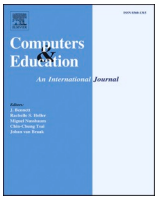
Computers & Education 205 (2023) 104899

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu



A game-based learning system based on octalysis gamification framework to promote employees' Japanese learning

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ARTICLE INFO

Keywords:
Adult learning
Games
Octalysis
Human-computer interface
Informal learning
Teaching/learning strategies

ABSTRACT

Using digital learning to assist in-service employees in promoting language skills has become an efficient way that can save training costs and profits. However, the employees' language learning performance often is not as expected due to low learning motivation, willingness, and persistence. Therefore, this study developed a game-based Japanese learning system based on the Octalysis gamification framework proposed by Chou (2016) to facilitate enterprise employees' learning effectiveness of Japanese as a second language (L2). All the eight core drives of the Octalysis gamification framework were adopted in the design of the learning functions and gamification mechanisms, including "epic meaning and calling," "development and accomplishment," "empowerment of creativity and feedback," "ownership and possession," "social influence and relatedness," "scarcity and impatience," "unpredictability and curiosity," and "loss and avoidance." This study used a true experimental design and recruited 54 Taiwanese employees from a Taiwan branch of an international Japanese business company to conduct a two-week experiment. The research participants were randomly assigned as the experimental and control groups respectively, using a Japanese learning system with or without a game-based design to support their Japanese learning. This study confirmed that the game-based Japanese learning system could significantly enhance the learners' engagement in learning behaviors, learning performance, learning motivation, and immersion experience. In addition, for most learning functions designed by applying the core drives regarded as intrinsic motivators in the Octalysis gamification framework, the more frequently the learners used the functions, the better they performed in learning performance. Moreover, several learning functions designed by employing positive or negative motivators also had significant positive correlations between the number of use and learning performance. This study contributes to the digital game-based language learning field by applying the Octalysis gamification framework to design an effective game-based Japanese learning system for company employees and examine the correlations between the use of the learning functions and learning performance.

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https://doi.org/10.1016/j.compedu.2023.104899
Received 17 April 2022; Received in revised form 16 August 2023; Accepted 17 August 2023
Available online 19 August 2023

1. Introduction

Under the current wave of globalization, multinational business cooperation between enterprises is becoming increasingly close. Therefore, the ability to communicate with customers and other enterprises' employees by using foreign languages has become the core competitiveness of an enterprise. The survey report on the internationalization of talents and management of foreign languages in Taiwan's large enterprises (The Survey of ETS TOEIC, 2018) indicated that more than 90% of enterprises attached importance to the cultivation of international talent and agreed with that second foreign language ability is one of the top three indicators that reflect an enterprise's competitiveness. If an enterprise fails to communicate globally or regionally with customers, or its effectiveness is low due to insufficient language skills of employees, it will affect the enterprise's competitiveness around the world (Forbes Insights, 2017). Therefore, improving employees' language skills and facilitating their language learning motivation and performance have become an important issue, particularly for multinational business companies.

For businesses, getting ready with equipment, venues, and instructors to train their employees who are already working requires dealing with high costs and a considerable amount of preparation effort. This challenge becomes even more intricate, particularly for large corporations that frequently need to train tens of thousands of employees simultaneously or organize in-service training across multiple countries. The use of digital learning to assist corporate employees in in-service training has been regarded as a good and convenient way. It is worth mentioning that many previous studies (Chen & Chen, 2021; Chen, Li, & Lin, 2020) have confirmed that videos are a kind of practical learning material with multimodal elements in promoting language learning performance. This is because they can simultaneously offer sounds, pictures, and subtitles to provide contextualized learning that would help learners comprehend the language better than the other types of learning materials, such as text materials, lecture notes, etc. They can also present content close to learners' daily lives to enhance their learning motivation and interests in language learning contexts (King, 2002). For example, in the research of Chen and Chen (2021), a video annotation and review mechanism was used to assist learners in English listening comprehension, which can effectively improve listening comprehension effectiveness, learning satisfaction, and technology acceptance. Also, several previous studies (Hayati & Mohmedi, 2011; Markham, 1989) have proved that videos with both native and second-language subtitles would benefit beginners because they could use their native language to understand the contents of a video. Therefore, this research uses videos to design learning materials to assist learners in Japanese learning.

