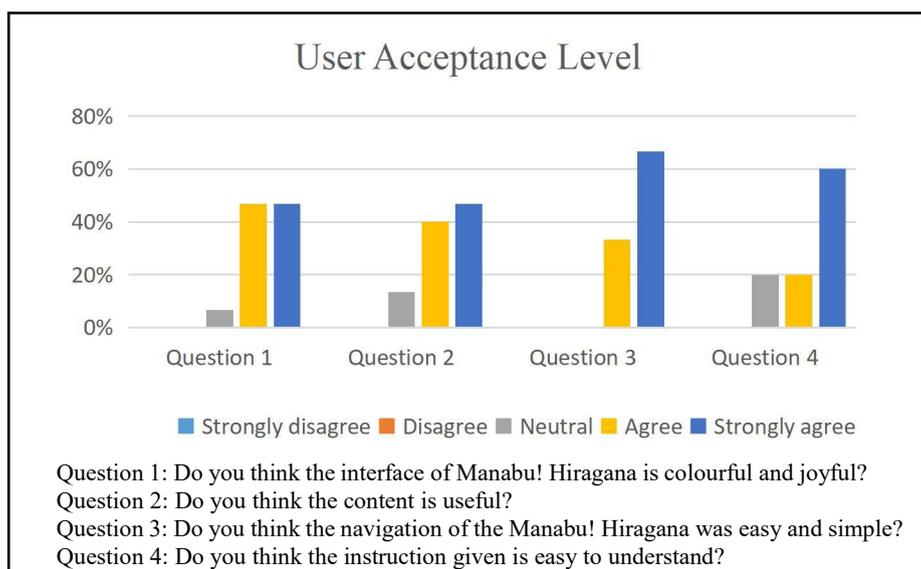


Figure 12 : The User Acceptance Level for Question 1 to 4

Based on Figure 13, most of the respondents (60%) strongly agreed that the functionality of the application is easy to understand, while 33.3% of respondents agreed with this statement, and 6.7% of respondents remained neutral. Next, for question six, there are eight out of 15 respondents (53.3%) who agreed that the application interfaces and the illustrative of functionality are easily identified.

Also, five respondents (33.3%) strongly agreed with the statement, whereas two respondents (13.3%) chose neutral with this statement. For question seven which is about whether the multimedia elements provided are appropriate, while 10 (66.7%) respondents strongly agree with this statement, there are four (26.7%) respondents who agree and the other one (6.7%) were neutral. Besides that, for question eight, nine respondents (60%) strongly agreed that the provided multimedia elements function well, five respondents (33.3%) agreed, and one respondent (6.7%) remained neutral.

