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DEVELOPMENT OF A MOBILE GAMIFIED INTERFACE FOR JAPANESE LANGUAGE LEARNING THROUGH DESIGN THINKING

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ABSTRACT

Learning Japanese scripts such as hiragana and katakana often present significant challenges for beginners due to the similarity in character shapes, the large number of characters to memorize, complex stroke orders, and the limited use of engaging and interactive learning media. Without proper learning strategies and tools, learners may quickly lose motivation and face difficulties in mastering these basic writing systems. This study aims to design the interface of a mobile-based gamified learning platform intended to increase learner motivation and improve the overall effectiveness of the learning process. The Design Thinking methodology was employed to gain in-depth insights into user needs, involving five iterative stages: empathize, define, ideate, prototype, and test. The resulting interface integrates gamification elements such as points, badges, levels, and quests to create a more engaging user experience. Usability testing conducted using the System Usability Scale (SUS) produced an average score of 82.5, which falls under the "excellent" category with a letter grade of B. These findings suggest that the developed interface is intuitive, easy to use, and well-received by users.

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I. INTRODUCTION

THE paradigm of modern education today emphasizes the importance of mastering 21st-century skills, which include not only digital literacy, collaboration, and critical thinking, but also the ability to independently manage and develop knowledge with the support of technology [1]. This transformation is driven by the emergence of one-to-one learning initiatives, which position mobile devices as the primary tools in facilitating teaching and learning processes [2], [3]. Mobile devices have become increasingly feasible for use in educational contexts due to improvements in wireless connectivity, portability, and their capacity to accommodate diverse learning needs in a flexible manner [4].

In parallel with this shift, there is a growing need to develop learning approaches that are not only adaptive but also engaging and interactive. One promising approach in this regard is gamification, the application of game elements such as points, badges, and leaderboards into non-game contexts like education, to enhance learner motivation and engagement [5]. In the context of foreign language learning, including Japanese, gamification has proven to be an effective instructional strategy to boost enthusiasm and retention through more enjoyable and stimulating learning experiences [6].

To ensure that mobile learning applications truly align with user needs, the Design Thinking approach is adopted as the design framework. This user-centered methodology focuses on a deep understanding of the user experience through five key stages: Empathize, Define, Ideate, Prototype, and Test. By integrating mobile learning, gamification, and Design Thinking, this study aims to design and develop a prototype interface for a Japanese language learning application that is not only pedagogically effective, but also enjoyable, user-friendly, and aligned with the real needs of today's learners.

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II. LITERATURE REVIEW

1) *Mobile-Gamification*

Mobile learning is an instructional method that enables learning to take place anytime and anywhere through the use of mobile devices. It is considered a dynamic and interactive form of learning that allows flexible access to learning resources, aiming to enhance student engagement and support personalized learning experiences [7]. With mobile learning, learning flexibility becomes possible. However, this flexibility alone may not be sufficient to fully support autonomous learning, and thus requires the integration of complementary strategies. One such approach is the implementation of gamification as a supporting concept or method. Zainuddin et al. define gamification as the application of game mechanics in non-game contexts with the purpose of motivating, engaging, and enhancing the user experience [8]. In educational settings, gamification is implemented through various mechanisms such as content-level progression, reward systems (e.g., points or badges), and leaderboards. This concept seeks to improve the learning process by incorporating elements of enjoyment and fun [9].

The application of gamification in mobile learning environments, referred to as mobile gamification is an approach that integrates game elements within the flexible use of mobile devices to create more engaging and enjoyable learning experiences. Khaddage et al. argue that mobile gamification is essential, particularly because the current generation of learners are digital natives, many of whom are accustomed to gaming and the use of mobile technologies in their daily lives [10]. Therefore, this strategy is considered effective in sustaining their engagement in learning. Furthermore, mobile gamification has been shown to improve learning performance and significantly boost learner motivation compared to conventional learning approaches [11].

a) *Gamification Elements*

Gamification, as a game-based concept, consists of various elements such as points, levels, badges, rewards, and quests [9]. These elements are selected to create an interactive and enjoyable learning experience, while also serving to motivate learners in effectively mastering Japanese language content. In the interface design of the learning platform, each element is carefully chosen based on its specific pedagogical function:

- Points are used to reward correct answers submitted by learners in assigned tasks.
- Levels represent learners' progress and act as an indicator of difficulty across different learning materials.
- Badges are awarded as symbols of achievement upon the successful completion of specific learning milestones.
- Quests are structured challenges designed to assess learners' comprehension of the presented material.

