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The Development of an Augmented Reality Game KANJI Write for Beginners

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Abstract

Learning how to write in Japanese is now a new trend in Malaysia, but Kanji is hard for non-native Japanese speakers to understand and memorize if not taught from young. Beginners who learn Kanji Japanese language faced difficulties in memorizing the kanji characters with correct stroke order. Thus, KANJI Write, an educational Augmented Reality (AR) adventure game was designed and developed to overcome the problem. The main purpose of the game is to help players memorizing the correct stroke order of Kanji characters through playing the game. Players will play as Nana, an Asian girl who has started learning Kanji and facing difficulties in memorizing Kanji stroke order. The art style of the game is following the direction of cuteness 3D low poly style. The most eye-catching point about this game is that the game level is activated by scanning the cards. After scanning those cards, players can start exploring and searching for the strokes needed to complete the level. A playtesting session was carried out and the result showed that KANJI Write successfully helped the players in memorizing the correct Kanji strokes order. The results also showed positive results in the game concept and the game visual. However, the game is still lacking in functionality and will be improved to increase the user experience rate.

Keywords: digital game-based learning, Kanji Japanese Language, augmented reality, 3D game, usability.

INTRODUCTION

KANJI Write is an educational Augmented Reality (AR) adventure game designed for beginner learners of the Japanese language, especially kanji. Kanji is a type of character similar to the Chinese character but with different pronunciations. The Japanese adopted the Chinese characters and

produced a new reading for every Kanji. KANJI Write is also known as an Augmented Reality (AR) game that integrates a virtual game world with an environment in real-time. By using AR, the mobile camera or scanner will scan the trigger image which is also known as a marker. Some virtual things such as 2D images, 3D models, or animations will then project onto the physical things in real-time.

The rationale of this game is to help beginner learners of the Japanese language to memorize Kanji with correct stroke order easily through playing the game. According to Ike, Hoe, Kim, & Y'ng (2021), Papadakis (2020) and Yu, Gao, & Wang (2021), data analyses showed that the gaming approach was both more effective in promoting students' knowledge of computer memory concepts and more motivational than the non-gaming approach. The challenges in the game helped them defined the stroke order within the time given. Aves (2011) stated that "stroke order is an essential of learning the basics of Kanji." Specific feedback provided in the game indirectly helped students figured out the way. If they cannot find the stroke in the correct order in time, they have to repeat that level until passing it. It helped the students improve their memory of Kanji.

Besides, the AR game will assist the Japanese language teachers in teaching and learning sessions. Games provide a useful and meaningful context for language use (Martin, 2016). Some games may improve the interaction and communication between students. Games can challenge the players and reduce their anxiety at the same time. A fun learning process will motivate the students to learn something. The traditional teaching method is the teacher will explain the word by giving the definition of it then showing the writing steps to the student. Games teach the same thing in another way. In another way, KANJI Write also helps to promote kanji to the foreigners who just started learning Japanese.

PROBLEM STATEMENT

The Japanese Language has become more popular in Malaysia. However, Kanji characters are hard for non-Kanji background learners to memorize (Yuki, 2009). Universiti Pendidikan Sultan Idris (UPSI) under the Faculty of Languages and Communication offered the Japanese Language subjects only focus on speaking rather than writing. Only a few Kanji words were taught to the students. An interview had been conducted with one Japanese Language and Communication lecturer. Based on the interview, it proved that most of the students in UPSI faced difficulties recognizing and memorize the correct stroke order especially for beginner students because every Kanji are combined by a different type of stroke to become complete Kanji. Each of them needs to follow the correct stroke order when writing the Kanji. As a beginner, the most important section of Kanji that they need to remember is number. Thus, numbers had been selected as the main content of this game.

The arisen of KANJI Write is due to a lack of learning aid especially digital games in the industry to learn and memorize Kanji stroke. There are a lot of Japanese language learning applications in Google Play Store or AppStore. However, those applications are just an application. Most of them are hard and not attractive to the learners (Japanese Learning Apps, 2021). Foreigners will only be

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willing to learn hiragana and katakana since kanji is hard to memorize. Therefore, KANJI Write is a good approach to attract people to learn Kanji using a AR mobile serious game.