When companies adopt digital learning to train employees' language skills, it is often found that employees are unwilling to engage in this kind of training due to a lack of the personal interaction and immediate feedback that traditional classroom settings offer, thus leading to a sense of alienation and a passive attitude toward digital learning. Additionally, learning a language in a boring way rather than interesting will create barriers to learning engagement and motivation, leading to learners losing their willingness to learn (Govender & Arnedo-Moreno, 2021). Therefore, it is necessary to consider developing gamified incentive mechanisms to facilitate active attitudes and learning motivation toward language training for in-service employees. Chen, Li, and Chen (2020) pointed out that learners who used a reading annotation system with a gamified incentive mechanism to assist reading are better than those who used a reading annotation system without a gamified incentive mechanism in the total number of annotations, annotation ability, reading motivation, immersion experience, and satisfaction. In the research of Tsay, Kofinas, and Luo (2018), a series of courses were designed, and various game mechanisms were used to promote students' learning performance. It was confirmed that gamified course design helps learners promote learner-centered learning effectiveness. Gamified language learning has been considered one of the state-of-the-art methods to promote second or foreign language learning (Zhang & Zou, 2022). In Acquah and Katz's review study (2020), researchers have adopted digital game-based language learning (DGBLL) across different ages of learners and found positive effects on facilitating second language acquisition and affective and psychologically related outcomes in most of the study results. However, most DGBLL research (Acquah & Katz, 2020) considered in-school students as research participants because schools can provide convenient access to a diverse pool of learners for research purposes. In contrast, very few studies have focused on applying DGBLL to enhance adults' language learning due to the difficulty of recruiting adult research participants, not to mention corporate employees (Govender & Arnedo-Moreno, 2021; Xu, Chen, Eutsler, Geng, & Kogut, 2020). It is worth noting that the results of previous studies on DGBLL for different aged learners may not be generalizable in employee training for adults due to differences in learning goals, contexts, and motivations. Also, most DGBLL studies adopted games to facilitate learning English as a second or foreign language (Acquah & Katz, 2020; Hung, Yang, Hwang, Chu, & Wang, 2018). Very few DGBLL studies focused on Japanese as a second or foreign language (Hung et al., 2018). The results of previous studies on DGBLL for other language development may not be generalizable in Japanese learning due to the unique linguistic and cultural aspects of the Japanese language. Moreover, although researchers have reviewed the most frequently adopted game elements in DGBLL studies (Govender & Arnedo-Moreno, 2021), there is a lack of research applying a systematic game design framework to develop DGBLL systems. Applying a systematic game design framework is essential for developing effective DGBLL systems as it ensures alignment between educational goals and game mechanisms, enhances engagement and motivation, and integrates pedagogical principles to create engaging and impactful language learning experiences. Therefore, this study developed the Game-based Japanese Learning System (GJLS) based on the Octalysis gamification framework, a learner-centered gamification design framework that lays out the eight core drives proposed by Chou (2016) to promote corporate employees' Japanese learning effectiveness.

This study considered that analyzing learners' learning behaviors can help teachers understand how learning behaviors of learners influence learning performance (Chen & Wang, 2020), learning retention determines how well learners can recall and apply previously acquired language knowledge and skills over time, learners with higher immersion experience tend to have better learning performance during learning processes (Hsieh, Lin, & Hou, 2013), and how to stimulate learners' learning motivation in learning processes is one of the critical factors that would affect learning performance (Lin, Chen, & Liu, 2017). Therefore, the effectiveness of the developed GJLS on behavioral engagement, learning performance, learning retention, learning motivation, and immersion experience was

examined by comparing it with a non-game-based Japanese Learning System (NGJLS) in this study. In addition, the correlations between the use of game-based learning functions and learning performance were investigated to get more insights into the appropriateness of the Octalysis gamification framework for designing a DGBLL system. The research questions of this study are listed as follows.

