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INTEGRATING GAME-BASED LEARNING AND COGNITIVE STRATEGIES IN KANJI INSTRUCTION: A CASE STUDY OF 'KANJI JOURNEY' RPG FOR JAPANESE JLPT N5 LEARNERS

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Abstract

This study evaluates the effectiveness of integrating game-based learning (GBL) and cognitive strategies in kanji instruction through an RPG-based educational game called Kanji Journey. A mixed-methods quasi-experimental design was employed using the ADDIE development model to enhance kanji retention among JLPT N5 learners. The game integrated repetition, narrative flow, and instant feedback, grounded in Dual Coding and Cognitive Load theories. Results showed a significant improvement in learners' post-test scores because the visual-verbal integration and gamified repetition reduced cognitive load and strengthened memory pathways. Learners also demonstrated higher motivation and engagement due to the interactive storyline, level progression, and contextual kanji usage. Expert validation confirmed that the game was pedagogically appropriate and technologically feasible. These findings suggest that RPG-based learning tools can effectively support kanji memorization and learner engagement. The study provides implications for designing cognitively aligned, inclusive digital media consistent with Sustainable Development Goals (SDGs) no 4, promoting quality and accessible language education.

Keywords: Cognitive strategies, Game-based learning, Japanese kanji, Memory retention, RPG.

1. Introduction

In the era of digital education, integrating technology into language instruction has become an essential strategy to increase learner engagement and improve cognitive outcomes. One increasingly popular method is game-based learning (GBL), which embeds game elements, such as challenges, narratives, repetition, and rewards, into the learning process to create interactive and immersive experiences [1]. GBL has been shown to enhance student motivation and support memory retention through visual and contextual learning pathways [2].

In Japanese language education, especially at the JLPT, mastering kanji is one of the most significant challenges for beginners [3-5]. Many methods have been suggested in how to learn the Japanese language (see Table 1).

Table 1. Previous studies on the Japanese language.

No.	Title	Reference
1	A comparative analysis of Japanese-English machine translation outputs using neural and statistical systems: google translate vs. Systran	[6]
2	Multilingualization on the current Japanese prefectural government web pages: the support status of easy Japanese for foreigners	[7]
3	Indonesian grammatical interference in translating relative clauses in Japanese comic strips	[8]
4	Japanese language education and examination for Indonesian specified skilled worker (SSW) candidates: an analysis of the pre-departure program	[9]
5	The utilization of the OJAD website to improve Japanese speaking skills in vocational high school	[10]
6	The development of “Manabu Bunpou” smartphone application for basic Japanese grammar learning	[11]
7	Utilizing cognitive illustration as a kanji memorization strategy in kanji learning	[12]
8	Needs-based curriculum design for business Japanese: a case study of Japanese studies students	[13]
9	Cultural interpretation in Japanese studies: a comparative analysis of nihonjijō curricula in Indonesia and Thailand	[14]
10	An analysis of techniques and accuracy in consecutive interpreting from Indonesian to Japanese: a case study of the Indonesian presidential state speech	[15]
11	Japanese quotative particles 'to' and 'tte' in daily conversation	[16]
12	Examining students’ metacognitive awareness in Japanese language learning: a survey-based study	[17]
13	Japanese learner anxiety: case study of language anxiety in an Indonesian-Japanese intercultural discussion forum	[18]
14	Analysis of students’ difficulties in learning Japanese	[19]

Traditional methods such as rote memorization and repetitive writing often lead to low retention and learner fatigue [20, 21]. Learners struggle to recognize complex visual symbols, associate multiple readings, and understand context-based

meanings. These difficulties are compounded by the abstract nature of kanji and the lack of engaging, interactive learning tools. Recent studies have introduced digital flashcards and basic games to assist kanji learning, yet few have explored the systematic integration of cognitive learning theories such as Cognitive Load Theory and Dual Coding Theory into game-based media [22]. These theories emphasize that learning improves when visual and verbal information are processed simultaneously and when extraneous cognitive load is minimized. At the same time, role-playing games (RPGs) have emerged as powerful educational tools that combine narrative flow, player autonomy, and level progression to reinforce engagement and long-term memory [23, 24]. However, most existing studies focus on GBL's effects on motivation and participation rather than its impact on long-term kanji retention. There is also a lack of RPG-based kanji learning tools grounded in a solid cognitive framework. Therefore, this study addresses this gap by developing and evaluating Kanji Journey, an RPG educational game that integrates GBL with cognitive strategies. The game is designed to systematically support kanji recognition, retention, and application through missions, quizzes, and visual storytelling aligned with JLPT N5 content.