LITERATURE REVIEW

An Augmented Reality Game

An augmented reality game is a game that combines the game's visual and audio content with the real-time environment. It blends the virtual image onto the real-time objects. Augmented reality was first started in 1957. AR games can be divided into three categories. Adventure AR games or geolocation games implement real-world maps into the game environment, which allow players to walk around in real-time while playing the game and solve the tasks given. An AR shooting game is also similar to adventure AR game. Sport AR Games or Quests are games that falls under sports genre game which can be play using AR mechanics. Players are required to running around in real life, searching through the neighbourhood, and travel across the country to complete the quests. Many studies related to AR games had been conducted for many purposes for example for health (Calle-Bustos, Juan, García-García, & Abad, 2017), engineering (Dinis, Guimarães, Carvalho, & Martins, 2017), primary school (López-Faican & Jaen, 2020) and many more. The researches proved that AR games give positive feedback and are effective in solving the problems raised.

An Adventure Game

An adventure game is a game that brings players to explore the game world while completing the task given. It mainly focuses on exploration, puzzle-solving, and narrative interactions with the game objects. According to Dillon (2006); Pitarch (2017) & Walelang, Liliana, & Budhi (2015), there are nine fundamental elements that must be included in an adventure game, which are (1) game rules, (2) game world, (3) plot, (4) theme, (5) characters, (6) items, (7) text, graphics and sound, (8) animation, and (9) user interface.

Kanji

According to Compton’s Encyclopaedia & Fact-Index (2004), Kanji are the Chinese characters adopted by the Japanese more than 1,500 years ago. However, the Japanese changed the reading of every Kanji into their own pronunciation. There are two types of reading for each kanji which are On'yomi (readings derived from the Chinese pronunciations) and Kun'yomi (the original Japanese readings). However, the writing of Kanji is still the same as the traditional Chinese characters. Japanese Language Proficiency Test (JLPT) is recognized as an academic certification and qualification at schools, companies, and society. There are five levels in the JLPT test starting from the easiest level, N5 to the hardest level, N1. The total Kanji contains in all JLPT levels is 4,050 kanji characters. Kanji that was introduced in this project only consisted of one of the categories from JLPT N5 which is number.

METHODOLOGY

Game Development Life Cycle (GDLC) had been used as guidelines in developing the games. Many previous researchers had been used GDLC in their research as a guideline in developing digital games (Alaoui, El Achaak, & Belahbib, 2021; Ameron & Sani, 2020; Hutapea, Simatupang, & Kasih, 2021; Ramadan & Widyani, 2013). GDLC consists of four (4) phases which are (i) pre-production, (ii) production, (iii) post-production, and (iv) testing.

Pre-Production

In the pre-production phase, there are three stages involved which are (i) ideation and brainstorm, (ii) story idea development, and (iii) development of gameplay. After finalizing the gameplay including the looks and feels of the game, a complete game concept document (GCD) had been prepared. Table 1 shows the summary of GCD.

Table 1: Summary of Game Concept Design

Item	Description
Project Title	KANJI write
Genre	Educational, cards, AR, adventure
Issue/ Problem	Learning Japanese is a new trend in Malaysia. However, kanji is hard for foreigners to understand and memorize.
Target Demographics	Beginner learners of Japanese language
Unique Selling Point (USP)	AR serious mobile game. Scanning the cards and play the specific level.
Platform & Minimum Spec	Android. Smartphone with camera.
Goals	Collect the kanji strokes with correct order to form a complete kanji character.
Rules	1. Scan card to reveal level. 2. Collect strokes with correct order within time given. 3. Destroy the enemies
Narrative	One day, Nana fall asleep in her Japanese class when her sensei (teacher) is teaching about kanji. She then enters a world full with kanji character stroke. She needs to find the correct strokes with correct stroke order.
Challenges	1. Number of strokes 2. Correct stokes order 3. Time constraint 4. Size of the level environment 4. Enemies/ monsters
Interaction	Scan AR card – To reveal the level Tap – button, collect items Press & Drag – To walk Swipe – To rotate the camera Spread & Pinch – To zoom in/ out
Feedback	Reward – Adding points, stars Penalty – Deduct points