1. Do learners who used the GJLS perform significantly better in terms of learning behavior than those who used the NGJLS?
2. Do learners who used the GJLS perform significantly better in terms of learning performance and learning retention than those who used the NGJLS?
3. Do learners who used the GJLS perform significantly better in terms of learning motivation than those who used the NGJLS?
4. Do learners who used the GJLS perform significantly better in terms of immersion experiences than those who used the NGJLS?
5. What are the correlations between the use of game-based learning functions and learning performance improvement?

2. Literature review

2.1. Digital game-based language learning

With the rapid development of interactive multimedia, computer games are becoming more immersive and attractive to players due to diverse types of multimedia, game elements, and interactive technologies. Through the combination of games and learning, games can bring fun and challenge to learners, enhance learners' learning motivation, improve learners' learning experience, and produce good learning effectiveness (Annetta, 2008; Robertson & Howell, 2008). Game-based learning is also more effective in promoting learners' positive achievement emotions and reducing their negative ones than traditional teacher-led instruction by providing precise and meaningful goals in the games (Lei, Wang, Chiu, & Chen, 2022). Game-based learning provides not only clear learning goals for learners but also immediate feedback according to learners' behaviors (Pellas, Konstantinou, Kazanidis, & Georgiou, 2016), thus efficiently enhancing learners' learning motivation (Prensky, 2001). Therefore, game-based learning has been confirmed as an effective method that can provide joyful experiences in the learning process (Wilkinson, 2016), and games with the appropriate design can enhance learning motivation and learning outcomes (Peterson, 2016; Squire, 2008). In other words, properly designed game-based learning mechanisms can increase learners' interest and motivation and drive learners to carry out repetitive training or learn unfamiliar things, which is very important for modern education.

Learning a second language is a lengthy and cumulative process for language learners. Without a strong motivation or effective learning strategies, learners often face difficulties and then give up, or become anxious, which affects their learning effectiveness. Spending time and effort learning outside work requires even more motivation for corporate employees. In recent years, game-based learning has been successfully applied to language learning, especially for second-language learning. Digital game-based learning has become one of the significant learning ways used for second and foreign-language learning (Zhang & Zou, 2022). In a review conducted by Acquah and Katz (2020), different types of digital games have been applied to enhance language learning across learners of different age groups. The review results showed that digital games could motivate learners to learn and interact with game functions or other learners to promote the learning performance of a second language because DGBLL makes fun, engaging, and challenging learning and allows for differentiation and learner autonomy. Acquah and Katz's study (2020) showed positive learning outcomes of DGBLL. Xu et al. (2020) also found that most studies they reviewed reported positive results in language acquisition using DGBLL. In Hung et al. (2018), most DGBLL studies confirmed positive effects regarding student learning on affective or psychological states, followed by language acquisition. Zou, Huang, and Xie (2021) reviewed 21 studies and concluded that digital game-based vocabulary learning could promote short-term and long-term vocabulary learning outcomes, facilitate reading and listening comprehension, enhance motivation and engagement, reduce anxiety, and encourage interactions among learners. Moreover, Li, Peterson, and Wang (2022) conducted a case study using Activity Theory to analyze the learning experience and learning outcomes of Chinese university students who used a massively multiplayer online game to perform the learning of English as a second language. The results showed that students could develop and practice autonomously in the learning process, and their confidence in vocabulary learning, listening comprehension, and oral fluency was also enhanced significantly. DGBLL could also be applied in second language learning to facilitate language acquisition, promote affective and psychological states such as immersion experience and flow experience, and enhance contemporary competencies and participatory behaviors related to cultural literacy (Acquah & Katz, 2020).