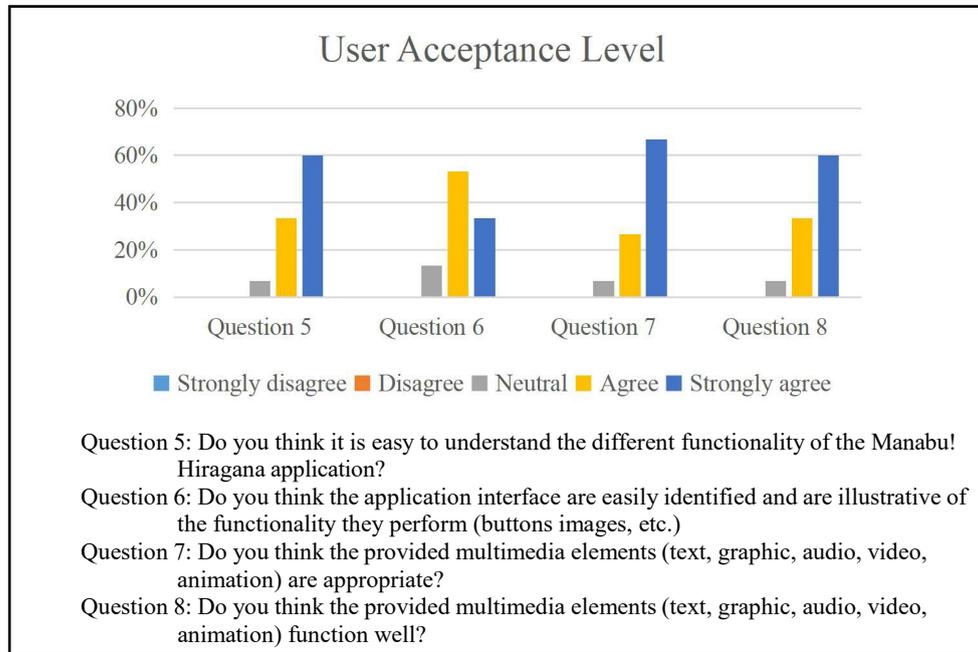


Figure 13 : The User Acceptance Level analysis of respondent (Question 5-8)

Questions 9 to 11 will be discussed as follows. There are 66.7% of respondents who strongly agree that the application is user friendly, and 33.3% respondents agreed. For question 10, there are a total of 11 respondents (73.3%) who strongly agreed that the application is good to control, whereas four (26.7%) respondents agreed that the application is good to control. Lastly, there are 10 respondents (66.7%) strongly agreed that the application is suitable for learning Hiragana, while there were five respondents (33.3%) who agreed with this statement. In short, it can be concluded that the application is acceptable by the respondent as it received a positive result towards the user acceptance test.

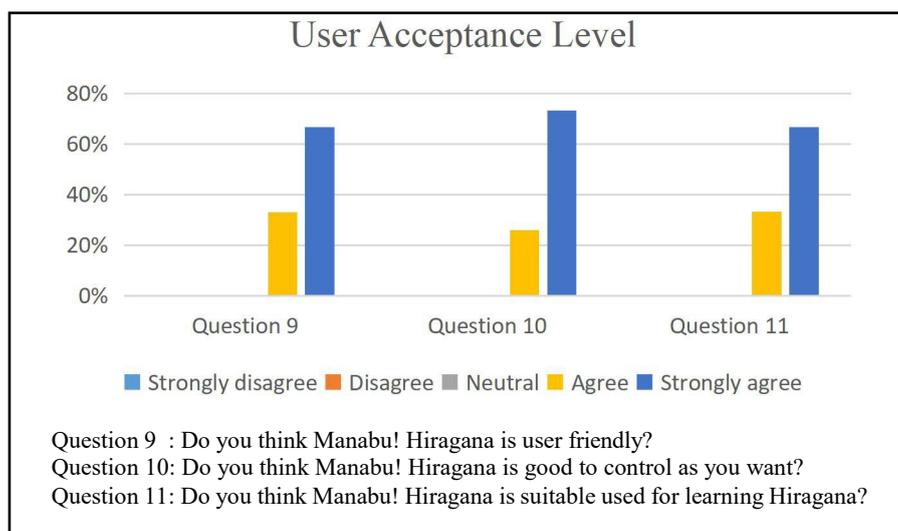


Figure 14 : The User Acceptance Level analysis of respondent (Question 9-11)

To determine the acceptability range of the application, the user accepting result is measured by using the SUS formula, and the total scores of respondents for each question, 602 is calculated as shown in Table 5.2.

Table 10: Respondent’s Score (User Acceptance Test)