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Production

The production phase had been divided into two parts. The first part focuses on the design including drawing, sketching, storyboarding, and prototyping meanwhile the second part focuses on the development including character development, assets development, modelling, and programming.

a) Design

The storyboard that was used as a visual guide during the development of the game had been developed based on the GCD and game storyline. The storyboard had been designing in fractions of series of scenes with numbering and displayed notes including the explanation of each scene. The storyboard also aligns with the game-level design that had been designed in GCD.

The concept of the protagonist design was determined based on the target audience, which is set as an Asian who is facing difficulties in memorizing Japanese Kanji characters with correct stroke order. In order to reflect the love towards Japanese culture, the protagonist wears a Japanese yukata and is a young and cute lady. Figure 1 shows the sketches of the main character in the game.

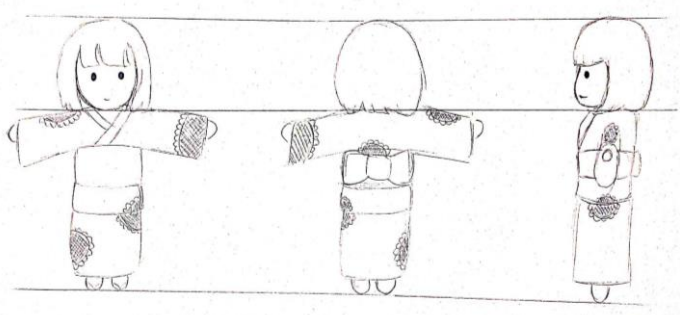

Figure 1: Inspirational sketches of main character named Nana

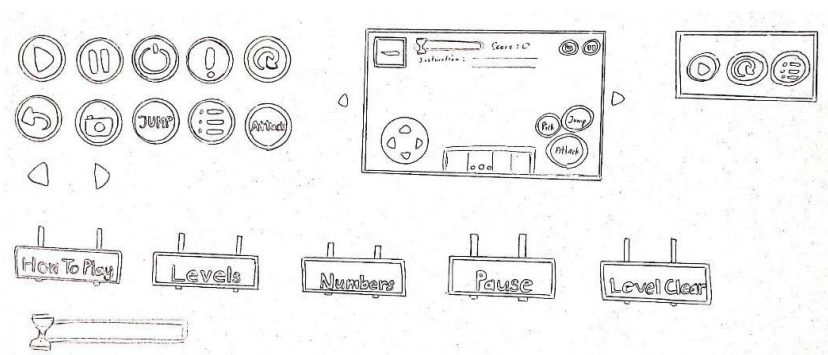

Figure 2: Graphic user interface (GUI)

The mood and theme of the game were most related to the Japanese culture to give a feel of experiencing the Japanese world. The design of the icon and button used in the game had been inspired by the Japanese theme. The colors used are set to light pastel color to present a refreshing and lovely style to the player. The user interface such as game buttons and titles also adopted the concept of 3D to match the game art. Figure 2 shows the early sketches of the graphic user interface meanwhile Figure 3 shows the sketches of AR cards that will be used for players to scan and show the AR. The illustration design of the card was based on the shape of the Kanji. Besides, it is also important to provide hints to the players when they are stuck in the game. A card consists of colorful graphics and texts will helps players memorizing the Kanji characters. Therefore, the design of each card combined texts and images to increase players' recognition of the Kanji characters.

Figure 3: Sketches of AR cards

b) Development

The output from the design phase had been continued in the development phase. All the development of character and game assets had been developed using Autodesk 3ds Max. Figure 4 and Figure 5 show the 3D model of the character and user interface of the game meanwhile Figure 6 shows the final design of AR flash cards.

