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Exploring the impact of octalysis gamification in japanese m-learning using the technology acceptance model

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Abstract
Indonesia is a country with the second highest number of Japanese language learners in the world. However, with the main language of Indonesia being derived from the roman alphabets, it makes Indonesian students hard to get used to learning Japanese alphabets, especially Kanji. This study aims to develop a gamified mobile learning application following the Octalysis gamification framework, and assess its impact in garnering student's acceptance to enhance their Japanese Kanji learning experience. This study was conducted quantitatively using the Technology Acceptance Model, and analyzed through the Structural Equation Model. The data were collected via questionnaires from 194 members of the local Japanese learning community. The variables analyzed in this research are *Perceived Usefulness*, *Perceived Ease of Use*, *Attitude Towards Using,* and *Behavioral Intention*. All variables are tested for validity and reliability using SPSS Statistics, and structural equation model analysis using SPSS AMOS. The results showed positive significant correlations between *Perceived Usefulness* and *Attitude Towards Using*, *Perceived Ease of Use* and *Attitude Towards Using,* and *Attitude Towards Using* and *Behavioral Intention.* The result also noted a negative correlation between *Perceived Usefulness* and *Behavioral Intention*. Each variable contributes to the acceptance of the gamified mobile learning application with a strong emphasis on *Perceived Ease of Use*, and a mild emphasis on *Perceived Usefulness*.

1. Introduction

Mobile applications have taken many shapes over the years to meet the demands of the ever-increasing number of smartphone users across the world. One such demand is the use of smartphones as a learning medium, aptly named M-learning. The usage of m-learning has been shown to provide a positive experience and enhance learning outcomes [1], [2]. Because of this, m-learning application varies greatly across different fields, and language learning stands tall along with other fields. Among those languages, the Japanese language is one of the most difficult second languages to acquire for non-native speakers. This is due to the stark contrast of its writing system compared to the widely used Roman alphabet, and its sentence structure being opposite to that of most languages [3], [4].

There are three known challenges most people face when learning Japanese as non-native speakers. Personal psychology, sociocultural issues, and the issues related to the Japanese language itself [5]. The latter mainly focuses on the learning problems faced in each aspect of the Japanese language such as grammar, pronunciation, hiragana and katakana writings, and kanji. Kanji has been known to be one of the biggest hurdles in learning Japanese. This is mainly because each of the kanji has various ways of reading according to the context provided [6], [7]. Due to the complicated nature of the language, an adequate learning environment is necessary to nurture learners' autonomy in order to invoke their active learning of said language [8]–[10].

Indonesia has one of the highest numbers of Japanese learners in the world, just second to China [11], [12]. Indonesian education has also been impacted by this number through the various levels of education that Japanese have been taught in Indonesia, so far as becoming an accepted education major in many universities. However, many Indonesians have expressed their struggles in learning Japanese, especially Kanji. Aside from the quantity of the Kanji characters themselves, they mainly faced difficulties in determining the readings of the characters [13]. The Indonesian language is mainly based on the Roman alphabet, therefore making Kanji characters a foreign concept to its native speakers. With many Indonesians taking the Japanese Language Proficiency Test (JLPT) as a prerequisite to work and study abroad, it is furthermore made urgent due to kanji being closely attributed to their overall learning progress [14].

These factors increase the cognitive load for Indonesians in learning Kanji, making it harder to learn and in the end, inhibiting their learning progress.

Gamification is the process of applying game-like elements in non-entertainment contexts to help encourage behavioral growth and is known for increasing the user's motivation [15]. Gamification has seen a wide range of applications in daily life, providing positive experiences to help maintain the motivation of uses ranging from health [16], and commerce [17], to e-government services [18], and education, which includes language learning [19]–[22]. Gamification comes in many forms and implementations, such as adaptive gamification [23], medium-coupling game design [24], and mechanics-dynamics-aesthetics framework (MDA) [25]. These frameworks provide the tools to analyze and integrate game mechanics into mobile learning environments. The Octalysis framework is one novel gamification design framework with the introduction of the eight core drives, granting a potential for a deeper exploration of the main factors that help in increasing user retention and behavioral growth [26]. The Octalysis framework has shown the capability to design a learning system based on intrinsic motivators to enhance language learner's motivation in study performance, behavior, and immersion [27]. The Octalysis framework is considered to be more effective in providing interactive learning experiences to students through the incorporation of the core drives, thereby making it more suitable in online learning environments [28]. The utilization of gamification in language learning, especially in the digital environment, has shown a positive impact on student's motivation and learning outcomes to continue learning the language [29].