The objective of this study is to examine whether *'Kanji Journey'* can improve kanji memory retention among beginner learners. The novelty lies in combining RPG game mechanics with cognitive principles such as dual coding, spaced repetition, and low cognitive load. The study also contributes a strategic model for developing technology-based language media that support sustainable development goals (SDGs) no 4 for quality, inclusive education in the 21st century.

2. Literature Review

2.1. Game and learning

Figure 1 illustrates that games can provide a means for language practice for students in language learning. Educational language games combine elements of entertainment, challenge, and interactivity, encouraging students to continue learning. Learners can significantly increase their cognitive and affective engagement by playing games, which helps them learn vocabulary, grammar, and communication skills in relevant and engaging contexts.

Fig. 1. Game in learning.

The use of games in learning has become a major focus in the development of modern educational strategies, especially in the digital era. Many reports regarding games have been well-developed (Table 2).

Table 2. Previous studies regarding games for the teaching and learning process.

No.	Title	Reference
1	The use of the Natuna game about the natural wealth of the natuna marine on national awareness of the post-millennial generation	[25]
2	Examining the effects of online games on the academic performance of BPEd students of Sultan Kudarat state university, Philippines	[26]
3	The effect of the team-games-tournament method on improving the learning ability of student with hearing impairment in multiplication concepts	[27]
4	Basic arithmetic learning through math online games for elementary school students during the pandemic	[28]
5	Ways to develop education for obtaining general physical qualities of young wrestlers through action games	[29]
6	Post-traumatic counselling through group games	[30]
7	Designing a notation card game media to improve the ability to read rhythmic music of 7th grade junior high school	[31]
8	Enhancing philosophy comprehension through what am I? Word guessing game	[32]
9	Game-based activity method: A case of grade 5 students	[33]
10	Designing English education game application for early childhood	[34]
11	Application of scrabble game in improving learning of simple sentence structure on the student with hearing impairment	[35]
12	Improving students' critical thinking through blended learning media learning game word wall	[36]
13	Effect small side games (SSG) on playing skills in handball sports	[37]
14	Rehabilitation program for surgical shoulder joint protrusion among team games players injured	[38]

Games function not only as entertainment tools but also as educational media capable of increasing learning motivation and student engagement [39]. The goal of GBL is to achieve a balance between learning through play and theoretical content. Students can explore challenging learning contexts, concepts, and specific learning objectives through GBL [40].

Games should be designed in such a way that students can play the cycles repeatedly without feeling fatigued. Furthermore, a good educational game must encourage certain emotional and cognitive responses to interactions with and feedback from the game to promote desired behaviours in students throughout these repetition stages [1, 41]. Evaluation of learning outcomes and question-and-answer procedures should be used during breaks in the game [42]. Teachers can create connections between the game and the real world through post-game Q&A sessions. Additionally, they establish links between events in the game and events in the real world, which connects students' understanding of the game with their education [43]. Games also enable the application of the principle of learning by doing, which enhances material retention through practice. Educational games can improve students' learning outcomes and their intrinsic motivation [24, 44].

2.2. Cognitive benefits of gaming

Figure 2 explains that some cognitive benefits of playing games include social skills and interactivity, improved memory and attention, and enhanced cognitive abilities [45]. Gaming continues to be a subject of interesting research and debate. Several studies have shown that gaming activities provide significant cognitive benefits, such as improved working memory, selective attention, problem-solving skills, and cognitive flexibility [46]. Educational games activate experiential learning processes that simultaneously involve visual, kinaesthetic, and conceptual aspects, thereby strengthening long-term memory pathways.

Fig. 2. Advantages of gaming for cognition.

Gamers have faster information processing abilities and higher visual-spatial capacity compared to non-gamers. In the context of learning kanji, which relies on recognizing complex visual forms and associating meanings, games can serve as a means to strengthen memory and consolidate information through repeated yet enjoyable practice. Furthermore, the mechanism of repetition with variation in games allows users to experience learning without feeling bored, which in turn encourages deep learning.

2.3. Gamification vs game-based learning

Gamification and GBL are two approaches commonly used in technology-based education, yet they have important conceptual differences, as illustrated in Fig. 3. Gamification refers to the use of game elements such as points, levels, badges, leader boards, and challenges in non-game contexts, including education. The goal is to increase students' motivation, engagement, and behaviour by mimicking the appeal and dynamics of games. In gamification, the learning process does not occur through the game itself but rather through a learning environment enriched with game mechanics.

