

***Fude Master: Japanese Writing Practice M-learning Application Based on Gamification
Theory and Its Evaluation with ARCS Model***

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Abstract

Foreign students have difficulty in learning Japanese, especially in kanji acquisition. This is caused by the difference in the writing system between the students' native language and Japanese. It is especially difficult to differentiate similar-looking Japanese characters for these foreign students. Fude Master, an m-learning app for learning Japanese with pattern recognition to judge user's handwritten input is developed to help writing practice. Gamification theory is implemented to increase user's motivation and participation. The m-learning app features game elements from gamification theory such as points, milestones, leaderboards, and more. The learning menus consist of Kanji, Vocabulary, and Sentence menus. The Kanji menu's materials are individual kanji characters. The Vocabulary menu's materials are words composed of the kanji. The Sentence menu's materials are how to use the words in a sentence. In accordance with gamification social elements, a Player Vs Player (PvP) menu is included. This PvP menu enables the user to play against another user in a timed quiz writing battle where the one who attains the highest point will win. The application is developed for smartphones with operating systems Android and iOS by using Ionic Framework. The backend system is developed with nodejs and socket.io. The application is tested on 10-20 foreigners whose native languages do not use kanji characters. Before using the application, a pre-test is held. Then after using the application, a post-test is held to measure the difference with the pre-test, and the respondents are asked to answer a questionnaire based on ARCS Model of motivation.

Keywords: ARCS Model, Gamification, Japanese Language, Kanji Acquisition, M-Learning, Writing Practice

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Introduction

Japanese is one of the most difficult languages in the world, especially for people whose native languages do not use kanji (Paxton & Svetanant, 2014) (Librenjak, Vučković, & Dovedan, 2012). The main cause is the difference between the writing and reading system of kanji and their native languages (Paxton & Svetanant, 2014). Japanese writing system incorporates simultaneously two different scripts: kana (hiragana and katakana) and kanji (Paxton & Svetanant, 2014) (Kim T. , 2014). The two kana scripts, katakana and hiragana, are composed of 46 characters with some similarly looking characters that are hard to be differentiated by foreign students (Ogawa & Enokida, 2014) (Istiqomah, Diner, & Wardhana, 2015). Furthermore, there are thousands of kanji, each with several meanings and readings, which causes learning kanji more challenging than hiragana and katakana (Paxton & Svetanant, 2014) (Librenjak, Vučković, & Dovedan, 2012) (Ogawa & Enokida, 2014). As of 2010, Japan Ministry of Education, Culture, Sports, Science, and Technology (MEXT) designated 2316 kanji as the required *jōyō* kanji (文部科学省, 常用漢字表, 2010). As such, kanji acquisition is still a prevalent problem for foreign students (Paxton & Svetanant, 2014) (Librenjak, Vučković, & Dovedan, 2012).

The increasing usages of smartphones and mobile devices have caused the e-learning market to expand steadily (Docebo, 2016). Current learners grew up with technology and therefore have a different approach to learning (Kiryakova, Angelova, & Yordanova, 2014). This causes a challenge for teachers to use different teaching methods so students will actively participate with strong motivation and engagement in their learning (Kiryakova, Angelova, & Yordanova, 2014).

Gamification has been implemented to increase users' participation and motivation by incorporating game elements such as points, leaderboards, and giving immediate feedback (Figueroa, 2015). According to Kiryakova, Angelova, & Yordanova (2014), implementing game techniques and mechanisms in learning could be done to achieve certain learning objectives, increase learners' motivation to complete the objectives, and incite friendly competitiveness in learners.

To measure the effectiveness of the e-learning system based on gamification theory, the ARCS model will be used. ARCS model of motivation includes four areas for promoting and sustaining motivation in the learning process: Attention, Relevance, Confidence, and Satisfaction.

For the author's bachelor thesis research, an e-learning system for learning Japanese was developed. The e-learning features pattern recognition so that users can practice handwriting Japanese characters directly on the phone screen. The application received positive feedback, notably for the convenient usage at any time and anywhere and the mnemonic feature that aided memorization (Tamara, Rusli, & Hansun, 2019). The research concluded with future research suggestions, such as improving the pattern recognition accuracy, adding more lesson materials, and provide a more engaging learning experience.

Therefore, continuing from previous research, an e-learning system for practicing handwriting is developed. The e-learning system implements gamification theory to increase learners' motivation and is evaluated by using ARCS model.

Hypothesis

The proposed e-learning system improves user's Japanese language ability to know at least 160 kanji and measure attention, relevance, confidence, and satisfaction level with ARCS model.

Goals

To develop an e-learning system for learning Japanese based on the gamification method and measure its effectiveness. The system includes:

- Using the developed e-learning application, users are able to improve their Japanese skill ability in understanding kanji, vocabulary, and usage in a sentence.
- The developed e-learning application provides an enjoyable learning experience.

Literature Review

Gamification

Gamification is the implementation of game elements and game to non-game activities (Kiryakova, Angelova, & Yordanova, 2014). The game elements are described in Table 1.

Table 1. Game Elements (Figuerola, 2015)

No.	Game Elements	Description
1.	Points	Numeric accumulation based on certain activities.
2.	Badges	Visual representation of achievements for the use shown online.
3.	Leaderboards	How the players are ranked based on success.
4.	Progress bars/ Progression	Shows the status of a player.
5.	Performance graph	Shows player performance.
6.	Quests	Some of the tasks players have to fulfill in a game.
7.	Levels	A section or part of the game
8.	Avatars	Visual representation of a player or alter ego.
9.	Social elements	Relationships with other users through the game.
10.	Rewards/ reward system	System to motivate players that accomplish a quest.