Among the DGBLL studies, vocabulary learning was the most commonly studied subject (Acquah & Katz, 2020; Govender & Arnedo-Moreno, 2021). Moreover, most DGBLL studies adopted games to facilitate learning English as a second or foreign language, and school-age students were the most frequently selected research participants in the existing DGBLL research (Acquah & Katz, 2020; Hung et al., 2018). It is worth noting that most of the games for language learning study were custom-built by DGBLL researchers, through which they can more flexibly align the gaming goals with the learning objectives (Hung et al., 2018; Xu et al., 2020). In this study, a game-based Japanese learning system (GJLS) was also custom-built to facilitate enterprise employees' Japanese learning performance.

2.2. The incentive mechanisms considered in digital game-based learning systems

In the realm of game-based learning, it is essential to apply suitable incentive mechanisms to effectively transform learners' enjoyment of playing games into motivation and interest in learning. Hamari, Koivisto, and Sarsa (2014) listed the ten most commonly used incentive elements in a game, including points, leaderboards, achievements/badges, levels, story/theme, clear goals, feedback,

rewards, progress, and challenge. Among them, leaderboards, badges, and points are the most popular game elements (Hew, Huang, Chu, & Chiu, 2016; Kyewski & Krämer, 2018). Moreover, Kiili's study (2005) indicated that the design issues of game-based learning should consider (1) A friendly operation interface: a game should provide a friendly game operation interface that can be familiarized by learners soon, making it easy for learners to learn; (2) Interactivity: a game needs to include natural interaction so that learners and the game have high interactivity; (3) Storytelling: the background of the game needs to be laid out to enable the learner's involvement; (4) Balance: the fairness and consistency of the game must be maintained to prevent learners from exploiting loopholes to gain benefits. The interview on game designs on facilitating learning and motivational outcomes in digital game-based learning conducted by Abdul Jabbar and Felicia (2015) indicated that several game elements, including avatars, virtual environments, narratives, animations, and graphics, were frequently used to provide learners with a highly entertaining and interactive learning experience. Besides, challenges in a game-based learning system were suggested to design with clear goals and feedback and give learners a good sense of control that matches their knowledge levels and skills to facilitate engagement. Also, control and choices can make learners pay more attention and interest in the learning activities they decide to complete. Interactive support tools are sometimes used to provide help and motivate learners during gameplay when needed. Moreover, feedback and different support tools were confirmed as fundamental functions to support learners in achieving their learning goals.

Park, Liu, Yi, and Santhanam's study (2019) found that whether game-based learning could enhance learning effectiveness or not are inconsistent. Many studies pointed out that game-based learning has positive effects on promoting learning motivation and participation (Hew et al., 2016; van Roy & Zaman, 2018), and game elements used in the learning activities are the key to determining learning motivation and participation (Chen, Liu, & Huang, 2019; Domínguez et al., 2013). However, several studies (de-Marcos, Garcia-Lopez, & Garcia-Cabot, 2016; Hanus & Fox, 2015) pointed out that game-based learning has adverse effects on learning effectiveness, while others (Hew et al., 2016; Huang & Hew, 2015) indicated that game-based learning has almost no impact on learning effectiveness. It is worth noting that Chen, Li, and Chen (2020) indicated that using game elements such as points, rewards, leaderboards, etc., to stimulate learning without thinking about their connections with learning goals will affect the effects of game-based learning on promoting learning performance.