Smartphones as a learning media have been increasing in the past years [30]. This is largely because of the pandemic, where everyone is forced into an online classroom environment through their devices. Therefore, making smartphones a readily available resource for everyone as a learning media. Due to how the digital environment further expands the benefits of gamification, in this study, smartphones were chosen as the media to implement the elements of gamification in language learning. Android were used as the operating system of choice due to its great support from the open-source community, and allowing for easy access for the public when the application is published on the Google Play Store [31]. These factors are very important in order to develop an easily accessible mobile-assisted language learning application for the user. Moreover, Android has acquired 93% of the smartphone market share in Indonesia, therefore having the biggest number of users out of all the other smartphones across the country [32].

Mastering Kanji poses a significant challenge in Japanese foreign language acquisition. The introduction of the Octalysis gamification framework further enhances the potential for positive learning experiences, opening new avenues for m-learning in language education. Therefore, this study proposed to develop a mobile application based on the Octalysis gamification framework to aid beginner learners in specifically learning Japanese Kanji. This study aims to contribute to the theoretical and practical understanding of building an adequate Japanese language gamified m-learning experience with the Octalysis framework and exploring the factors that impacted the success of implementing gamification in the context of an m-learning environment.

2. Research Method

The research was conducted quantitatively using the Technology Acceptance Model (TAM) to assess the effectiveness of the Octalysis gamified m-learning application in helping students learn Japanese Kanji as seen in Figure 1. The questionnaire was designed in different segments. The first segment was used to record the respondents' demographic, and the subsequent segments were related to each variable of the TAM consisting of questions adopted from previous research that have been modified to suit the current study [33]–[36]. Each question utilized the 5-point Likert scale where the point would range from (1) being strongly disagree, and (5) being strongly agree.

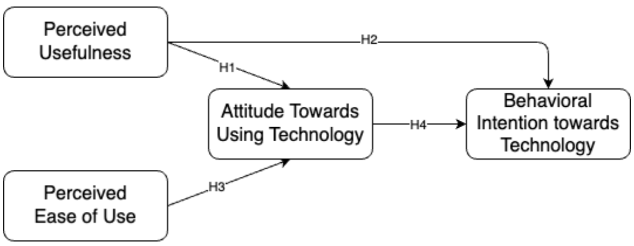


Figure 1. Technology Acceptance Model

2.1 Perceived Usefulness

Perceived usefulness (PU) pertains to the extent to which an individual believes that employing a specific technology would improve their learning performance [37]. Perceived usefulness has been shown in previous studies to have a significant association with one's attitude toward using the technology, and behavioral intention toward the technology [38], [39]. Therefore, this study hypothesized perceived usefulness as a factor that determines the attitude in using an m-learning application and the intention toward using said application.

H1: Perceived Usefulness affects the users' attitude toward the use of gamified m-learning application.
H2. Perceived Usefulness affects the users' intention toward using gamified m-learning application.

2.2 Perceived Ease of Use

Perceived ease of use (PEU) is defined as the degree to which an individual believes that a technology is easy to learn, reducing the burden required by the memory to operate the technology [40]. Perceived ease of use has been known to be a contributing factor to one's attitude toward using an m-learning application, showing a positive correlation [41]. This study thereby hypothesized that perceived ease of use contributes to the user's attitude toward using the application.
H3: Perceived Ease of Use affects the users' attitude toward the use of gamified m-learning application.

2.3 Attitude Toward Using the Technology

Attitude towards using (ATU) is defined as the response of an individual, whether positively or negatively when using a certain technology [42]. An individual's attitude in using the technology has been shown to be a strong motivator in their behavioral intention to use the m-learning application [43]. This study postulated that the user's attitude toward using the m-learning application positively affects their intention to use the application.
H4: User's attitude affects their intention in using gamified m-learning application.