Gamification provides the advantage of promoting an increased level of commitment and motivation of users (Kiryakova, Angelova, & Yordanova, 2014). Despite not being directly linked to knowledge and skills, gamification can contribute to the students' knowledge and skills growth by affecting their behavior, commitment, and motivation (Kiryakova, Angelova, & Yordanova, 2014).

ARCS Model

ARCS model of motivation includes four areas for promoting and sustaining motivation in the learning process: Attention, Relevance, Confidence, and Satisfaction (Poulsen, Lam,

Cisneros, & Trust, 2008). These four aspects are explained below (Poulsen, Lam, Cisneros, & Trust, 2008):

1. Attention

Attention refers to the learners' interest in incorporating the taught concepts or ideas. Attention is the most important aspect because it is the starting point to motivate the learners.

2. Relevance

Relevance must be established by using language and examples that the learners are familiar with. If attention is not sustained and relevance is not conveyed, learners will not be motivated to learn.

3. Confidence

The confidence aspect's focus is to establish learners' positive expectations for success. The confidence level is often associated with motivation and the effort to achieve a performance goal. Confidence is built through personal achievement's positive reinforcement, by giving well-timed and relevant feedback.

4. Satisfaction

Satisfaction must be gained by learners from the learning experience, such as a sense of achievement, praise from a higher-up, or mere entertainment. When learners appreciate the results from feedback and reinforcement, they will be motivated to learn.

System Development

Development Environment

The e-learning system is developed for smartphones with the operating systems Android and iOS. The development was carried by using the Ionic framework and programming language Typescript for the mobile application. For the backend, node.js and socket.io were used. MySQL is used as the database.

System Flow

The e-learning system has three main learning menus, which are the Kanji, Vocabulary, and Sentence menus. There's also a My Word List menu for the user's favorite words, as well as a PvP (Player vs Player) menu where the user can compete with other users through a quiz battle. Figure 1 depicts the Main Menu and the relevant game elements as listed in Table 1.

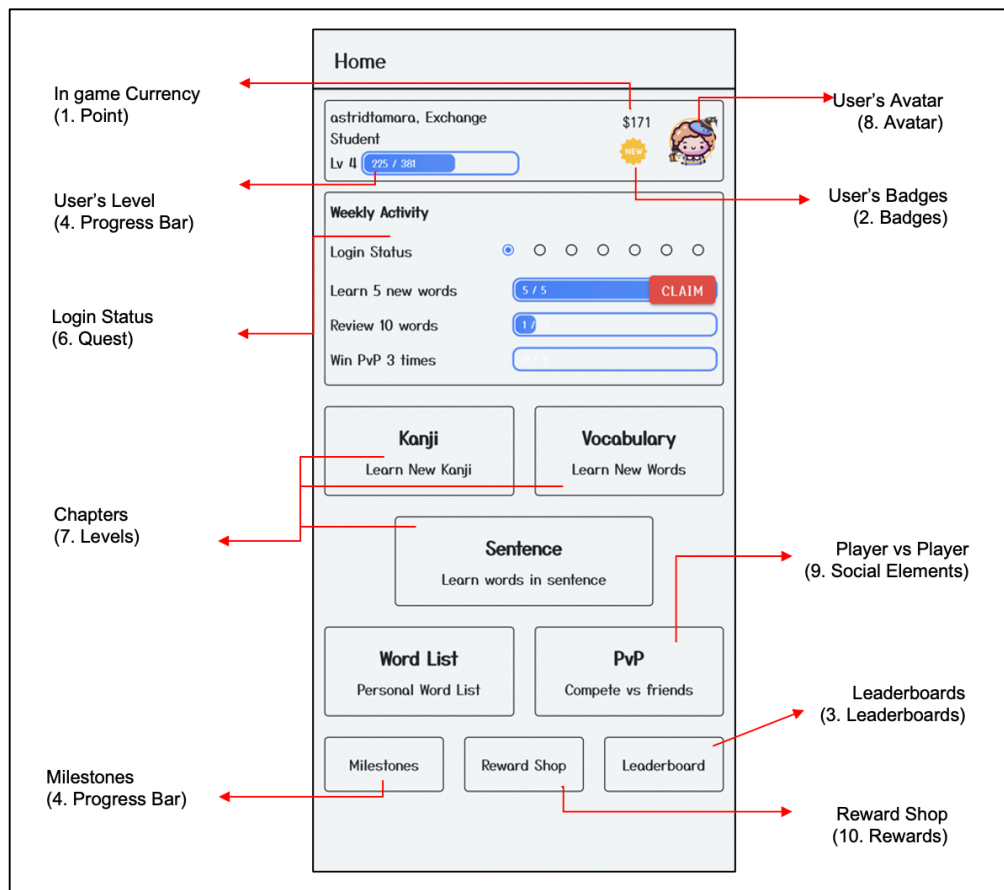


Figure 1. Main Menu

The Kanji menu contains learning materials of individual kanji characters, included are their readings, stroke order, meanings, and example words. Handwriting practice can be done on a rectangular canvas in the middle of the screen. After clicking the button on the bottom right screen, the server will be able to determine the correctness of the handwriting. Figure 2 depicts the Kanji menu.