Similarly, designing appropriate incentive mechanisms to create enjoyable and immersive experiences for learners in DGBLL is also crucial. Some studies (Acquah & Katz, 2020; Govender & Arnedo-Moreno, 2021; Xu et al., 2020) investigated the game elements applied in DGBLL to promote second language learning. For example, according to a literature review, Acquah and Katz (2020) concluded six key game features in language learning games, including ease of use, challenge, rewards and feedback, control or autonomy, goal orientation, and interactivity. The scoping review by Xu et al. (2020) examined the effects of employing DGBLL to promote learning English as a foreign language on learning effectiveness. They found that the popular game element adopted by more than 80% of the studies was ongoing feedback, indicating that timely feedback was provided in most digital games. Additionally, Xu et al. (2020) also suggested that the game design could be further improved by adopting game elements, including uncertainty, control, and adaptive challenges, which were found to be used less in the reviewed studies. Govender and Arnedo-Moreno (2021) conducted an examination of game design components, unveiling that within DGBLL, the prevailing elements encompass feedback, theme, points, narrative, and levels. Furthermore, their study emphasized the necessity for further investigation into the less conventional design components of DGBLL, which have exhibited potential in fostering language acquisition. Moreover, Chik (2014) stressed balancing gaming and learning is critical because it was found that learners might concentrate on gaming more than learning, leading to poor learning outcomes. In addition, Ishaq, Rosdi, Zin, and Abid (2022) presented a theoretical model that combines the elements of sociocultural theory with gamification concepts and elements to design a language learning game (LLG) in a cultural context. The four gamification components employed in the LLG include goal orientation, accomplishments, reinforcements, and a fun orientation. The experimental result showed that LLG could more significantly enhance learning performance than mobile learning and traditional instruction. Although game elements have been reviewed and discussed in previous studies, an integrated framework for researchers to systematically consider and apply proper game elements in designing a language-learning game is still lacking. This study aims to

Table 1
The eight core drives of the Octalysis gamification framework and the corresponding intrinsic/extrinsic, white/black hat motivators.

Core Drives	Description	Intrinsic/Extrinsic Motivators	White/Black Hat Gamification
Epic Meaning and Calling	Make people believe that they are doing things more significant than themselves or that they were selected to do something.	–	White (Positive)
Development and Accomplishment	Provoke people' intrinsic desire to make progress, develop skills, reach mastery, and ultimately overcome challenges.	Extrinsic	White (Positive)
Empowerment of Creativity and Feedback	Engage people to create new things and try different combinations as well as allow them to see their creations, get feedback, and make response to it.	Intrinsic	White (Positive)
Ownership and Possession	Make people feel like they own or can control something that they are motivated to gain more or to make what they own better.	Extrinsic	–
Social Influence and Relatedness	Include all the social elements that make people connect or compete with others, or relate to other people, places, things, or events.	Intrinsic	–
Scarcity and Impatience	Arrange things that are scarce, unique, and hard to obtain immediately to motivate people to get it.	Extrinsic	Black (Negative)
Unpredictability and Curiosity	Make people want to know what is going to happen next.	Intrinsic	Black (Negative)
Loss and Avoidance	Make people act to avoid losing opportunities or happening negative things.	–	Black (Negative)

bridge the gap.