2) *Design Thinking*

The Design Thinking method has gained significant attention in recent years [12], due to its ability to address complex problems across various industrial contexts [12], [13]. According to Brown, Design Thinking was initially introduced and applied in the business and education sectors [15], and has since evolved to be widely adopted in the field of information technology (IT). This method is recognized as a relevant and innovative approach in facing the challenges of the Fourth Industrial Revolution, while also promoting the development of 21st-century skills such as critical thinking, collaboration, and creativity [13]. Conceptually, Design Thinking is a user-centered problem-solving approach grounded in empathy toward human needs and experiences [16]. It also emphasizes the importance of creativity and innovation throughout the design process. According to the d.school at the Hasso Plattner Institute of Design, Stanford University, the Design Thinking process consists of five key iterative stages: Empathize, Define, Ideate, Prototype, and Test (see Figure 1). These stages are cyclical, allowing for repeated refinement of solutions.

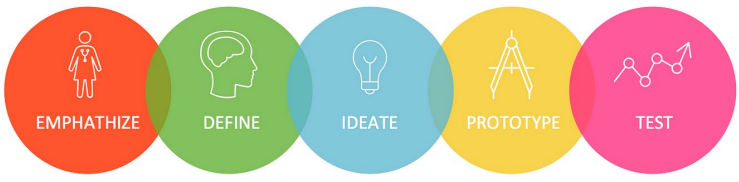

Figure 1. Stages in Design Thinking

The first stage, Empathize, is considered the most crucial as it focuses on developing a deep understanding of users' emotions, needs, and motivations [17], [18]. In the Define stage, the insights gathered are synthesized to formulate a clear and specific problem statement [19], [20].. The third stage, Ideate, aims to generate a wide range of creative ideas and alternative solutions. These ideas are then transformed into early representations in the Prototype stage, which may take the form of interface mockups or physical models with limited functionality. Finally, in the Test stage, the prototypes are evaluated through user feedback to improve and refine the proposed solutions [20].

3) Japanese Language Learning

Japanese language learning involves the mastery of four fundamental skills: listening, speaking, reading, and writing, as well as an understanding of the unique Japanese writing system, which consists of three types of scripts: hiragana, katakana, and kanji. Instruction in Japanese typically covers essential vocabulary, basic grammar, and simple sentence structures used in everyday conversation.

III. METHODS

This study employed a Research and Development (R&D) approach aimed at designing and developing a mobile gamification-based Japanese language learning application. Additionally, the design thinking methodology was applied as a guiding framework to help the researcher develop a product tailored to the users' needs. The target users of this study were eleventh-grade students at a public high school at Kuta, Bali who selected Japanese as an elective subject. The selection of these participants was based on the characteristics of the intended users of the application—namely, learners who are beginners in studying the Japanese language. By following the five stages of the design thinking method, the data collection and analysis techniques used in this study are outlined as follows:

1) Emphatize

Initial data collection was conducted through interviews with an experienced Japanese language teacher to identify the needs and challenges encountered in learning Japanese. Table 1 presents the list of questions posed to the interviewee. The outcome of this stage was the development of an empathy map, consisting of four quadrants: said, did, thought, and felt, to articulate the interview results in a detailed and structured manner [15].

TABLE 1.
INTERVIEW QUESTIONS USED IN THE EMPATHIZE STAGE

ID Question	Question Item
N-01	Are there any issues encountered in the process of learning Japanese?
N-02	What are the difficulties faced in memorizing Japanese characters?
N-03	What are the challenges in writing Japanese characters?
N-04	What are the challenges in using Japanese characters in context?
N-05	Is there a need for learning media to support Japanese language acquisition?
N-06	Is it necessary to have an integrated platform for learning all aspects of the Japanese language?
N-07	Is gamification suitable for the development of Japanese language learning media?
N-08	How should the instructional material be structured in a gamified learning platform?

2) Define

In this stage, the designer identifies the core problems that cause frustration or significant obstacles in achieving the goals of Japanese language learning. One or more user personas are also developed at this stage, fictional characters created to represent specific target users [19].

3) Ideate

The ideation stage focuses on generating innovative solutions based on the problems that have been narrowed down and defined in the previous stage (i.e., *define*). At this point, as many ideas as possible are developed, since the design thinking approach encourages broad exploration (go wide), pushing beyond the boundaries of the initially identified problems [15], [19].