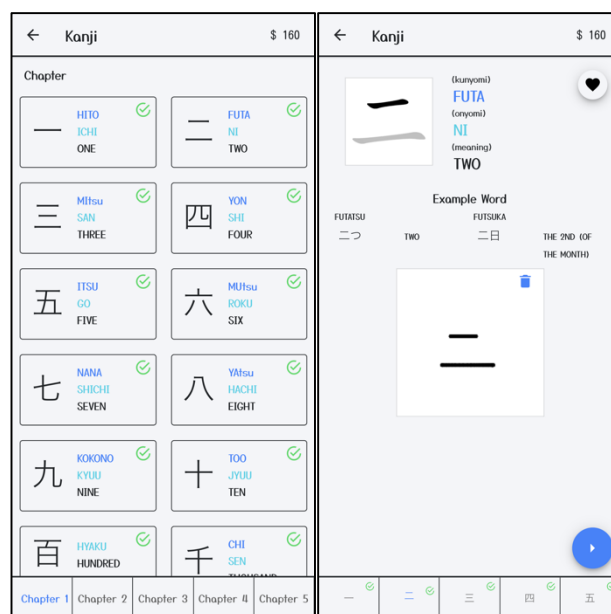


Figure 2. Kanji Menu

The Vocabulary menu contains learning materials of words composed of individual kanji characters in Kanji menu. Similar to the Kanji menu, a rectangular canvas is present in the middle of the screen for users to practice writing and get the server's feedback. The Vocabulary menu is shown in Figure 3.



Figure 3. Vocabulary Menu

The Sentence menu contains learning materials about using the words in the Vocabulary menu correctly in a sentence. Similar to the Kanji and Vocabulary menu, the Sentence menu also includes a rectangular canvas for handwriting input. The Sentence menu is shown in Figure 4.



Figure 4. Sentence Menu

In the PvP menu, the user can play against another user in a battle to answer questions by writing on the canvas. The user with the faster time and more correct answers will win. However, there are several items that user can use to boost own's progress or hinder

opponent's progress. The PvP menu is shown in Figure 5.

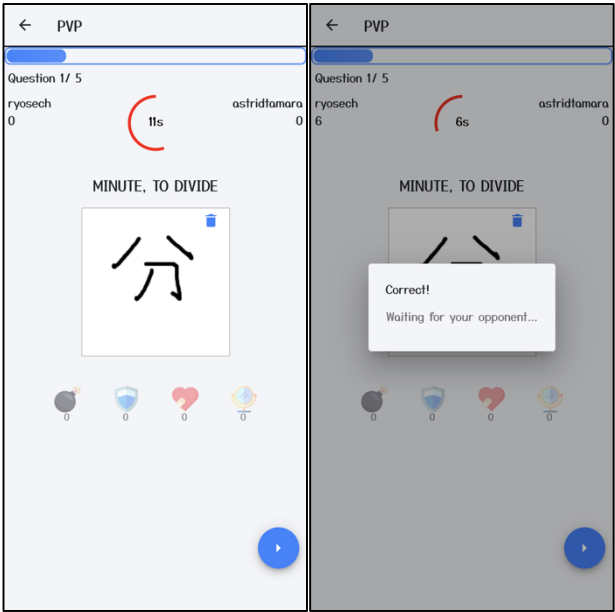


Figure 5. PvP Match

The Milestone lists the user's progress with each challenge. When the users reach a 100% completion rate on the challenge, they may unlock the badge and title associated on the challenge. By practicing writing, the user may accumulate in-game currency that can be spent to buy avatar frames, application themes, and PvP items. The Milestones and Reward Shop are shown in Figure 6.

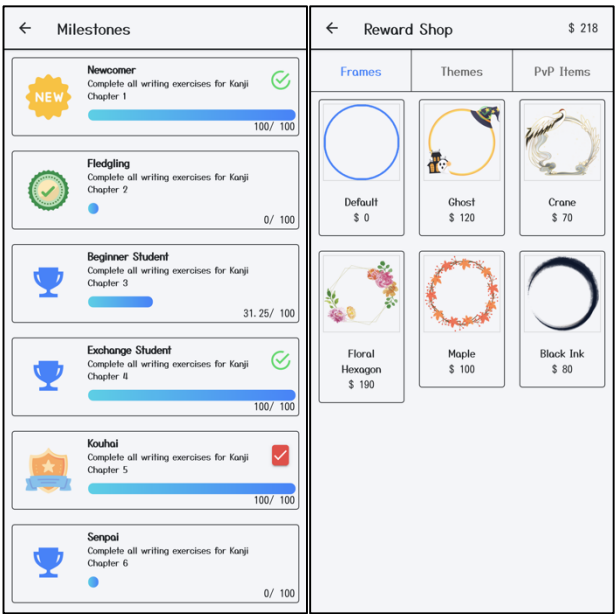


Figure 6. Milestones and Reward Shop

The user's Profile screen shows the user information and the number of PvP wins and losses. On this screen, the user can also freely choose their avatar, badges, and title that are shown on their profile. The number of PvP wins and losses is also reflected in the Leaderboard Screen, where the users are listed by the highest win count and lowest loss count. The Profile and Leaderboard screens are shown in Figure 7.

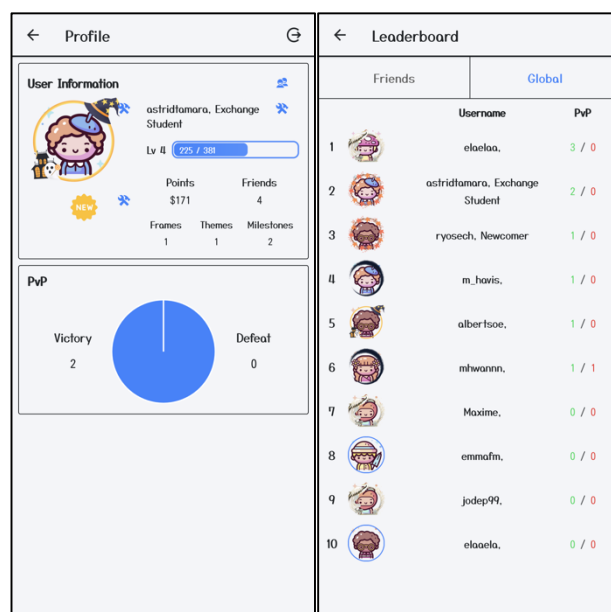


Figure 7. Profile and Leaderboard Screen

Evaluation

Experiment Flow

The experiment to evaluate the application was held between June 1st, 2021, until June 8th, 2021, for a total of five sessions. Each session lasted for around 1 hour to 1.5 hours and was participated by three to six people via online video meeting. In total, the experiment was participated by 22 volunteers whose native languages do not use kanji and have not taken any JLPT. Each session schedule and total participants are listed in Table 2.