No	Question	Likert Point					Marks
		1	2	3	4	5	
1	Do you think the interface of Manabu! Hiragana is colourful and joyful?	0	0	1	7	7	66
2	Do you think the content is useful?	0	0	2	6	7	65
3	Do you think the navigation of the Manabu! Hiragana was easy and simple?	0	0	0	5	10	70
4	Do you think the instruction given is easy to understand?	0	0	3	3	9	66
5	Do you think it is easy to understand the different functionality of the Manabu! Hiragana application?	0	0	1	5	9	68
6	Do you think the application interface are easily identified and are illustrative of the functionality they perform (buttons images, etc.)	0	0	2	8	5	63
7	Do you think the provided multimedia elements (text, graphic, audio, video, animation) are appropriate?	0	0	1	4	10	69
8	Do you think the provided multimedia elements (text, graphic, audio, video, animation) function well?	0	0	1	5	9	68
9	Do you think Manabu! Hiragana is user friendly?	0	0	0	5	10	70
10	Do you think Manabu! Hiragana is good to control as you want?	0	0	0	4	11	71
11	Do you think Manabu! Hiragana is suitable used for learning Hiragana?	0	0	0	5	10	70
Total							746

The formula used to get the usability result based on SUS:

$$Y = \frac{P}{Q} \times 100\% \quad \text{Eq. 1}$$

Where,

P= Total scores of respondents for each question.

Q= Total maximum of respondents’ scores.

Y= Percentage score.

Therefore,

$$\begin{aligned}
 Y &= \frac{746}{825} \times 100\% \\
 &= 90\%
 \end{aligned}$$

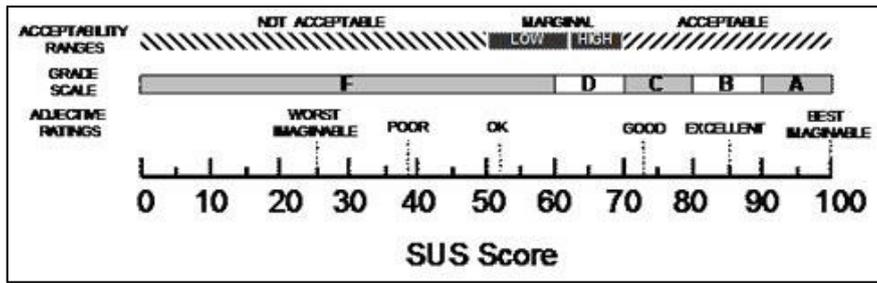


Figure 15 : The scale of the SUS score [12]

In short, based on the Figure 15, the result with overall percentage 90% which falls in acceptable range, therefore the gamification application that adopts the VARK model is acceptable.

5. Conclusion

In conclusion, the Manabu! Hiragana application is a Hiragana mobile learning application that is designed for children between 7 to 9 years old to learn basic Hiragana character and vocabulary.

Based on the result of user acceptance test and learning outcome acquisition, a positive result is provided as most of the respondents strongly agreed and agreed with the statement therefore it can be concluded that Manabu! Hiragana is suitable and has the ability for children to learn Hiragana in a more multimedia interactive way to engage their learning interests. The gamification with a challenge approach by implementing an unlock feature which inspires the user to challenge and complete all levels and ensure that the user completes the program without missing any knowledge provided. The well supported multimedia elements such as the text, graphic, audio, etc which provide a colourful and attractive interface for users to have a joyful experience while using the application.

Although the application was successfully developed with the corresponding benefits, however some weaknesses were found after testing the application. For instance, the learning contents provided is limited so that not more than 10 vocabulary words are provided in each of the learning sections in the learning module. The absence of instruction or restriction on writing modules which might give a wrong cognitive toward the learning content by providing a chance for users to write whatever they want on the screen. These limitations of the application can be improved in the future according to the needs of users. The suggested ideas on improving or resolving the limitation of the application are to provide more learning content and expand the topic field into the application. More games and quizzes are suggested to entice users to learn while playing and to enhance the interest and enthusiasm of the user in using the application. Instruction and restriction on the write module can be added in the future to ensure the user can learn the content in the proper way. Improving and providing a version of an application that can be run on all Android devices regardless of display resolution.

In conclusion, Manabu! Hiragana successfully developed and achieved all three objectives of the project with the assist of the Multimedia Mobile Content Development (MMCD) framework. Perhaps, the application can be continuously enhanced and improved in the future.

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