Conversely, GBL entails the utilization of games as the primary medium of instruction, wherein educational content and gameplay elements are comprehensively integrated. Within this approach, learners do not merely receive information passively but actively participate in problem-solving, exploration, and decision-making processes embedded in the game environment. GBL facilitates an immersive, profound, and contextualized educational experience, characterized by a high degree of affective and cognitive engagement. Consequently, this approach

is particularly well-suited for complex subject matter that necessitates practice-oriented comprehension and simulation.

Fig. 3. Comparison between gamification and game-based learning.

Although different, both gamification and GBL utilize the appeal of games to achieve instructional objectives, and approaches can significantly enhance student motivation and engagement when applied appropriately. In the development of educational media such as Kanji Journey, the GBL approach is more predominant, as the game is designed as an educational RPG that directly integrates kanji learning into the game mechanics. However, gamification elements such as scores, levels, and achievements are also employed to reinforce student motivation. Therefore, a proper understanding of these two approaches is essential for developers of technology-based educational media.

2.4. Game-based learning technology in vocabulary development

GBL technology has been widely applied in vocabulary development, particularly in foreign language education. The successful language acquisition largely depends on vocabulary mastery, and GBL can accelerate this process through emotional and cognitive engagement. Digital games such as digital flashcards, vocabulary quizzes, and vocabulary-based role-playing games have been proven effective in expanding language learners' lexical repertoire [47, 48]. In the context of the Japanese language, kanji mastery presents a major challenge due to the complexity of character forms and meanings. Therefore, the integration of GBL technologies, such as the Kanji Journey game-designed with principles of gamification and interactive learning-holds significant potential to enhance kanji-based vocabulary acquisition through visualization, strengthened associations, and enjoyable, repeated engagement.

Behaviourist Theory supports the use of positive reinforcement and repetition in games to strengthen learning outcomes. Cognitive Load Theory emphasizes the importance of minimizing extraneous cognitive load, which GBL achieves by integrating visual and interactive media to reduce mental strain [22]. Additionally, Dual Coding Theory highlights the effectiveness of combining verbal and visual information-an approach leveraged by GBL platforms such as Kanji Journey through the use of animations, text, and graphics to enhance kanji retention. By integrating these theories, the framework demonstrates how GBL not only

increases learner engagement but also promotes long-term kanji retention through an enjoyable and immersive game-based environment.

In the context of language learning, a GBL approach enables an active and meaningful learning process. GBL utilizes game elements such as challenges, instant feedback, and point and level systems to create an engaging and competitive learning environment. This approach aligns with constructivist theory, which emphasizes the importance of direct experience and active participation in the learning process. Thus, the integration of games into Japanese language learning, particularly for kanji, which is symbolic and abstract, serves as a promising strategy to enhance comprehension and retention.

An educational game is a game designed for learning purposes, while still offering elements of play and enjoyment. It combines educational content, learning principles, and computer game mechanics. GBL is a learning method that utilizes specially designed game applications to support the learning process. The type of game typically used in GBL is the educational game. GBL is a learner-centred instructional approach that employs electronic or digital games for educational purposes. In GBL, learners actively play a game to learn. One example of GBL implementation is when a teacher creates a simple game, such as a word chain, or uses flashcards as a learning medium. The duration of such GBL activities is generally limited to the scheduled class time.

2.5. RPG in game-based learning

GBL has emerged as an effective pedagogical approach for enhancing language learning experiences. By incorporating game elements such as challenges, rewards, and interactive storylines, GBL creates an engaging learning environment that encourages active student participation. In the context of foreign language instruction, numerous studies have shown that GBL improves vocabulary acquisition, memory retention, and learning motivation. GBL also supports self-directed learning through exploration-based design, which is particularly important for mastering complex aspects such as writing and recognizing kanji characters in the Japanese language.

One of the prominent genres in GBL is the RPG, which offers a narrative-driven virtual world and scenario-based learning. RPGs enable learners to acquire knowledge through role-based experiences, complete missions, and develop cognitive and linguistic skills through systematic in-game interactions. The integration of RPGs in GBL enhances learning engagement and supports repetition through game mechanics, aligning with Behaviourist Theory. Furthermore, RPGs that incorporate visual, textual, and action-based elements promote multimodal learning, both of which suggest that information presented through multiple channels can accelerate internalization and memory retention.

Adventure games RPGs are games in which players assume roles to build and experience a story. Players take on specific characteristics embodied by the characters within the game. This type of game has existed since the 1980s. At that time, Akalabeth: World of Doom was released and is considered the first game in the RPG genre worldwide. Another well-known RPG game series in Japan is Final Fantasy, developed by the game studio Square Enix.