Figure 4: 3D model of main character

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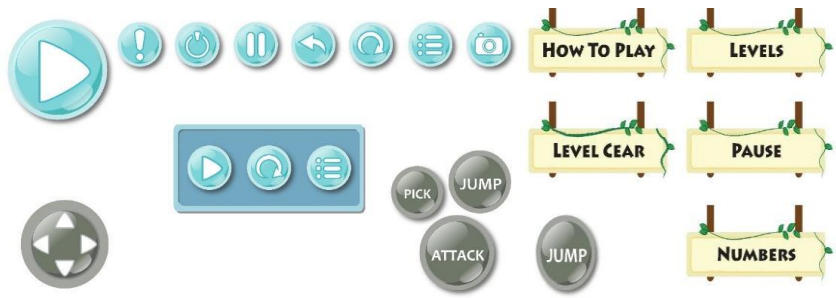

Figure 5: Final design of buttons and UI

Figure 6: Final design of flash cards

After completed the development of 3D characters, the development of the game had been developed using the Unity game engine. All the 3D modelling had been transferred to Unity and the programming process had been done in Unity. Figure 7 shows the screenshot of the main menu game which is the player needs to click the start button to enter into the game. There are also quit and information buttons. The information button provided information about how to play the game. Figure 8 shows the screenshot of the level selection of the game. There were 103 Kanji characters in JLPT N5 level. All these Kanji can be categorized into six categories. KANJI Write only included 14 kanji from the Numbers category. Each level had a different theme for some reason. The factor that differentiates the levels of difficulties was the challenges. Different times are given, the numbers of strokes, the existence of monsters or obstacles. Figure 9 shows the player who used the AR flashcard in level one. Meanwhile, Figure 10 shows the screenshot of gameplay for level two of KANJI Write.

Figure 7: Screenshot of main menu

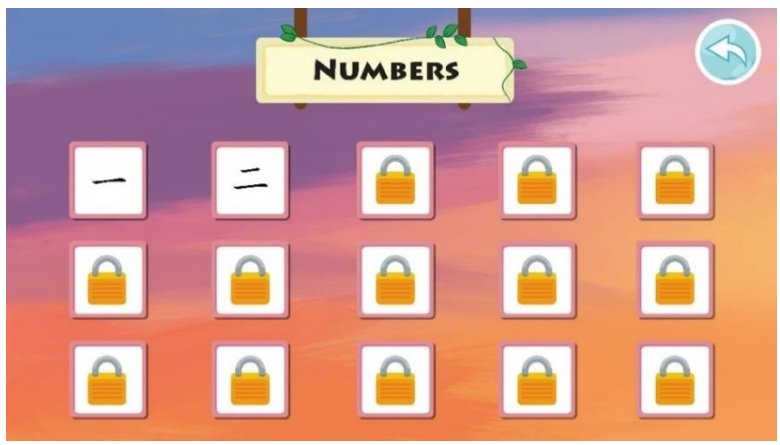

Figure 8: Screenshot of level selection in the game

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Figure 9: Player used the AR flash card

Figure 10: Screenshot of game play

Post-Production

After completing the production phase, a functionality test had been conducted among researchers to ensure if each function in the game worked as planned. Some promotional items were designed and developed including the poster, game merchandise, a game-based module, game walkthrough, game trailer, and website.

a) Testing

After going through all the processes of game development, the final phase is testing. The usability testing had been conducted to investigate the likeability, appearance, functionality, usability, and learnability of KANJI write by recruiting the potential target players to try out the game while the game is still in the development stage. A set of questionnaires consists of 23 questions had been

distributed among 30 students who enroll in the Japanese language class at UPSI. The questionnaire had been adopted from the original Software Usability Measurement Inventory (SUMI) developed by Kirakowski and Corbett (1993) (Alborzi et al., 2000; Ibrahim, Ahmad, & Shafie, 2016; Kortum & Sorber, 2015; Moreno-Ger, Torrente, Hsieh, & Lester, 2012). The respondents had been given 20 minutes to play the KANJI write and they need to answer the questionnaire provided at the end of the testing. The respondents had to rate the checklist using the three selections which was D = Disagree, U = Uncertain, and A = Agree.