Table 2. Experiment Session Schedule Table

No.	Begin	End	Total Participants
1.*	June 1 st , 2021, 00:15 JST	June 1 st , 2021, 02:45 JST	4
2.	June 4 th , 2021, 03:00 JST	June 4 th , 2021, 04:00 JST	3
3.	June 7 th , 2021, 22:30 JST	June 7 th , 2021, 23:30 JST	5
4.	June 8 th , 2021, 00:00 JST	June 8 th , 2021, 01:00 JST	5
5.	June 8 th , 2021, 01:15 JST	June 8 th , 2021, 02:25 JST	5
Total			22

*The first session had a break of approximately one hour because of technical difficulties.

The experiment session began with an introduction to the research and experiment flow. This was followed by a pre-test, to measure their initial Japanese language ability. After the pre-test, they were asked to study Japanese by using the application. Afterward, a post-test was held to measure the score difference with the pre-test. Finally, the respondents answered a questionnaire based on ARCS Model of motivation.

The pre-test and post-test were held using Kahoot, a learning platform to facilitate real-time quizzes. This was done to ensure that the tests were done at the same time for every respondent.

The pre-test and post-test are composed of 15 questions which are taken from the learning materials available in the application. The test questions are the same for both pre-test and post-test, to measure the score difference before and after using the application.

The questionnaire based on the ARCS model was distributed to measure the effect of the application. The questionnaire is composed of 36 questions, with 6 questions each corresponding to the Attention, Relevance, Confidence, and Satisfaction aspect of the ARCS model. A 5-scale Likert scale is used to measure the score, ranging from 1 (Not true) to 5 (Very true).

Table 3 lists questions about the Attention part of the ARCS model. The questions revolve around things that help keep the users retain their interest in using the application.

Table 3. Attention Questions Table

Attention	
1.	The way the chapters are arranged helped keep track of my progress.
2.	I want to unlock all milestones and collect all themes and frames.
3.	Using items in PvP made me excited.
4.	I like playing a match against another student (PvP).
5.	Being able to write on screen helped me remember how to write the kanji.
6.	I want to keep learning Japanese using this application.

Table 4 lists questions about the Relevance part of the ARCS model. The questions are about things that let the users feel that they can connect the things they learn from the application with themselves.

Table 4. Relevance Questions Table

Relevance	
1.	Kanji, Vocabulary, and Sentence materials included words that I want to learn.
2.	The kanji stroke order, <i>kunyomi/onyomi</i> reading, and example word gave me more understanding about the character.
3.	I believe my Japanese language competency will improve by using this application.
4.	I think this application is useful for me.
5.	I can use the knowledge I gained from this application in real life.
6.	Using the application helped me overcome the difficulty of learning Japanese words.

Table 5 lists questions about the Confidence part of the ARCS model. The questions are about their motivation and effort to achieve success in learning Japanese.

Table 5. Confidence Questions Table

Confidence	
1.	The lesson materials were suitable for a beginner's competency level.
2.	As I practice writing on the screen, I was confident that I could learn the words.
3.	Winning PvP mode gave me confidence that I understood the lesson well.
4.	Losing PvP mode made me want to practice more so I can win next time.
5.	Completing the exercises and accumulating points gave me a satisfying feeling of accomplishment.
6.	If I keep learning using the application, I believe I can pass a test on it.

Table 6 lists questions pertaining to the Satisfaction part of the ARCS model. The questions revolve around the satisfaction they feel while learning, such as feeling rewarded and enjoying their progress.

Table 6. Satisfaction Questions Table

Satisfaction	
1.	With the points I have accumulated, purchasing themes, frames, and PvP items gave me a satisfying feeling of accomplishment.
2.	Unlocking milestones achievement made me feel I have improved.
3.	Attaining a high rank on the leaderboard made me feel proud.
4.	I take pride in winning PvP matches against other students.
5.	Practicing writing kanji was enjoyable by using this application.
6.	Getting points for practicing and playing PvP made me feel rewarded.

Respondents' Information

The experiment was participated by a total of 22 respondents. Out of 22 respondents, 45.5% (10 people) are male and 54.5% (12 people) are female. Their age range falls into 10-19 years old (2 people) and 20-29 years old (20 people). All these respondents' native languages are not languages that use kanji, 86% (19 people) are Indonesians while 14% (3 people) are French.

All of them have not taken JLPT and therefore are beginners in the Japanese language. The gender, age, native language, and JLPT level of respondents are displayed in pie charts in Figure 8.