RPGs typically follow a consistent narrative structure, as players take on the role of a character. An RPG is a game in which players control fictional characters in a fantasy world, governed by specific rules that shape interaction and storyline progression. One of the advantages of playing RPGs is the ability to assume another identity within a story, which indirectly enhances creative abilities. Moreover, RPGs always contain elements of challenges and problem-solving, allowing players to develop their problem-solving skills through gameplay. RPGs often present compelling narratives that immerse players in the game world. Through these story elements, players can develop a sense of empathy toward the characters involved.

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However, the RPG genre also has its drawbacks. One such limitation lies in the narrative content presented in these games. Some RPGs feature stories that may not be appropriate or appealing to all demographics, making them unsuitable for every player.

2.6. The application of RPG in Kanji learning

In Japanese language learning, particularly in the area of kanji, RPG-based and GBL offers an innovative approach capable of addressing traditional challenges such as high cognitive load, lack of contextual usage, and monotonous repetition. Through games like Kanji Journey, learners can interact with characters and challenges that require them to recognize, read, and comprehend kanji within a narrative context. The use of RPGs in kanji instruction significantly enhances intrinsic motivation and visual symbol retention. Another study supports these findings, showing that learners recognize character forms and meanings more quickly when materials are delivered through mission-based game environments. Thus, RPGs are not only relevant but also strategic in supporting kanji learning in the digital era.

In the context of kanji learning, the application of RPG elements has proven to make a significant contribution to enhancing learner participation and retention. RPGs allow students to engage in active learning through narratives, missions, and tiered challenges, which indirectly promote repetition and memory reinforcement. In Japanese language learning, the main challenge lies in the complexity of kanji characters and the low rate of long-term retention. By embedding kanji content into an interactive RPG environment, students are not only repeatedly exposed to the material but also engaged in meaningful and contextualized learning processes. Students who learn through RPG platforms demonstrate significantly greater improvement in vocabulary acquisition and character recognition compared to those using traditional learning methods. Furthermore, the use of visual and audio elements in RPGs has been shown to effectively support dual coding of information, in line with Dual Coding Theory, thereby enhancing long-term memory storage.

Research on the effectiveness of RPGs in Japanese language learning, particularly in kanji mastery, has shown promising results. The use of digital RPGs incorporating Japanese character-based quizzes can enhance learners' intrinsic

motivation and cognitive engagement. In Japanese language learning and discovered, game environments provide a safe space for students to experiment with the language, including kanji-based vocabulary, without the social pressures commonly found in conventional classrooms. Supportive game environments, equipped with immediate feedback and tiered missions, help increase natural repetition and exposure to kanji. It developed an educational RPG using Unity for basic-level kanji learning and reported significant improvements in students' post-test results as well as higher retention scores after two weeks. These findings reinforce the assumption that integrating visual, narrative, and challenge-based elements in RPGs can stimulate affective engagement and strengthen memory retention of complex kanji characters.

2.7. Cognitive load theory in visual learning

Cognitive Load Theory states that the effectiveness of learning is greatly influenced by how information is presented and how cognitive load is managed by learners. In the context of learning, there are three types of cognitive load: intrinsic, extraneous, and germane. Intrinsic load refers to the complexity inherent in the material itself, while extraneous load is caused by inefficient presentation of information. Germane load contributes positively to the formation of knowledge schemas. Therefore, the design of learning media that minimizes extraneous load and supports germane load is essential to optimize the learning process.

In kanji learning, the use of visual media such as digital educational games can reduce extraneous cognitive load by presenting information in a structured and engaging manner. Games like Kanji Journey visually and contextually display kanji shapes, meanings, and readings within an interactive narrative. This visualization not only clarifies the information but also enhances students' mental engagement in the learning process, thereby increasing working memory capacity and accelerating the internalization of knowledge. This strategy is especially suitable for beginner learners who often struggle to memorize the complex and abstract forms of kanji.

The integration of GBL within the framework of Cognitive Load Theory plays a role in promoting meaningful cognitive engagement, which is part of the germane load. When students actively complete challenges and comprehend the game's narrative, they do not merely memorize passively but build conceptual understanding through interaction. In other words, learning media such as Kanji Journey can shift cognitive load away from irrelevant activities toward deeper and more effective information process. This strengthens the argument that RPG- and visually-based learning designs hold great potential in supporting language learning, particularly in kanji mastery.