2.4 Behavioral Intention Towards the Technology

Behavioral intention (BI) is defined as a mental process representing an individual's preparedness to engage in a new technology, serving as the precursor to the usage of the technology [39]. Because of its direct antecedence with the actual usage of a technology, behavioral intention is implied to be the factor that determines the acceptance of a new technology [43]. This study aimed to understand the acceptance of the gamified Japanese Kanji m-learning application through user's behavior intention in using the application.

A research question about Japanese learning is formulated about Japanese learning as well as reviewing previous literatures to unveil the problems and shortcomings in implementing m-learning to learn Japanese. The research question that has been formulated was used as the problem statement throughout the research process. As a result of the problem statement, a gamified m-learning application was developed as the media to study the effectiveness of gamification in helping students learn Japanese Kanji. Figure 2 below visualizes the chronological stages of the research, including problem formulation, application design, data collection and analysis, and drawing the conclusion.

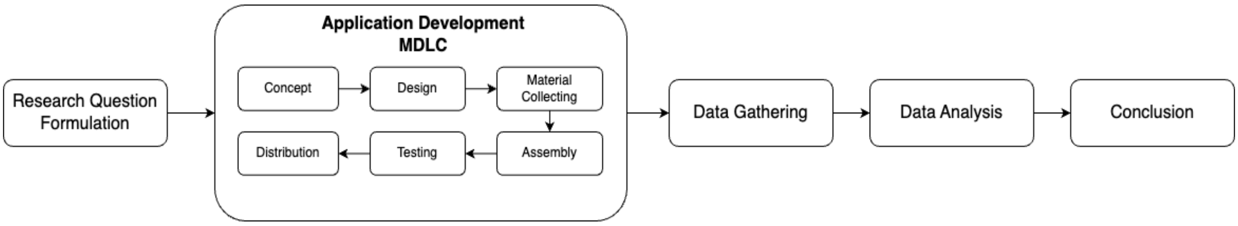


Figure 2. Research Stages

The gamified m-learning application was developed based on the existing problem statement and was done by following the Multimedia Development Life Cycle (MDLC) framework visualized in Figure 3. The MDLC framework proposed 6 steps of developing a system, namely the conception phase, designing the concepts, gathering materials for the implementation, assembling the system, testing, and distributing it to the public.

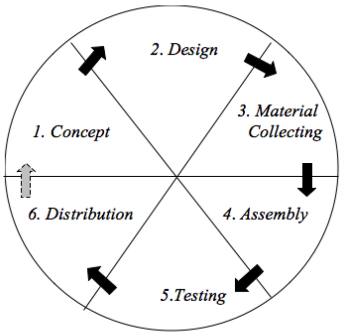


Figure 3. Multimedia Development Life Cycle

After developing the application, it is distributed along with the questionnaire to 200 members of the local Japanese learning community in Batam. The targeted respondents were those who had little to no experience of learning Japanese, were aged 18 or older, and had an Android smartphone. All the data that had been gathered were screened for outliers and incomplete data.

The remaining data that had been cleaned from the outlier were analyzed on the SPSS software for correlation between variables using the Structural Equation Model (SEM). The results of the analysis provide insight and assessment of the effectiveness of the Octalysis gamified m-learning application in helping students learn Japanese Kanji.

3. Results and Discussion

This study comprises of two different main stages. The first stage commenced the development of the gamified m-learning application. The application was developed using the the Dart programming language with the Flutter framework as it has shown to provide positive user satisfaction [44]. The second stage of the research continued with the study on the developed m-learning application on its acceptance among early Japanese learners.

3.1 Application Development

3.1.1 Concept Analysis

The application was designed with gamification in mind using the Octalysis framework. The octalysis framework focuses on the eight core drives that motivate someone in performing activities and decision-making [26], [45]. Figure 4 shows the entirety of the gamification elements present in the Octalysis framework. The designed application has at least one of each core drive which amounts to a total of 13 elements.