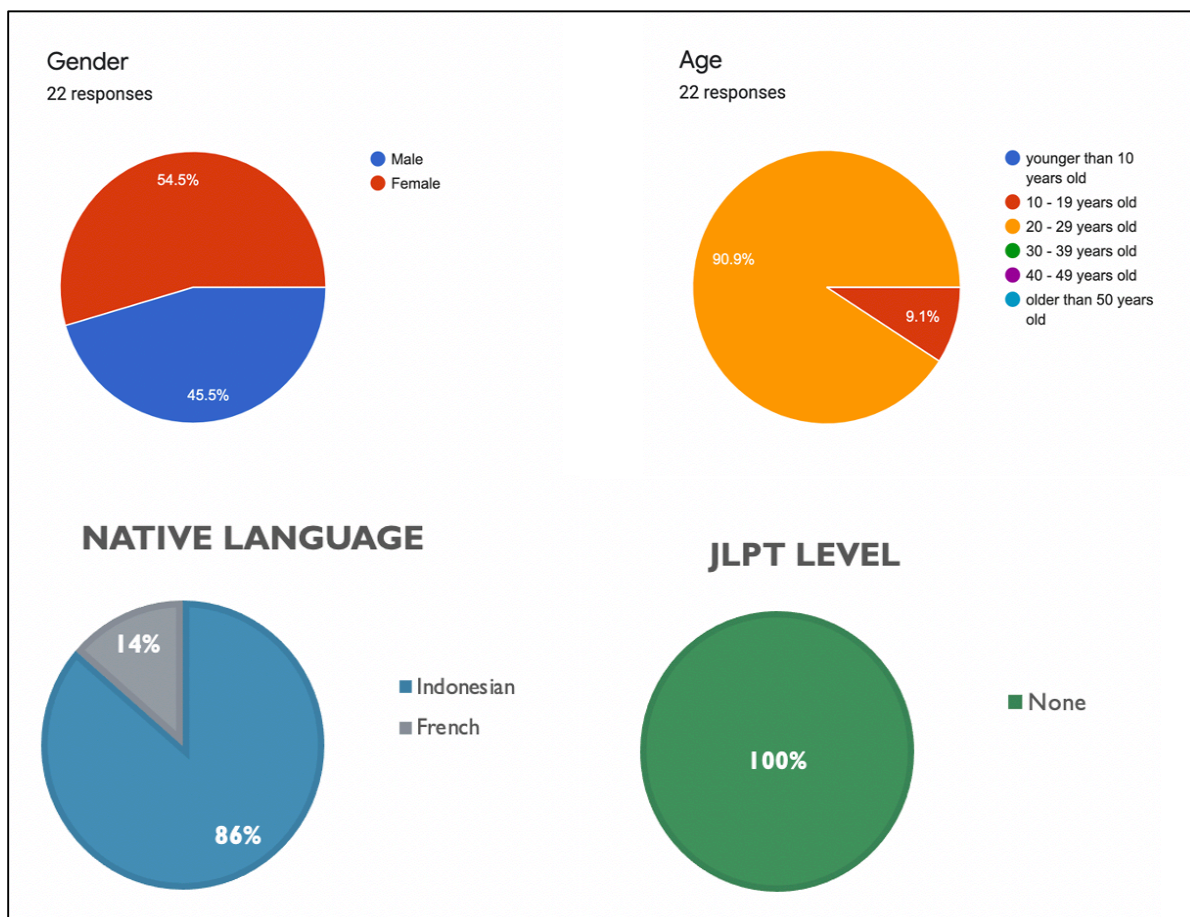


Figure 8. Respondents' Gender, Age Distribution, Native Language, and JLPT Level Distribution Pie Charts

Pre-Test and Post-Test Result

The result of the pre-test and post-test is shown in Table 7. With 15 as the perfect score, the pre-test average is 7.27 and the post-test average is 12.05. The minimum score for pre-test is 2 while for post-test is 8. The maximum score for pre-test is 14 while for post-test is a perfect score of 15. The respondents' score improves by 4.77 points on average which means their Japanese language ability improves after using the application. Every respondent had their scores improved, except one person, but the person had a high enough score in the pre-test (only 2 mistakes). The highest score difference is 13, by which the respondent got a perfect score during the post-test.

The pre-test and post-test score differences are visualized in a bar graph in Figure 9. The graph is ordered by pre-test score in ascending order. By looking at the graph, it is apparent that the lower pre-test score produced a greater improvement than the ones with a high pre-test score.

Table 7. Pre-Test and Post-Test Result Table

No.	Name	Pre-Test Score	Post-Test Score	Difference
1	YTH	2	15	13
2	A	3	12	9
3	J	4	12	8
4	KTW	5	8	3
5	M	5	9	4
6	R	5	11	6
7	L	6	10	4
8	M	6	11	5
9	M	6	14	8
10	F	7	11	4
11	AS	7	12	5
12	R	7	14	7
13	N	8	11	3
14	JD	8	12	4
15	SS	8	12	4
16	MH	8	15	7
17	D	9	12	3
18	E	9	12	3
19	G	10	12	2
20	W	10	12	2
21	JCY	13	13	0
22	JD	14	15	1
Average		7.27	12.05	4.77
Minimum		2	8	0
Maximum		14	15	13