2.8. Dual coding in Kanji learning

Dual Coding Theory explains that the learning process is more effective when information is presented through two primary channels of representation: verbal and visual. In this context, when learners receive information simultaneously through words and images, these two types of representation are processed by different but complementary cognitive systems. Verbal representation includes linguistic symbols such as text or sound, while non-verbal representation involves images, visual objects, or animations. The interaction between these two systems

forms dual memory pathways that reinforce each other and facilitate the encoding and retrieval of information.

The application of this theory in Japanese language learning, particularly in kanji mastery, is highly significant. Kanji, as a logographic writing system, requires understanding of complex visual forms as well as their meanings and pronunciations. By integrating visual representations (such as animations, icons, or illustrations of kanji shapes) and verbal representations (such as readings and meanings) into learning media like the Kanji Journey game, learners can access information through two cognitive pathways simultaneously. This not only strengthens long-term memory retention but also helps learners build holistic conceptual connections between kanji symbols, their readings, and meanings.

Furthermore, GBL platforms like Kanji Journey leverage the power of Dual Coding Theory through the presentation of dynamic visuals, supportive text, and interactive audio. As learners interact with game elements that integrate kanji text, pronunciation audio, and visual context, stronger mental associations are formed compared to traditional learning methods. This multimodal approach enhances the effectiveness of internalization and information retrieval processes by activating dual pathways in working memory. Therefore, the application of Dual Coding Theory serves as a fundamental basis in designing technology-based instruction that supports more meaningful and efficient kanji learning.

3. Method

This study employed a mixed-methods approach with a quasi-experimental design and instructional media development using the ADDIE model (Analyse, Design, Develop, Implement, Evaluate) illustrated in Fig. 4. Detailed information regarding this method is explained elsewhere [49].

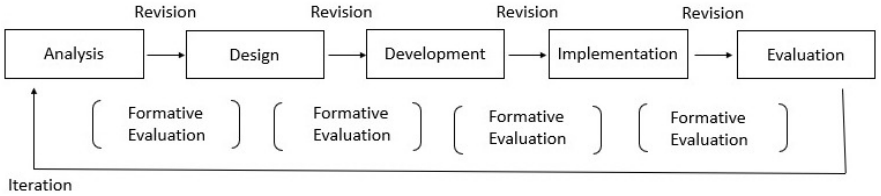

Fig. 4. ADDIE instructional design model for kanji journey development.

This model structured the development of the Kanji Journey RPG game and ensured iterative evaluation at each stage. Participants included 60 first-year Japanese language students purposively selected based on their lack of JLPT certification, basic digital skills, and no prior exposure to game-based kanji instruction. They were divided into experimental and control groups. The experimental group used Kanji Journey over four weeks, while the control group learned Kanji using conventional methods. The instruments used in this study are shown in Fig. 5. These include:

(i) the Kanji-Dex, a personalized digital encyclopaedia of discovered kanji (Fig. 5(a)).
(ii) a GIF-based stroke order animation that visually demonstrates how to write each kanji (Fig. 5(b)); and

(iii) an interactive kanji puzzle integrated into gameplay to reinforce symbol recognition and recall (Fig. 5(c)).

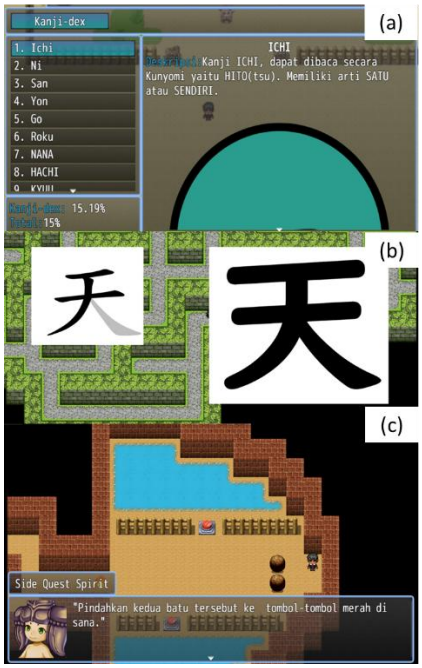

Fig. 5. Game-based feature examples: (a) kanji-dex, (b) stroke order GIF, (c) puzzle challenge.

Additional tools included JLPT N5 pre- and post-tests, perception questionnaires, and interview protocols. Data analysis involved normality and homogeneity testing, paired and independent t-tests, and descriptive analysis of learner perception and engagement. We analysed statistics to get a better understanding of the results. Detailed information on how to analyse using statistical analysis is reported elsewhere [50-52].