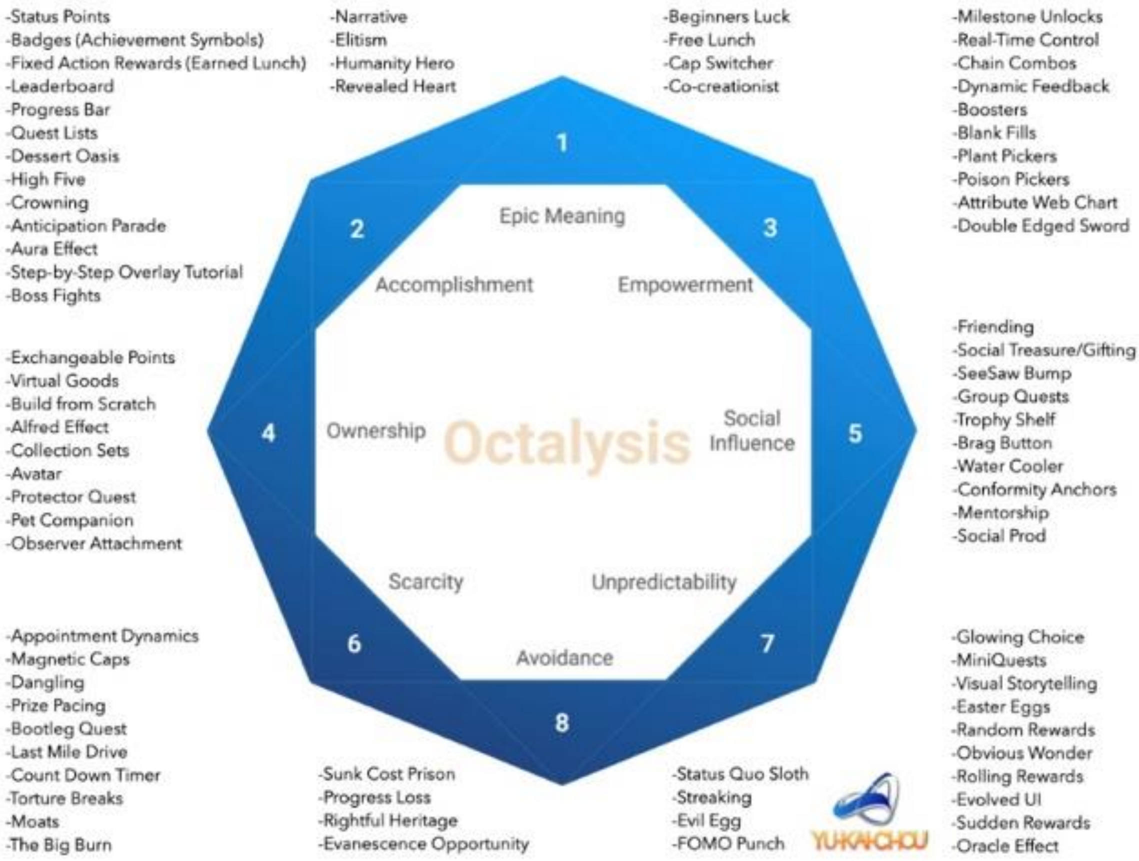


Figure 4. Octalysis Gamification Framework

The chosen elements of the gamification are detailed further on the implementation and then mapped into specific features of the m-learning application. Table 1 below lists the elements that are going to be present in the application. The result of the concept phase is a table of features listing the concrete implementation of each element in the application.