RESULTS AND DISCUSSION

As mentioned above, five elements of usability had been tested during the testing which are (i) likeability, (ii) appearance, (iii) functionality, (iv) usability, and (v) learnability. Likeability tests the enjoyment levels or emotional reaction of users to the game. Appearance refers to the overall design of KANJI Write. Functionality measures the extent to which users feel that the features of the game work well or not. Usability is the degree to which something is able or fit to be used. Learnability measures the speed and facility with which users feel that they have been able to learn how to use features in the software when necessary.

Figure 10 shows the result for the likeability element, Figure 11 shows the result for the appearance element, Figure 12 shows the result for the functionality element, Figure 13 shows the result for the usability element, and Figure 14 shows the result for the learnability element. Overall, the results from the usability testing show positive feedback from the respondents. Thus it is proved that the KANJI Write meets all the tested usability requirements and players had good experiences playing the game.

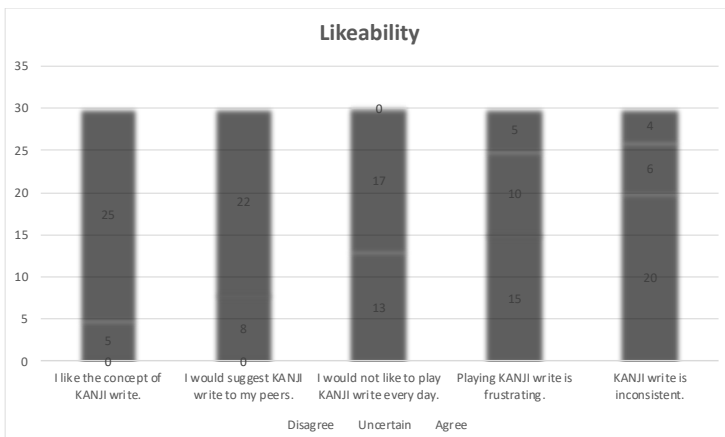

Figure 10: Results of Likeability element

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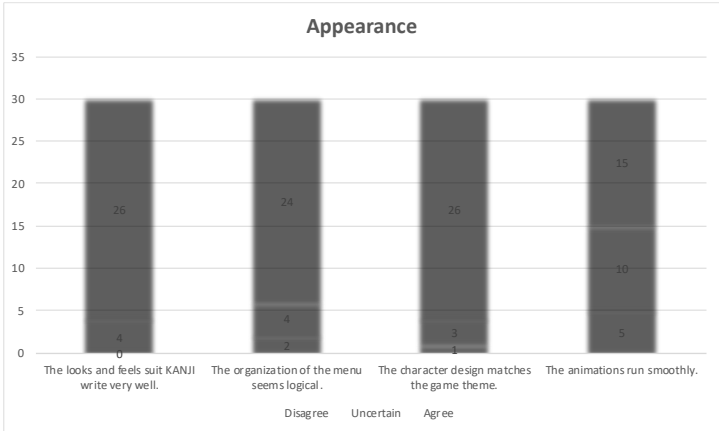