2.3. The Octalysis gamification framework used in game-based learning

Undoubtedly, motivation is a necessary force to drive game behaviors. Chou (2016) suggested that the most essential core objective of a gamification framework is to provoke users' motivation so that motivation can drive users' behaviors. He proposed a user-centered Octalysis gamification framework to classify gamification mechanisms into eight core drives applying motivational psychology and behavioral economics. Table 1 shows the eight core drives of the Octalysis gamification framework and the corresponding intrinsic/extrinsic, white/black hat motivators. The eight core drives are (1) epic meaning and calling: make people to believe that they are doing things more significant than themselves or they were selected to do something; (2) development and accomplishment: provoke people's intrinsic desire to make progress, develop skills, reach mastery, and ultimately overcome challenges; (3) empowerment of creativity and feedback: engage people to create new things and try different combination as well as allow them to see their creations, get feedback, and make response to it; (4) ownership and possession: make people feel like they own or can control something that they are motivated to gain more or to make what they own better; (5) social influence and relatedness: include all the social elements that make people connect or compete with others, or relate to other people, places, things, or events; (6) scarcity and impatience: arrange things that are scarce, unique, and hard to obtain immediately to motivate people to get it; (7) unpredictability and curiosity: make people want to know what is going to happen next; (8)loss and avoidance: make people act to avoid losing opportunities or happening negative things. According to Chou (2016) Octalysis gamification framework, the three core drives, including "development and accomplishment," "ownership and possession," and "scarcity and impatience," are regarded as extrinsic motivators, and the other three core drives, including "empowerment of creativity and feedback," "social influence and relatedness," and "unpredictability and curiosity," are intrinsic motivators. Moreover, Chou (2016) also proposed "White Hat Gamification" and "Black Hat Gamification" to discuss positive motivators and negative motivators in the Octalysis gamification framework. "White Hat Gamification" is the use of mechanisms that apply positive motivators to make people feel powerful, successful, satisfied, and in control when they engage in gamified activities. On the other hand, the "Black Hat Gamification" adopts mechanisms of negative motivators to make people feel uncertain, afraid of losing something, and out of control. In the Octalysis gamification framework, "epic meaning and calling," "development and accomplishment," and "empowerment of creativity and feedback" are the positive motivators, while the "scarcity and impatience," "unpredictability and curiosity," and "loss and avoidance" are the negative motivators. As stated by Chou (2016), negative motivators are potent in motivating desired behaviors, but they will lead to bad feelings if used for a prolonged time. However, Chou (2016) also stressed that using negative motivators is not necessarily harmful or unethical. It depends on how the game designers appropriately use "Black Hat Gamification" to provoke good behaviors and apply "White Hat Gamification" to make people willing to participate in the activities continuously.

Currently, the Octalysis gamification framework proposed by Chou (2016) has been applied in different domains and has drawn increasing attention from educational settings (Weber, Grönewald, & Ludwig, 2022). The Octalysis gamification framework was applied as a framework to analyze or evaluate the learning platforms, games, or gamified learning environments (Ouariachi, Li, & Elving, 2020; Reyes, López, Ponce, & Mazón, 2021; Seifert & Gez, 2021; Tomcho, Lin, Long, Coggins, & Reith, 2019), to evaluate the degree of students' motivation in participating in online learning activities (Marisa et al., 2020), or to design learning activities and games to promote learning (Araújo & Carvalho, 2022; Cunha, Barraqui, & De Freitas, 2018; Mårell-Olsson, 2019; Sánchez & Cano, 2020; Toasa, Celi, & Herrera, 2020). The use of the Octalysis gamification framework to design games and gamified curriculums was confirmed with the effects on promoting better learning outcomes and motivating and engaging students more in learning (Cunha et al., 2018; Sánchez & Cano, 2020; Toasa et al., 2020). However, according to the literature review of this study, no study has applied the Octalysis gamification framework for designing DGBLL. Therefore, this research attempted to employ the Octalysis gamification framework to develop the learning functions and gamification mechanisms of GJLS and examined its effects on the Japanese learning effectiveness of company employees. Since motivation is the key to driving learning behaviors, it is expected that the GJLS developed based on the Octalysis gamification framework would also promote the learning behaviors of the learners. In the previously reviewed literature, although the researchers provided good discussions on how the game elements could be applied to promote learning performance, the correlations between the use of gamification features and learning performance were not empirically investigated. Therefore, this research would also investigate the learning behaviors of using the GJLS to aid Japanese learning and explore the correlations between the use of different learning functions corresponding to the eight core drives and Japanese learning performance.

2.4. Effects of digital game-based language learning on immersion experience

Flow theory was first proposed by Csikszentmihalyi (1975) and defined as when an individual concentrates his attention on the activity they are engaged with. That is, filtering out perceptions that are entirely irrelevant to the activity will lead to a flow state. This immersive experience will enable individuals to gain a sense of intrinsic satisfaction from participating in the activity without the need for other elements to enhance their self-fulfillment (Csikszentmihalyi & Csikszentmihalyi, 1988). According to the flow theory, "challenge" and "skill" are two essential factors that affect individuals to enter a flow state. A flow state only happens when the challenge of a game and the gaming skills of a person reach a balanced state with each other (Csikszentmihalyi & Csikszentmihalyi, 1988). This state can drive the self to challenge higher and more complex gaming levels and strive to learn new things (Abuhamdeh & Csikszentmihalyi, 2012; Moneta & Csikszentmihalyi, 1996). Due to this temporary and subjective immersive experience, a flow state also makes individuals willing to continue to engage in certain activities (Csikszentmihalyi, 1990) and to work hard to keep on this experience (Csikszentmihalyi & Csikszentmihalyi, 1988).