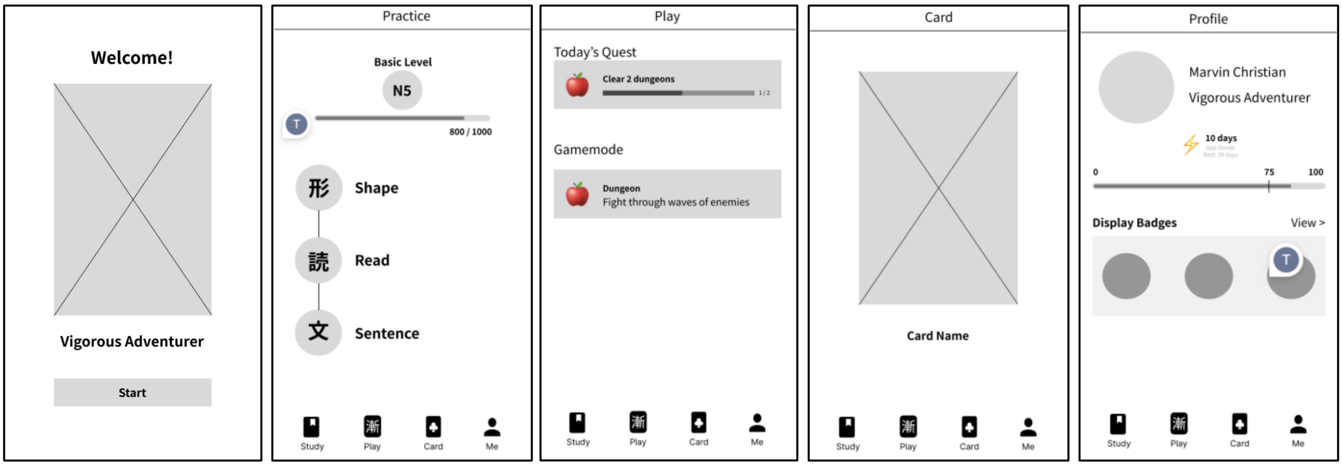
Table 1. Gamification Element Mapping

Core Drive	Element	Implementation
Epic Meaning	Free lunch	Hero card with unique titles
	Narrative	Overarching narrative
Accomplishment	Quest List	Daily Practice
		Daily Quest
	Progress Bar	Experience Level
	Badges	Achievements
Empowerment	Poison Pickers	Different types of playable cards
Ownership	Build-from-scratch	User-created collections
Social Influence	Trophy Shelves	Badge Shelf
Scarcity	Dangling	Three lives per day
Unpredictability	Mystery Box	Random reward after each game
Avoidance	Rightful Heritage	Sign-in to save flashcards
	Sunk Cost Prison	Depleted life if they leave mid-game
	Streaking	Practice streaks and highest streaks

3.1.2 Design

The design of the application began with a low-fidelity prototype design, where a representation of what the application is going to look like was sketched out. At this stage, the focus of the design was the layout of each element and the visual image of the implementation for each gamification element that has been mapped prior.

Figure 5 below shows the layouts for the four main menus of the application. Figure 5a encapsulates the onboarding phase of the application and introduces the Free Lunch element of unique titles, and overarching narrative into the application. Figure 5b presents the practice screen containing the first half implementation of the Quest List element and the Experience Level of the Progress Bar element. Figure 5c presents the play screen containing the second half of the Quest List element, Poison Pickers, Dangling, Mystery Box, and Sunk Cost Prison. Figure 5d presents the card screen containing the Build-from-scratch and Rightful Heritage elements. Figure 5e presents the user profile screen containing the Badges, Trophy Shelves, and Streaking elements of the gamification.



(a) (b) (c) (d) (e)

Figure 5. Low-fidelity Prototypes for the Main Menus

3.1.3 Material Gathering

The material gathering phase began with the introduction of content to the layouts. In this phase, 103 Japanese Kanji of the N5 level were selected and prepared in JSON format to be inserted into the application at a later stage. In the current layout sketches, UI elements were also collected and implemented to enhance the visual of the application. The UI elements such as the color schemes, themes, and application logo were decided at this stage to advance the low-fidelity prototype into a high-fidelity prototype. Digital assets such as badges, icons, and player cards were also designed accordingly with the color scheme as seen in Figure 6.

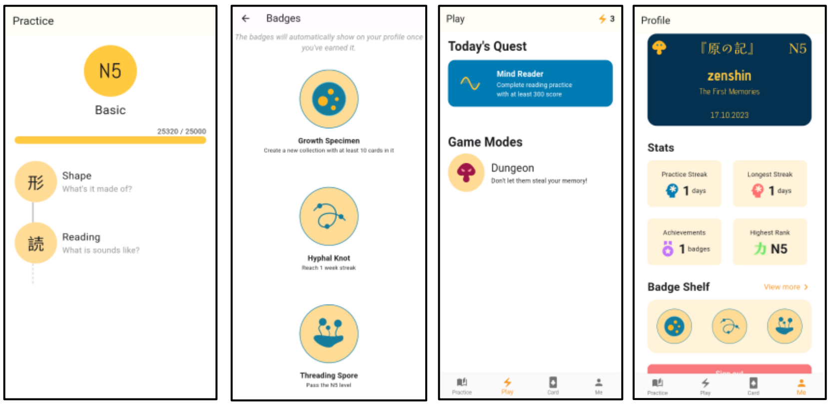


Figure 6. High-Fidelity Prototypes with Badges, Icons, and Player Cards

3.1.4 Assembly

The application assembly took place as soon as the high-fidelity prototype was finished. This phase began with the analysis of the system overall flow, and data model which the application uses to store user's data throughout the use of the application. The data were stored in two different sources, caches and states were stored in-memory using the SharedPreferences API, and persistent data were stored in a cloud database via Firebase Firestore.