4) Prototype

The prototype stage is carried out to realize the proposed solutions [17]. The prototype was developed iteratively,

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starting from a low-fidelity prototype using wireframe designs created with draw.io, progressing to a high-fidelity prototype developed using Figma as the design framework.

5) Test

This stage aims to evaluate the developed prototype. The evaluation in this study focused on the usability of the designed user interface. A standardized questionnaire instrument, the System Usability Scale (SUS) [21], was used during this stage, consisting of 10 questionnaire items. Table 2 presents the SUS items utilized in this evaluation.

TABLE 1I.
INTERVIEW QUESTIONS USED IN THE EMPATHIZE STAGE

ID Question	Question Item
SUS-01	I feel that I would use this Japanese language learning application frequently.
SUS -02	I find this Japanese language learning application to be overly complex.
SUS -03	I find this Japanese language learning application easy to use.
SUS -04	I think I would need technical support to be able to use this Japanese language learning application.
SUS -05	I feel that the features in this Japanese language learning application are well integrated.
SUS -06	I find too much inconsistency within this Japanese language learning application.
SUS -07	I believe that most people would learn to use this Japanese language learning application very quickly.
SUS -08	I find this Japanese language learning application to be confusing to use.
SUS-09	I feel confident using this Japanese language learning application.
SUS-10	I feel that I would use this Japanese language learning application frequently.

IV. RESULTS AND DISCUSSION

1) Design Thinking Procedure

The Design Thinking method was applied in designing a mobile gamification-based learning media for Japanese language education. This section presents the outcomes derived from the implementation of the research method as previously described.

a) Emphatize

An empathy map was used to identify the users' difficulties and needs, allowing the developers or designers to view the problem from the users' perspective when designing the interface. The results of this stage can be seen in Figure 2.

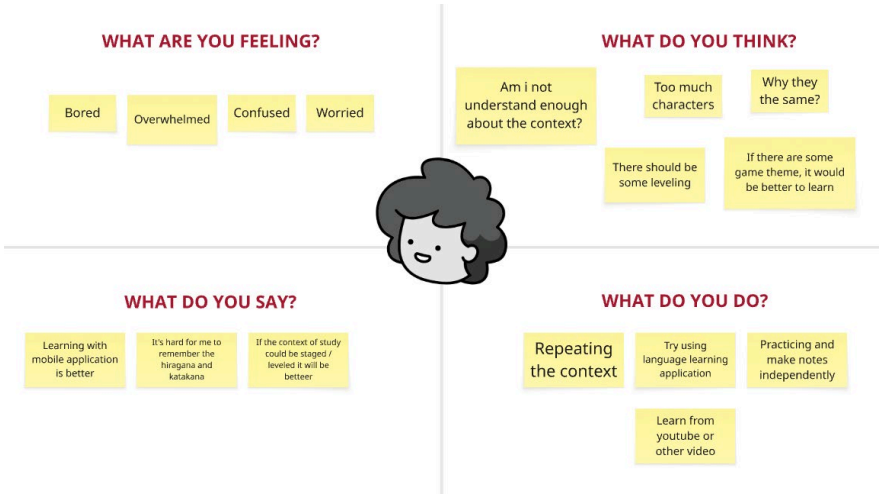

Figure 2. Result of Empathy Map

b) Define

Based on the results obtained from the empathize stage, a deeper understanding was gained regarding the users' needs, challenges, and learning habits in studying the Japanese language. These findings were further analyzed and formulated into a list of key learning difficulties in Japanese language education, as presented in Table 3. The list of difficulties above then served as the foundation for creating a user persona. A user persona is used to represent the general characteristics, needs, and challenges experienced by users, thereby assisting in designing solutions or

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interfaces that align with user expectations. Based on the table of difficulties, the resulting user persona is presented in Figure 3.