Figure 11: Results of Appearance element

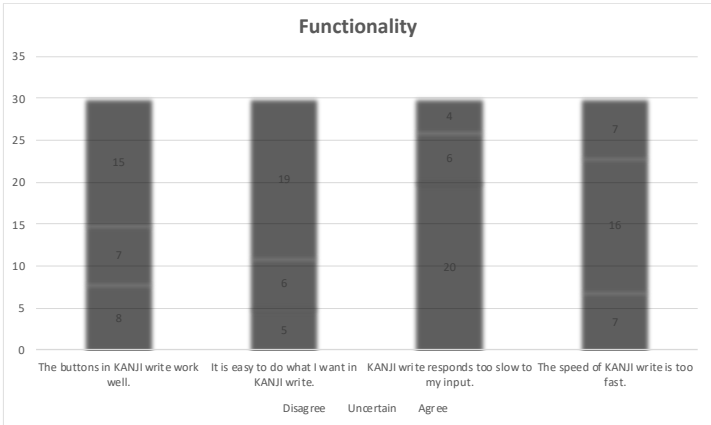

Figure 12: Results of Functionality element

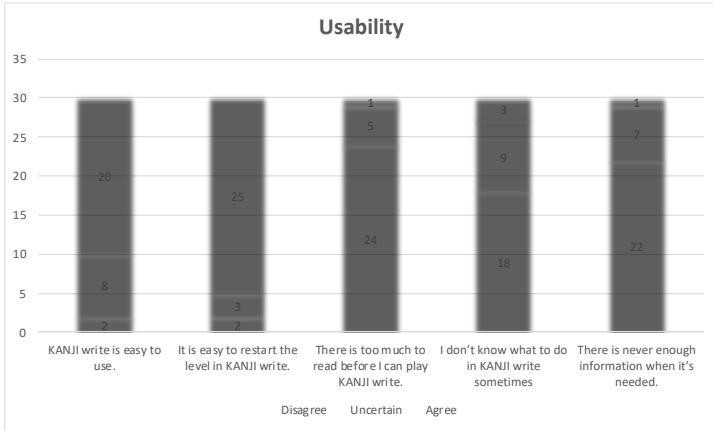

Figure 13: Results of Usability element

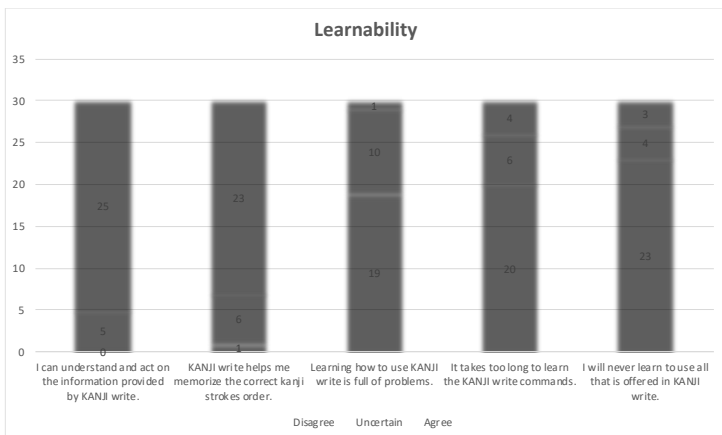

Figure 14: Results of Learnability element

Based on the usability results, KANJI Write meets all the tested usability elements. However, the game still lacks functionality and should be improved to increase the user experience. Most of the respondents like the uniqueness of KANJI Write in terms of the idea and the visual. The looks and feels suit the game very well and the organization of the menu seems logical. It was easy to use and learn KANJI Write and the levels were easy to restart, the speed of the game is not too fast. They also can understand and act on the information provided by KANJI Write. Most important, they admitted that KANJI Write helped them memorize the correct kanji strokes order.

CONCLUSION

KANJI Write is a 3D augmented reality adventure game that had been developed to help beginners of kanji learner especially UPSI students who enroll the Japanese language in order to recognize and memorize the Kanji characters' incorrect stroke order. The main content of the game is category number based on JLPT N5 which consists of 14 game levels. The usability testing had been conducted and based on the findings and feedback, it shows the positive results and feedback from the respondents. Thus, it is proven that KANJI Write had met all the tested usability elements including likeability, appearance, usability, and learnability.

Based on the findings of the study, it is recommended that:

1. KANJI Write game could be a learning tool for UPSI students that can be used in Japanese language subjects under the Faculty of Languages and Communication.
2. Instead of numbers, other categories for example verbs, expressions, and nouns in JLPT N5 can be added as content into KANJI Write.
3. The game can be improvised so that the player does not need the flash AR card to play the game.

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