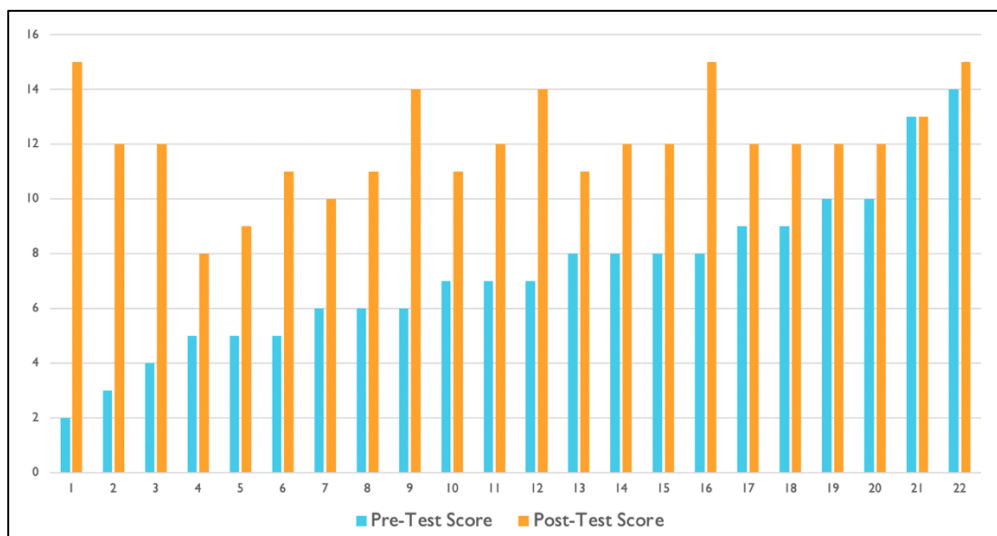


Figure 9. Pre-Test and Post-Test Result Bar Graph

The dispersion graph in Figure 10 shows that most of the respondents fall into the top middle area, which means that those whose pre-test scores are in the middle range had improved to a certain degree. Three people in the left bottom area (Low to Low circle) scored low on pre-test and post-test, which means they improved although not significantly. Two people in the top right area (High to High circle) scored high on both pre-test and post-test, one person managed to improve and gain a perfect score on post-test while the other one managed to maintain the score. Three people in the top left area (Low to High circle) scored low on pre-test and high on post-test, which means that they had a significant improvement in Japanese ability after learning with the e-learning system. None are in the bottom right area, which means all respondents oversee a certain degree of improvement in Japanese ability after using the e-learning system.

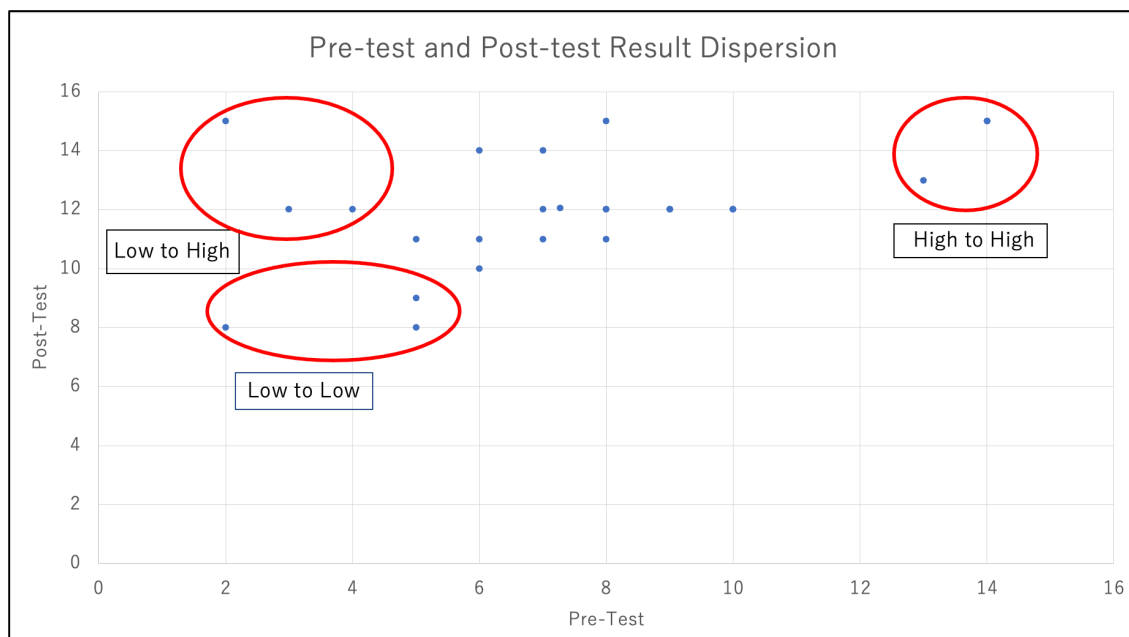


Figure 10. Pre-Test and Post-Test Result Dispersion Graph

Based on the result of the pre-test and post-test, Table 8 shows a breakdown for each kanji's correct answer. During the pre-test, the Kanji with the lowest correct answers are 赤 (aka, red) and 米 (kome, rice) at 5 points. However, both kanji saw significant improvement during the post-test. The kanji 赤 (aka, red) improved to 17 correct answers, making a 12 point difference. The kanji 米 (kome, rice) improved to 15 correct answers, making a 10 point difference. The kanji with which the respondents are most familiar is 一日 (tsuitachi, the first day of the month) with 17 points at the pre-test. At the post-test, the kanji is 一日 saw an improvement to 21 points, which is one point short of the perfect score (22 points).

During the post-test, the kanji with the lowest correct answer is 南口 (minamiguchi, south exit), which also has the lowest difference between pre-test and post-test of 3 points. This shows that it is the hardest kanji to learn. Meanwhile, during the post-test, the kanji with the highest correct answer is 円 (en, round/yen) and 川 (kawa, river). The kanji 円 (en, round/yen) has the highest difference of 13 points, making it the easiest kanji to learn. The kanji 川 (kawa, river) has the second-highest difference of 13 points, making it the second easiest kanji to learn.