TABLE III.
LIST OF DIFFICULTIES IN LEARNING JAPANESE

ID Question	Question Item
K1	Difficulty in memorizing kana characters (hiragana and katakana)
K2	Confusion in distinguishing similarly shaped characters
K3	Unfamiliarity with the stroke order and writing method of Japanese characters
K4	Lack of knowledge regarding character pronunciation
K5	Limited availability of engaging and interactive learning media
K6	Absence of immediate feedback for learners
K7	Low motivation due to the lack of a reward or progress tracking system

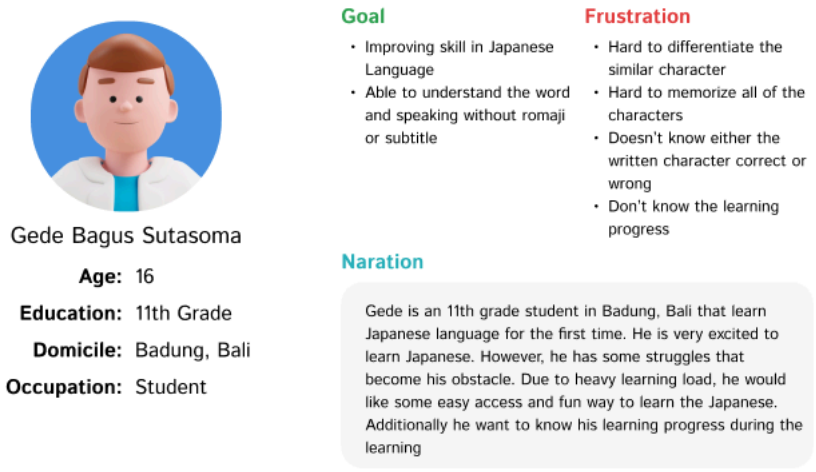

Figure 3. User Persona

c) Ideate

After the users' problems and needs were defined in the define stage, the next step was to develop ideas or solutions to address the identified issues. The solutions generated in the ideate stage would form the core features in the interface design of the Japanese language learning media. This stage also resulted in the creation of a wireframe, serving as a foundational structure to support the development of a high-fidelity design. Figure 4 shows the low-fidelity design of the features to be developed, consisting of four main menus: drill learning, romaji quiz, handwriting quiz, and character speak quiz. The sequence of use is designed to be sequential, meaning users must first complete the drill learning menu before proceeding to the next stages.