4. Results and Discussion

4.1. Analysis

The analysis stage began with problem identification related to kanji learning difficulties experienced by Japanese language learners. A preliminary study conducted in September 2023 involving 30 beginner-level learners revealed that most participants struggled to memorize visual kanji forms (83.3%), distinguish readings (76.7%), and understand contextual meanings (70.0%). Additionally, 66.7% cited a lack of engaging learning media. These findings are consistent with earlier studies that emphasized the limitations of traditional methods in kanji learning [20, 21].

As shown in Table 3, we presented a summary of previous studies highlighting similar challenges and the need for innovation in kanji instruction. These data confirmed the urgent need for innovative media that:

(i) Integrate visual-verbal elements to enhance kanji retention,
(ii) Minimize cognitive load through structured design [22],
(iii) Promote engagement via interactive and rewarding gameplay.

The development of *Kanji Journey*, an RPG-based learning game, was proposed as a strategic solution to address these pedagogical and motivational needs.

Table 3. Results of a preliminary study on kanji learning challenges.

No.	Challenge Aspect in Kanji Learning	Respondents
1.	Difficulty remembering the visual forms of kanji	83.3%
2.	Confusion with onyomi and kunyomi readings	76.7%
3.	Difficulty understanding the meaning of kanji in context	70.0%
4.	Lack of engaging and appealing learning media	66.7%

Further analysis of learner preferences (Table 4) showed that 86.7% of respondents preferred digital or game-based media, with 80% attracted to visual and animated features. Features such as rewards, interactive elements, and flexibility were also highly favoured.

Table 4. Results of preliminary learning data analysis on learning media.

No.	Learning Medium Preference	Respondents
1.	Want to learn with digital-based applications/game	86.7%
2.	Interested in media with visualization and animation	80.0%
3.	Like reward and challenge systems	73.3%
4.	Want interactive and flexible features	76.7%

4.2. Design

After identifying the key challenges faced by JLPT N5-level learners, the design phase focused on formulating the structure and pedagogical integration of the RPG game Kanji Journey (Table 5).

Table 5. Learner preferences on instructional media.

No.	Preferred Learning Media Aspect	Respondents
1.	Prefer learning with digital/game-based applications	86.7%
2.	Interested in media with visualizations and animation	80.0%
3.	Enjoy reward and challenge systems	73.3%
4.	Want interactive and flexible features	76.7%

Note: This table shows that most learners highly value digital learning environments that are engaging, visually rich, and include motivational elements.

This stage aimed to align game elements with cognitive principles such as Dual Coding Theory and Cognitive Load Theory, while also ensuring consistency with the JLPT N5 kanji curriculum. The initial design process included:

(i) A storyline and world map that reflect progressive kanji difficulty.
(ii) A reward and level-up system to sustain learner motivation.
(iii) Missions and quiz structures embedded with kanji recognition, reading, and usage tasks.
(iv) Visual and auditory cues for multimodal engagement

Figure 6 illustrates a wireframe of the Kanji Challenge screen and the Mini Quiz screen, showing how players interact with kanji via contextual tasks and puzzles. To ensure instructional relevance, kanji were selected based on the official JLPT N5 list provided by the Japan Foundation. Parallel to visual and interface design, the team conducted a Quiz Relevance Analysis to ensure that all missions and evaluations reflected actual curriculum objectives.

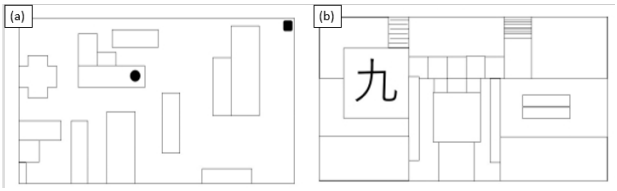

Fig. 6. Sample wireframes of the 'Kanji Journey' RPG: (a) Kanji challenge screen; (b) Mini game quiz screen.

In addition, a Storyboard and Flowchart were developed to map the learner's journey, integrating narrative progression with spaced repetition and mission-based reinforcement. This design ensures that players revisit kanji characters multiple times in different contexts, an essential technique for long-term memory retention [21]. The narrative also provides scaffolding through supporting characters, which offer guidance, contextual examples, and verbal-visual pairings to support the learning process.

By designing the game with these components in mind, Kanji Journey becomes more than entertainment, it evolves into a strategic learning environment that fosters active engagement and retention of abstract Japanese symbols through a cognitively grounded RPG experience.

4.3. Development

The development of the Kanji Journey RPG was executed using RPG Maker MZ, a widely used no-code platform for 2D game development that supports layered dialogue, quest scripting, and custom quiz mechanics. The development process was aligned with the previously designed storyboard and instructional framework based on the ADDIE model. Figure 7 presents the overall development flow, beginning from problem identification to iterative evaluation and refinement.