Figure 7 describes the flow of the practice functionality, where 3 kanjis were randomly chosen and used for the daily practice. Each kanji has a countdown timer that translates to the score that the user receives, where the quicker they guess correctly, the higher their point. At the end of the practice session, their score was used as a gauge to measure the experience points they get and whether or not they receive a badge for it.

Figure 7. Practice Feature Flowchart

Meanwhile, Figure 8 describes the flow of the play functionality. The initial process began with a setup of a periodic state listener that continually decreased the player's health points throughout the game. The setup process proceeded by preparing the kanji options and depleting the player's life as the implementation of the Sunk Cost Prison element. After the setup is complete, the user can pick a card, and answer the kanji written on the card. The program checks for the answer, and if it is correct, it adds the timer on the state listener thereby increasing the player's health, and calculates the damage dealt to the enemy. The game ends when either the player's health point reaches zero, which triggers the "lose" screen, or when the enemy is defeated which triggers the "win" screen. After the game ends, the program resets all states related to the game to ensure a clean experience for each game.

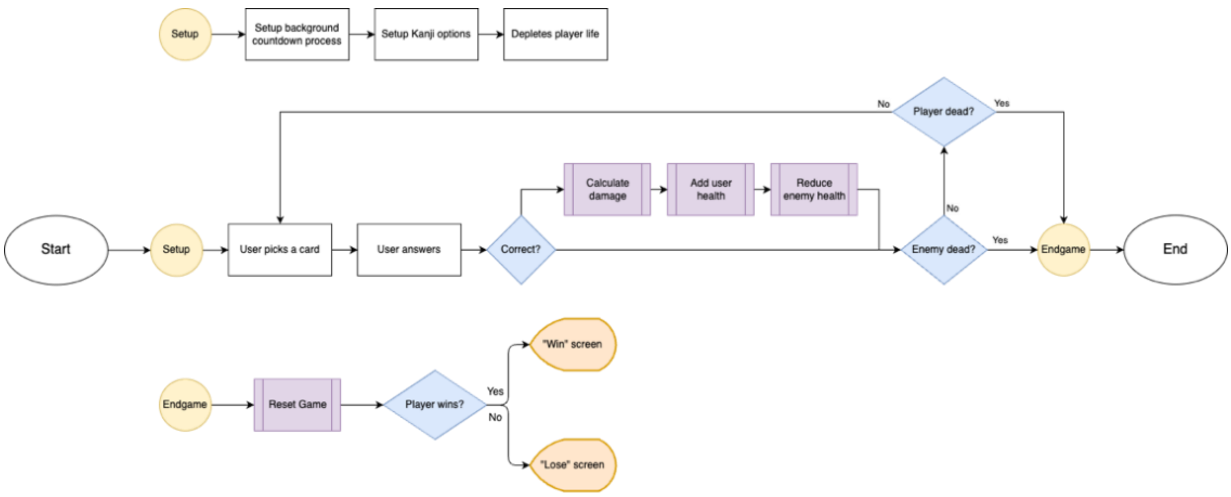


Figure 8. Play Feature Flowchart

3.1.5 Testing

The testing of the application was done through black-box testing, where the functional requirements were assessed to see if the application was fit for use. The black-box test was conducted using the release APK on a real phone to simulate valid user interaction on the application, unveil potential bugs and features that are not functioning properly. The scenario of the black-box test is documented in table 2 along with the conclusion based on the actual and expected result.