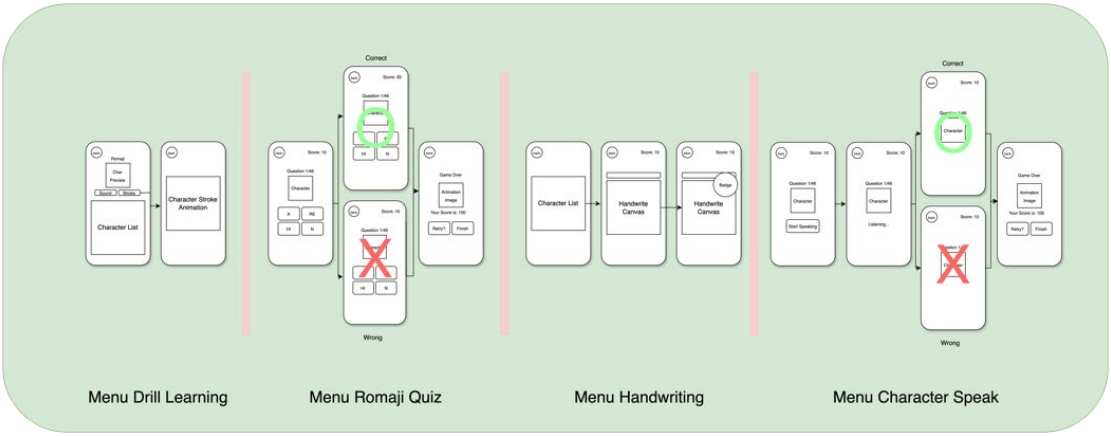

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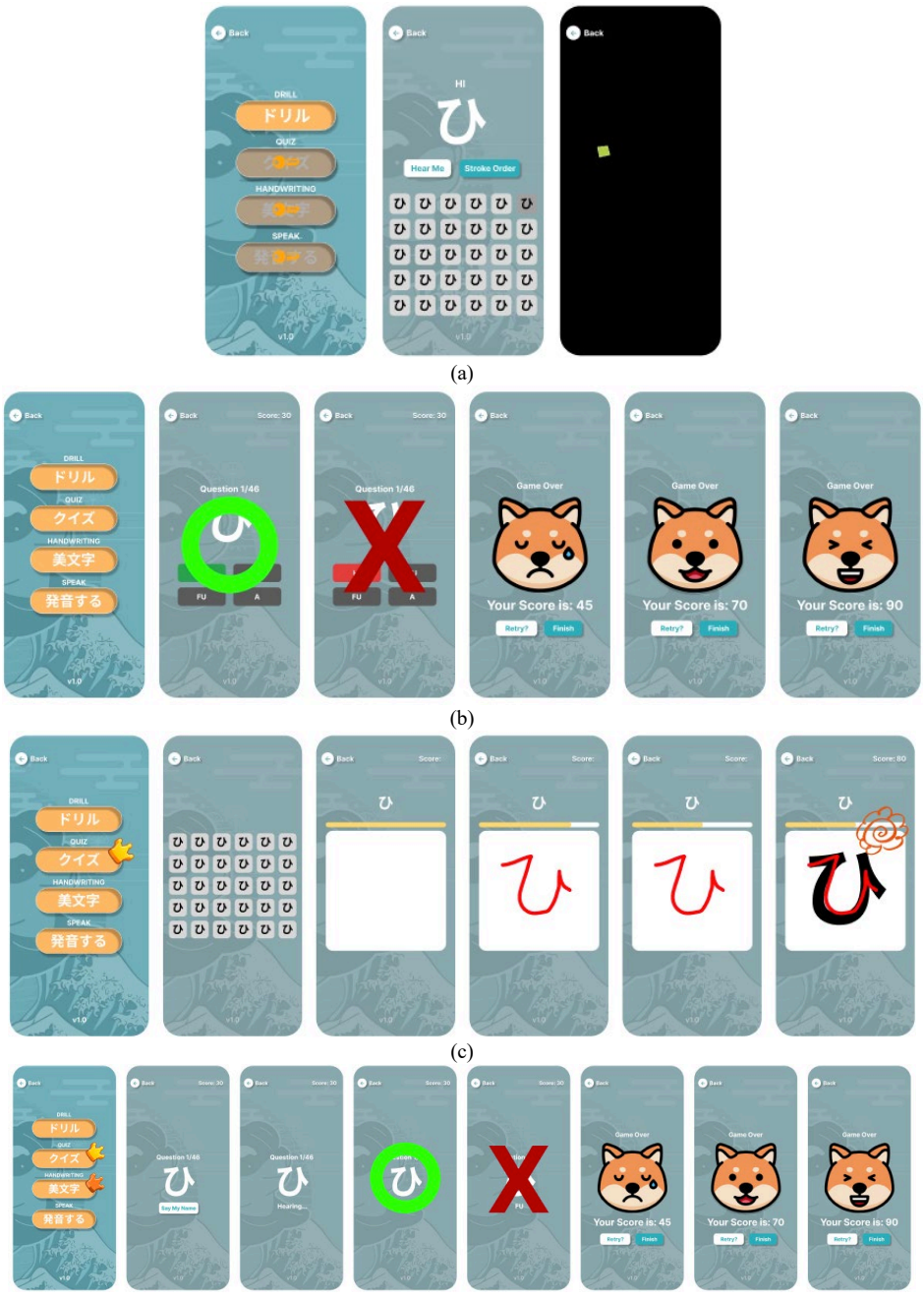
Figure 4. Low-Fidelity Design

- Drill Learning: This is the basic feature where users can first learn the character names, pronunciation of each character, and stroke order for writing each character.
- Romaji Quiz: This feature allows users to test their memory of the romaji (Latin script) equivalents for each Japanese character.
- Handwriting Quiz: Using this feature, users can assess the accuracy and correctness of their handwriting for each Japanese character.
- Character Speak Quiz: This quiz is provided to test the users' pronunciation of the displayed characters, allowing them to practice and evaluate their speaking skills.

d) Prototype

The previously developed low-fidelity design was then further refined into a high-fidelity prototype by incorporating color schemes, graphics or illustrations, and various gamification elements. At this stage, users are able to interact with the prototype, although the features are not yet fully functional. Therefore, the next stage requires more comprehensive system development to ensure full implementation and functionality.



(d)

Figure 5. High Fidelity Prototype; (a) Drill Learning; (b) Romaji Quiz; (c) Handwriting Quiz; (d) Speaking Character

e) Test

The usability testing was conducted using the System Usability Scale (SUS) method, which employs a numerical rating scale ranging from 1 to 5. A score of 1 represents a negative response or strong disagreement, while a score of 5 indicates a positive response or strong agreement from the respondents. The results from the administered questionnaire are presented in Table 4. Based on the results of the administered questionnaire, the average SUS score obtained was 80.625, which corresponds to a letter grade of B in the SUS grading method. This letter grade indicates that the designed interface is considered "excellent" according to the adjective rating scale. The conversion of the SUS score to the grading and adjective rating methods is shown in Figure 6.