Table 8. Pre-Test and Post-Test Kanji Correct Answer Table

No.	Kanji	Pre-Test	Post-Test	Difference
1.	円	9	22	13
2.	赤	5	17	12
3.	今	15	19	4
4.	北	9	18	9
5.	川	10	22	12
6.	九日	15	20	5
7.	日本	13	17	4
8.	電車	9	13	4
9.	去年	11	20	9
10.	好き	12	18	6
11.	一日	17	21	4
12.	南口	8	11	3
13.	米	5	15	10
14.	安い	13	16	3
15.	中国	9	16	7
Average		10.67	17.67	7
Min		5	11	3
Max		17	22	13

The pre-test and post-test kanji correct answer is visualized in a graph in Figure 11. The graph is ordered by the kanji appearance in the test. The result is further visualized in the dispersion graph in Figure 12. The kanji 赤 (aka, red) and 米 (kome, rice) occupy the top left area remember (Low to High circle) which means it is easier to. The kanji 一日 (tsuitachi, first day of the month), 九日 (kokonoka, ninth of the month), and 今 (ima, now) occupy the top right area (High to High circle). which means many respondents could recognize the kanji in pre-test and post-test. Looking at the center area (Low to Low circle), the kanji 南口 (minamiguchi, south exit) and 電車 (densha, train) were correctly answered in lower numbers in both pre-test and post-test, making them the hardest kanji to learn. As there are no kanji located in the bottom right area, all kanji saw improvement between pre-test and post-test.