In the content development phase, game mechanics were built to reinforce kanji recognition and application. The development stages included:

(i) Content Processing and Resource Preparation: Selection and integration of kanji-related assets (forms, meanings, pronunciations) along with pedagogical scripting.
(ii) Game Environment and Map Creation: The design of immersive learning spaces like *Akero Inn*, *Murakami Village*, and the *Kanji Labyrinth*.
(iii) Event Programming and Dialogues: Using RPG Maker's JavaScript and event-based system to create interactions, quizzes, and dynamic quests.
(iv) Feature Implementation: This included name input systems, quiz logic, the *Kanji-dex*, and conditional branching for exploration.

Figure 8 displays key development screenshots, including

(v) Figure 8(a) shows the process of resource integration into RPG Maker.

(vi) Figure 8(b) illustrates the creation of a village map representing *Murakami Village*.
(vii) Figure 8(c) demonstrates event programming for kanji-based tasks and interactions.

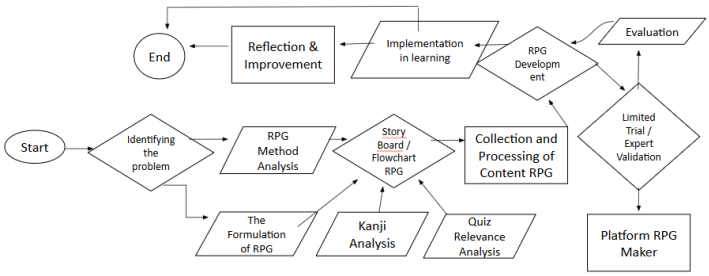

Fig. 7. Development process flowchart of Kanji Journey using RPG Maker.

Fig. 8. RPG Development Process:
(a) Resource input into RPG Maker, (b) Map creation for Murakami Village, (c) Event scripting for learning mechanics.

The game's educational logic is embedded within interactive quests. For example, learners must recognize and match kanji characters to complete story-based missions. The level system ensures spaced repetition, while the visual progression enhances memorability.

Incorporating avatars, interactive puzzles, and a kanji encyclopaedia (Kanji-dex) not only supports self-paced review but also encourages player autonomy and active learning, key components of constructivist pedagogy. Voice-over features and dynamic audio elements further amplify the dual coding effect by integrating visual and auditory stimuli

The development phase successfully translated the theoretical framework into an immersive, structured, and learner-centred game environment. This game was then subjected to internal trials for debugging and refinement before pilot testing with learners.

4.4. Implementation

After development, the Kanji Journey RPG prototype was implemented in a limited trial involving one first-year Japanese language class (n = 30) (Table 5). Participants engaged with the game over four weeks, while a control group (n = 30) continued with conventional kanji learning methods. The implementation stage aimed to evaluate usability, gameplay flow, learner engagement, and learning outcomes. In parallel, expert validation was conducted by two professionals: a Japanese language educator and an educational technology specialist. Their evaluation focused on content accuracy, pedagogical alignment, user interface

quality, and motivational appeal. Table 6 presents pre- and post-test results using the Wilcoxon Signed-Rank Test.

Table 6. Pre-test and post-test summary using Wilcoxon signed-rank test.

Comparison	N	Mean Rank	Sum of Ranks
Negative Ranks (Post > Pre)	22	30.5	1586
Positive Ranks (Pre > Post)	3	10.33	31
Ties	5	–	–
Total	30	–	–

Note: The test shows significant improvement in kanji retention, as most post-test scores were higher. *Wilcoxon Sig. = 0.000 < 0.05.*

The Wilcoxon Signed-Rank Test results show a statistically significant increase in post-test scores (Asymp. Sig. = 0.000), indicating that the RPG media had a meaningful impact on kanji retention. The dominance of negative ranks (n = 22) confirms improvement in most participants after playing the game. This supports the effectiveness of repeated, gamified exposure as a learning tool.

Expert reviews provided further insights:

(i) The Japanese language expert stated: *"The media aligns with JLPT N5 standards and effectively visualizes kanji in a narrative format, aiding learner comprehension. Minor clarifications are needed for ambiguous terms."*

(ii) The educational technology specialist noted: *"The game demonstrates strong application of GBL principles, with appropriate reward systems, scaffolded quests, and learner autonomy features. It motivates sustained use and independent learning."*

Key strengths highlighted included:

(i) Integration of narrative and challenge structures.
(ii) Repetition without monotony.
(iii) Kanji-dex feature promoting active review.