TABLE IV.
RESULT OF SUS QUESTIONNAIRE

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Score of SUS
R1	5	2	5	1	5	1	5	1	5	2	95
R2	4	2	5	1	5	2	4	1	5	1	90
R3	4	2	5	2	4	2	4	2	3	3	72,5
R4	5	2	4	2	5	2	4	3	5	3	77,5
R5	4	3	5	4	4	2	5	1	4	2	75
R6	4	2	5	4	5	2	5	1	5	2	82,5
R7	4	2	4	2	4	2	5	1	4	2	80
R8	5	2	5	1	4	2	4	1	5	2	87,5
R8	5	2	4	2	5	2	4	2	3	2	77,5
R10	4	2	5	1	5	1	4	1	3	1	87,5
R11	5	1	4	2	5	1	5	2	5	1	92,5
R12	4	2	4	4	4	2	3	2	3	2	65
R13	5	2	4	2	4	1	3	1	3	1	80
R14	5	2	5	1	4	2	5	2	4	2	85
R15	3	1	5	2	4	1	5	1	4	2	85
R16	2	2	4	2	4	2	4	2	2	2	65
R17	5	2	5	1	5	1	4	1	4	2	90
R18	5	1	5	2	5	3	5	2	5	1	90
R10	4	2	4	2	3	2	3	2	3	2	67,5
R20	3	2	4	2	3	2	4	2	3	2	67,5
					Average score of SUS						80,625
					Grade Score						B

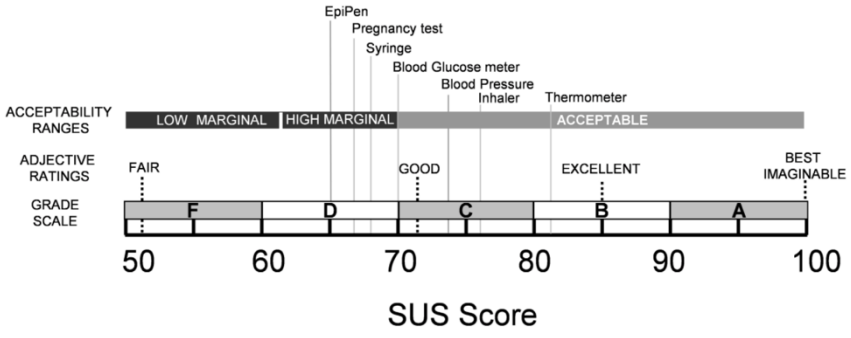


Figure 6. SUS Score Conversion Matrix

2) Discussion

The interface design of the Japanese language learning media based on mobile gamification was carried out through the five stages of Design Thinking: empathize, define, ideate, prototype, and test. During the empathize stage, several issues were identified, including: (1) learners having difficulty distinguishing kana characters; (2) learners struggling to memorize kana; (3) lack of knowledge about the pronunciation of each character; (4) unfamiliarity with the stroke order of writing kana; (5) and low motivation due to the lack of interactive media. These issues were then grouped into several key points in the define stage.

Based on the identified problems, the ideate stage generated a solution in the form of a mobile gamification-based learning media, incorporating game elements such as points, levels, badges, and quests. This idea was then tested in the prototype stage using the System Usability Scale (SUS) method. The results of the SUS test conducted with 20 respondents showed an average score of 82.5. This score falls under the "excellent" category in the SUS scoring conversion matrix. This indicates that the designed media interface is easy to use and well-received by users. These findings are consistent with the study by Destriani & Heroza, which found that combining Design Thinking with gamification results in high acceptance in educational media design [22]. Furthermore, gamification has been shown to enhance both learner motivation and performance [23]. Additionally, the Design Thinking approach enables the development of solutions that address problems effectively and can even lead to creative breakthroughs [24].

V. CONCLUSION

Based on the research conducted, several key findings were identified:

1. The interface design process of the learning media adopted the Design Thinking approach, which consists of five stages: empathize, define, ideate, prototype, and test.
2. Japanese language learning presents several challenges, including difficulties in memorizing and distinguishing kana characters, lack of familiarity with character writing, and the use of learning media that lacks interactivity.
3. The high-fidelity prototype of the learning media interface achieved an average score of 82.5, which falls under the "excellent" category. This score indicates a high level of user acceptance and ease of use for the designed interface.

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