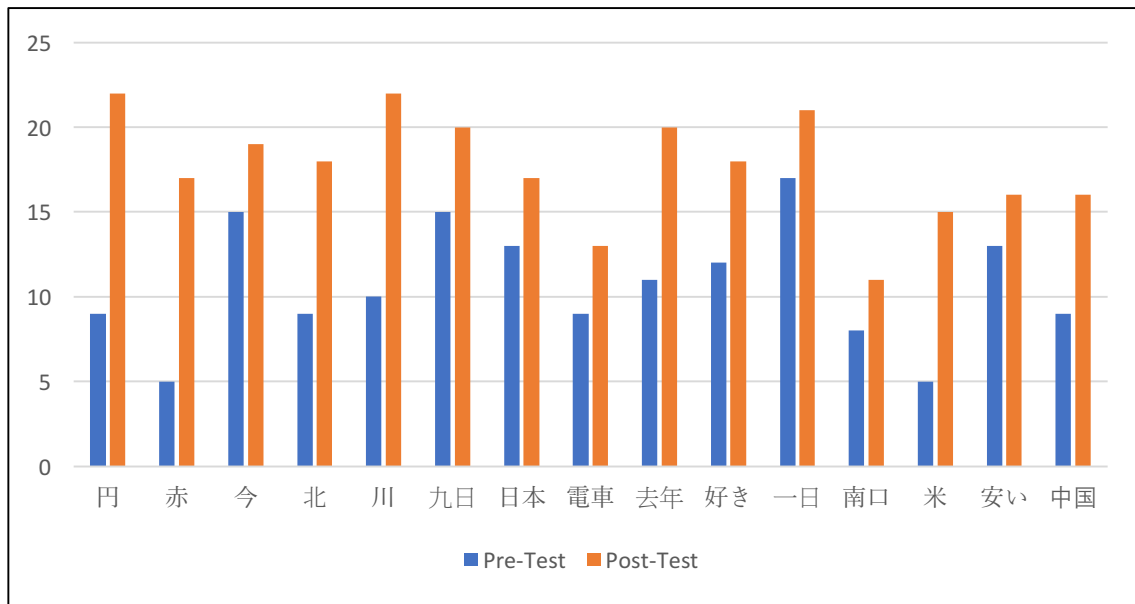


Figure 11. Pre-Test and Post-Test Kanji Correct Answer Bar Graph

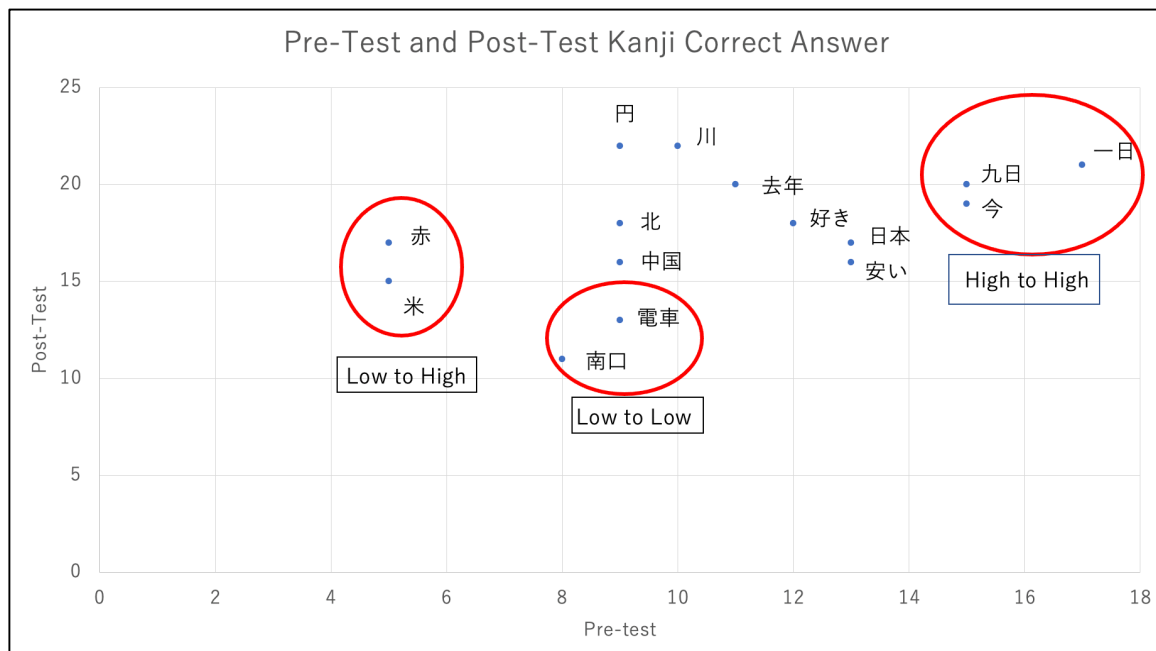


Figure 12. Pre-Test and Post-Test Kanji Correct Answer Dispersion Graph

Questionnaire Result

The questionnaire's ARCS score is depicted in the bar chart in Figure 13. The score for Attention is 4.64, Relevance is 4.63, Confidence is 4.58, and Satisfaction is 4.71. The average score of all four aspects of ARCS is 4.61 out of 5. This falls into the range of 4 (Mostly True) and 5 (Very True), which means that the application has successfully conformed to the ARCS model of motivation. The questionnaire's result shows that the application can retain the respondents' attention to learn, the respondents understand the lessons and feel they are relevant, the respondents build their confidence and are motivated to achieve more, and the application provides enough reward for the respondents to feel satisfied and enjoy the learning process.

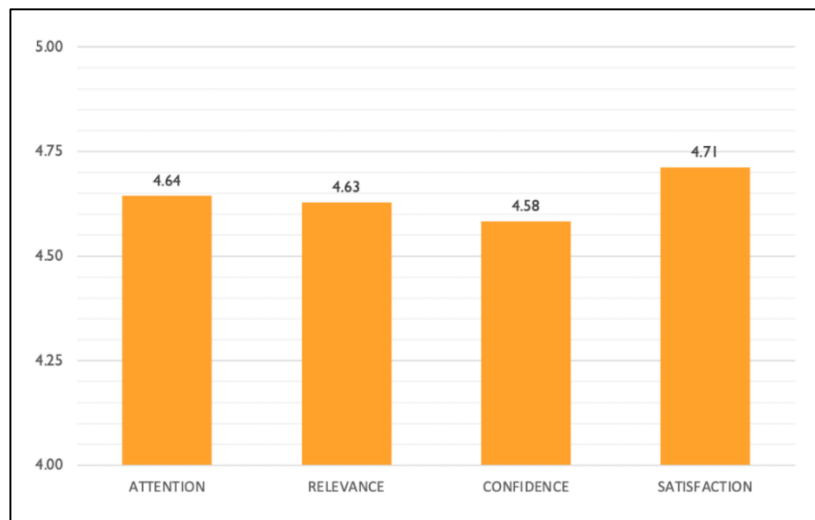


Figure 13. Graph of Questionnaire's ARCS Score

Conclusion

The e-learning system for learning Japanese based on Gamification Theory has been completed. The e-learning system is developed for both Android and iOS operating systems. There are three main learning menus, the Kanji, Vocabulary, and Sentence menus. In each menu, the user can practice handwriting the Japanese character by writing on the screen and getting immediate feedback from the server.

An experiment to evaluate the application's effect was held via an online meeting between June 1st to June 8th, 2021. It was participated by 22 volunteers whose native languages are not using Kanji and have not taken JLPT. The experiment conducted pre-test, application testing, post-test, and questionnaire in order.

The pre-test and the post-test result show that the respondents' test scores improved after using the application. The questionnaire based on ARCS Model shows that the application can motivate the respondents to learn Japanese enjoyably.

Future Works

Based on the feedbacks written by the respondents, there are suggestions to:

- Add more reward variations and challenging milestones.
- Improve the User Interface (UI) and User Experience (UX) for easier to use.
- Improve PvP part to allow multiplayer and make it better.

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References

- Docebo. (2016). *Elearning market trends and forecast 2017-2021*. Retrieved July 1, 2021, from <https://www.docebo.com/resource/elearning-market-trends-and-forecast-2017-2021/>
- Figuerola, J. (2015). Using Gamification to Enhance Second Language Learning. *Digital Education Review*, 27(21), 32-54.
- Istiqomah, D., Diner, L., & Wardhana, C. (2015). Analisis Kesulitan Belajar Bahasa Jepang Siswa SMK Bagimu Negeriku Semarang. *Journal of Japanese Learning and Teaching*, 4(1).
- Kiryakova, G., Angelova, N., & Yordanova, L. (2014). Gamification in Education. *9th International Balkan Education and Science Conference*. Edirne, Turkey.
- Kim, T. (2014). *A Guide to Japanese Grammar: A Japanese approach to learning Japanese grammar*. United States: CreateSpacePublishing.
- Librenjak, S., Vučković, K., & Dovedan, Z. (2012). Multimedia assisted learning of Japanese kanji characters. *MIPRO 2012 : Proceedings, 35th International Convention on Information and Communication Technology, Electronics and Microelectronics*. Opatija, Croatia.
- Ogawa, J., & Enokida, F. (2014). *Colloquial Japanese: The Complete Course for Beginners*. New York: Routledge.
- Paxton, S., & Svetanant, C. (2014). Tackling the Kanji hurdle: Investigation of Kanji learning in Non-Kanji background learners. *International Journal of Research Studies in Language Learning*, 3(3), 89-104.
- Poulsen, A., Lam, K., Cisneros, S., & Trust, T. (2008). ARCS Model of Motivational Design.
- Tamara, A., Rusli, A., & Hansun, S. (2019). Utilizing E-learning with Pattern Recognition and Mnemonic to Enhance Japanese Characters Learning Experience. *International Conference on Engineering, Science, and Industrial Applications (ICESI)*. Tokyo.
- 文部科学省. (2010, November 30). 常用漢字表. Retrieved July 1, 2021, from http://www.bunka.go.jp/kokugo_nihongo/sisaku/joho/joho/kijun/naikaku/pdf/joyokan_jihyo_20101130.pdf