Table 2. Black-box Testing Result

Test Item	Expected Result	Actual Result	Verdict
Register screen	User is able to make a new account and receive a hero card with title	User is able to make a new account and get a custom hero card with title	Passed
Login screen	User is able to log into the application with the account they registered	User is able to get into the application and see their data	Passed
Practice screen	User is able to play by clicking the icon and see their exp level	The exp bar is shown clearly, and user can click the icon to play	Passed
Daily quest	The daily quest is refreshed every day at 12 AM and be completed	The quest is updated every day and can be completed based on the requirement	Passed
Play screen	The health bar decreases gradually and user can answer the cards to attack the enemy	The health bar decreases as the game progresses, and user can pick a card to answer and attack the enemy	Passed
Player card	User can see the player card with their name and title	The player card is shown with the user's name and title	Passed
Achievements	User can see the list of badges and achieve them based on the requirements	The badges can be seen and achieved based on the requirements	Passed
Daily practice streak	User can see their streak based on the consecutive days they've practiced	The streaks are displayed and updated according to the days they've practiced	Passed
Daily lives	User only have three lives to play the game each day and it is depleted each game or if they leave mid-game	Three lives are provided and they're depleted once they've played or left mid-game	Passed

Beyond black-box testing, based on the response from the questionnaire, over 88% of the users reacted to the Japanese m-learning application positively. They expressed engagement in using the application to learn Japanese Kanji, and even stated that it helped them to be motivated in learning Kanji while using the application. Along with the successful black-box testing scenarios, the m-learning application was considered ready to be distributed.

3.1.6 Distribution

Once the application's tested yielded positive results from the black-box testing, the APK was built and signed for its release version. This release APK contains the final working application without the debugging widgets and components in the way of the experience. The distribution of the APK was done in tandem with the research questionnaire via a link attached on the Google Form with an additional tutorial and guide on how to install the application on an Android phone that can be followed easily.

3.2 Research Findings

3.2.1 Respondent Profile

The questionnaire was distributed to a total of 194 respondents. The results gathered were checked for outliers using the z-value descriptive analysis method. The analysis considered the dataset clear of any outliers. The respondents in this study were members of local Japanese language learning community with little to no background in learning Japanese. The majority of the respondents were aged 18 to 21 years old with over 93% of the total respondents as presented in Table 3.

Table 3. Respondents' Age

Age Range	Frequency	Percentage
18 – 21	181	93.3%
22 – 25	12	6.2%
> 25	1	0.5%
Total	194	100%

Table 4 shows that there were also quite a handful of the respondents who did not have prior background of learning Japanese, amounting to a total of 62.9%.

Table 4. Respondents' Experience

Experience	Frequency	Percentage
Have Prior Experience	76	39.1%
No Prior Experience	118	62.9%
Total	194	100%

3.2.2 Instrument Validity

The research instruments were tested for its accuracy in measuring its intended indicators through the validity test. The Pearson's Product Correlation method was used to assess the validity of each question item through its correlation value. An indicator is deemed valid when its correlation value is higher than 0.5 [46]. Table 5 indicates that the test yielded correlation values above 0.5 indicating the validity of the research instrument.

Table 5. Instrument Validity Analysis

Indicator	Variables			
	Perceived Usefulness	Perceived Ease of Use	Attitude Towards Using	Behavioral Intention
PU01	.860			
PU02	.817			
PU03	.842			
PU04	.796			
PU05	.763			
PU06	.816			
PEU01		.779		
PEU02		.852		
PEU03		.754		
PEU04		.807		
PEU05		.734		
PEU06		.806		
ATU01			.810	
ATU02			.848	
ATU03			.772	
ATU04			.696	
BI01				.794
BI02				.887
BI03				.794
BI04				.928

3.2.3 Instrument Reliability

The research instrument was also tested for reliability to assess its consistency in providing accurate results. The reliability test was done by measuring the Cronbach's Alpha for each of the research variables. A variable is deemed reliable if the measured alpha is above 0.7 [47]. The test yielded alpha values ranging from 0.788 to 0.899 which regarded the instrument to be reliable as can be seen in Table 6.

Table 6. Instrument Reliability Analysis

Variable	Cronbach's Alpha	Verdict
Perceived Usefulness	.899	Reliable
Perceived Ease of Use	.878	Reliable
Attitude Towards Using	.788	Reliable
Behavioral Intention	.873	Reliable

3.2.4 Data Analysis

After the data has been assessed for validity and reliability, the statistical significance was analyzed through model analysis using SPSS AMOS. This allows us to further study the acceptance factor of Octalysis gamification in Japanese m-learning application, and to prove the research hypotheses. To achieve this, the previously tested and prepared datasets were imported into the model represented in SPSS AMOS and then calculating the influencing key factors using SEM.