Student feedback was collected via a post-use questionnaire (Table 7). The survey, using a 5-point Likert scale, assessed visual quality, content clarity, and usability. Some suggestions included:

(i) Add difficulty levels.
(ii) Increase interactive animations.
(iii) Improve mobile compatibility.

These insights informed the subsequent revision phase and demonstrated the RPG's practical viability as an instructional tool.

Table 7. Student perception of kanji journey RPG.

Aspect	Indicator	Strongly Agree	Conclusion
Visual	Clear kanji visuals	100%	Highly readable and visually appropriate
Content	Easy-to-understand kanji explanations	62.5%	Generally well-received
Usability	Easy to use and navigate	87.5%	Accessible and user-friendly
Motivation	Boosts motivation and memory retention	75%	Encourages learning engagement

4.5. Evaluation

The final phase of the ADDIE model involved a comprehensive evaluation of Kanji Journey's effectiveness in supporting kanji retention and enhancing user experience. This evaluation focused on three key dimensions: visual design, learning content, and usability. The evaluation also aimed to assess learners' motivation and engagement, following the gameplay experience. A survey questionnaire was distributed to the 30 participants in the experimental group after the implementation phase (Table 8). The instrument used a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." Students rated statements regarding visual clarity, ease of navigation, content relevance, motivation, and memory support.

Table 8. Questionnaire evaluation summary of kanji journey.

Aspect	Key Statement	Agreement (Agree/Strongly Agree)	Conclusion
Visual	The game is suitable for beginners	87.5%	The game is well-aligned with the learner level
	Kanji characters are displayed	100%	Effective kanji visualization
	The game's navigation is easy to understand	87.5%	User-friendly and intuitive interface
Content	The kanji explanations are easy to follow	100%	Learning content is accessible
	The media is entertaining and enjoyable	87.5%	Engaging learning experience
	The language used is simple and clear	75%	Instructions are well constructed
	Kanji selection is varied and comprehensive	75%	Covers diverse and relevant materials
Usability	The game is a useful alternative learning medium	87.5%	Practical for classroom integration
	The game helps in remembering the kanji characters	87.5%	Supports memory retention
	Motivates me to study kanji more actively	75%	Increases learner motivation
	Easy to access and use on available devices	87.5%	Technologically accessible and practical
Feedback	Suggestions to add levels, actions, and a mobile version	Majority	Indicates a need for iterative development and flexibility

These findings indicate a high degree of learner satisfaction across all evaluated dimensions. In particular, the kanji visualization and interface design received the strongest responses, confirming that the RPG platform successfully facilitated the dual coding of verbal and visual information. Participants also praised the structured repetition and level progression, which align with Cognitive Load Theory, by reducing extraneous load and reinforcing memory through narrative scaffolding.

Although a few participants (12.5%) reported limited motivation or entertainment value, the majority of learners expressed strong agreement that Kanji Journey helped remember kanji and served as a viable instructional aid. Feedback also highlighted the importance of incorporating additional features, such as mobile access, customizable difficulty levels, and expanded interactive elements, to enhance future iterations.

Overall, the evaluation supports the integration of GBL-based RPGs like Kanji Journey into early-stage kanji instruction, especially for learners who face difficulty retaining symbolic visual content.

4.6. Contribution to sustainable development goals (SDGs)

The implementation of the *Kanji Journey* RPG aligns directly with SDG 4: Quality Education, which promotes inclusive, equitable, and lifelong learning opportunities. By integrating technology, cognitive strategies, and interactive media, this study supports accessible and engaging language instruction for beginner learners. The game-based approach encourages learner autonomy, fosters motivation, and enhances cognitive development, especially in symbol-heavy subjects like kanji. This innovation is particularly relevant for digital-native students and addresses gaps in conventional education methods. Furthermore, the adaptability of the platform enables its future application across diverse educational settings, including underserved regions, thereby contributing to inclusive and equitable educational innovation on a global scale. This adds new information to the current studies on SDGs, as reported elsewhere [53-57].

5. Conclusion

This study demonstrated that integrating GBL and cognitive strategies through the Kanji Journey RPG significantly improved kanji retention among JLPT N5 learners. The use of narrative flow, visual repetition, and interactive feedback enhanced learner motivation and reduced cognitive overload. Based on pre- and post-test analysis and perception surveys, most participants showed notable gains in kanji recognition and engagement. These outcomes occurred because the RPG format provided structured repetition and dual coding, which facilitated long-term memory. Despite its effectiveness, the study was limited by its short implementation period and single institutional context. Future research should explore broader applications of GBL for kanji mastery across diverse proficiency levels and longer durations.

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