According to the SEM analysis shown in Table 7, three of the proposed alternative hypotheses are accepted, with one null hypothesis accepted. It is shown that perceived usefulness and perceived ease of use have statistically significant positive correlations with one's attitude in using the application. This is indicated by the positive estimated path coefficient values (β = 0.176 and β = 0.803) and very low probability values ($p < 0.001$) signified by "***" therefore accepting the alternative hypotheses H1 and H3. The findings also noted a significant positive correlation between one's attitude towards using the application with their intention (β = 1.740, $p < 0.001$) and accepting the alternative hypothesis H4. However, it is shown that there is a significant negative correlation between perceived usefulness and behavioral intention (β = -0.674, $p < 0.001$), thus rejecting the alternative hypothesis of H2.

Table 7. SEM Analysis Result

Hypothesis	Path	β	S.E	C.R.	P-Label	Verdict
H1	PU → ATU	.176	.022	7.909	***	Accepted
H2	PU → BI	-.674	.044	-15.220	***	Rejected
H3	PEU → ATU	.803	.044	18.077	***	Accepted
H4	ATU → BI	1.740	.084	20.764	***	Accepted

3.2.5 Discussion

The study focused on determining the impact of a gamified Japanese Kanji m-learning application in user's acceptance and helping them learn more effectively using the model based on TAM. Based on the analysis done through the SEM method, the first hypothesis (H1) was accepted, denoting that the more useful a gamified m-learning application is, the more likely they're going to use it and positively affects their attitude. The similar result applies to the acceptance of the third hypothesis (H3), indicating when the gamified application is easy for them to use, it positively affects their attitude in using the application. This result agrees with previous studies related to gamification in mobile learning [36], [48].

From the analysis, it is also shown that the fourth hypothesis (H4) is accepted with a strong positive correlation. This signifies that their positive attitude towards using the gamified m-learning application increases their intention and engagement in incorporating the application into their learning journey. This result agrees with previous studies stating a positive correlation between the two variables [36].

However, according to the result, the second hypothesis (H2) is rejected with a negative significant correlation. This result contradicts the findings from a previous study by (Panagiotarou, 2020) [48]. It is indicated that the less useful they perceive the application to be, the more likely they're going to engage with the application. This hints at the perceived usefulness of a technology does not play an important role in increasing user's intention and motivation of using the application.

4. Conclusion

This research focused on studying the impact of gamification on the acceptance of Japanese Kanji m-learning for the beginner level using the Technology Acceptance Model analyzed through Structural Equation Model. This research observed the four main variables of TAM, namely Perceived Usefulness, Perceived Ease of Use, Attitude toward Using, and Behavioral Intention. The result showed significant relationships between *Perceived Usefulness* and *Attitude toward Using,* describing the more useful the application is, the more positively it affects the attitude toward using the application in helping them learn Japanese. It is also noted that *Perceived Ease of Use* showed a similar relationship with *Attitude toward Using*, which describes the easier it is to operate and navigate through the application, the more positively it affects their attitude. Another positive correlation was also observed between *Attitude toward Using* and *Behavioral Intention*, describing the more positive they feel toward the application, the more it engages them in using the application. However, a negative correlation was shown between *Perceived Usefulness* and *Behavioral Intention*, this indicated an increase in the application's usefulness shows a decrease in their intention and engagement of using the application.

This study postulated the importance of gamification as a medium to help increase students' experience in learning Japanese Kanji. To successfully implement the gamification, there are several points to look after, mainly the balance put into the application's usefulness and a focus on developing a user-friendly interface of the application to promote the ease of use.

To further advance this study, it is possible to explore various elements, mainly developing an m-learning application to support other foreign language learning, or even branching into other fields. Furthermore, a better synergy between the Octalysis elements could be improved by mapping and incorporating elements of complementary core drives. Local members of the Japanese community were the main participants of this study which caused an uneven distribution of the members' experience in learning Japanese and a limited population. Future studies are recommended to enlist participants from different regions, and conceivably with higher overall Japanese skill levels.

Notation
β : Estimated path coefficient
S.E. : Standard error.
C.R. : Critical ratio.

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