In the past years, researchers (Hsieh et al., 2013) have found that learners with higher immersion experience have better learning performance during learning processes. The interactive and innovative technologies of games contribute to immersive experiences and thus positively impact the learning experience (Phipps et al., 2016). For example, Zhou, Yu, Liao, and Shi (2017) confirmed that a game-based language learning system called ADVENTURE developed in their study could simultaneously improve language skills and immersive experience for language learners. If immersive experience can stimulate learners' interest and motivation in learning, the quality and effectiveness of learning can be effectively improved. Therefore, this study uses the immersion experience questionnaire developed by Cheng, She, and Annetta (2015) to analyze the level of engagement and immersion experience of the learners in both groups in this study when they respectively use a game-based and a non-game-based Japanese learning system to learn Japanese.

2.5. *Effects of digital game-based language learning on learning motivation*

Some scholars believed that learning motivation is a psychological process that can stimulate, guide, and maintain behavior for a long time (Schunk, 1990). Learning motivation can be roughly divided into intrinsic motivation driven by personal pleasure and extrinsic motivation triggered by external stimuli. Intrinsic motivation is not related to external rewards. It is mainly driven by curiosity, satisfaction, and a sense of accomplishment triggered by subjectivity. Therefore, intrinsic motivation is closely related to incentive mechanisms and immersive experiences. Learners with intrinsic motivation can show stronger self-confidence and interest in learning (Valerio, 2012) and have a much more significant impact on learning effectiveness than external motivation. Several past studies (Dewey, 1913; Lipstein & Renninger, 2006) pointed out that interest can promote participation, efficiency, effort, and persistence in learning. There is indeed a positive correlation between learning motivation and learning effectiveness (Lin et al., 2017).

Huang and Huang (2015) confirmed that the handheld sensor-based vocabulary game significantly improved the low-achieving students' learning motivation and performance in vocabulary learning. Moreover, Connolly, Stansfield, and Hainey (2011) also confirmed that students' attitudes towards the Alternate Reality Games (ARGs) developed in their study for supporting language learning were very positive because the games could provide the motivational experience expected by the students. Therefore, how to stimulate learners' learning motivation in learning processes is also one of the critical factors that would improve and have a significant impact on language learning effectiveness. Accordingly, this study adopted the "Motivated Strategies for Learning Questionnaire (MSLQ)" developed by Pintrich, Smith, Garcia, and McKeachie (1991), as a research tool to examine learning motivation after using the GJLS developed by this study to aid Japanese learning.

3. Research methodology

3.1. *Experimental design and procedure*

The study used a true experimental research method to randomly assign 54 research participants into the experimental and control groups to learn Japanese using the GJLS and NGJLS, respectively. Both GJLS and NGJLS were developed by this study and have the same learning functions, video materials, and test questions except for gamification mechanisms. That is, the only difference between both systems is that the NGJLS does not have any gamification mechanisms and is similar to a standard simulation test system, but the GJLS has gamification mechanisms developed based on the eight core drives of the Octalysis gamification framework. A learner using the GJLS or NGJLS can freely select learning units, watch videos, learn words and pronunciation, and then take a test. After completing a test, the correct and incorrect answers will be displayed. The learner can return to the unit list and choose the next unit to learn. The examples of the learning and test interfaces of GJLS and NGJLS are shown in Figs. 1 and 2, respectively. A detailed design of the GJLS is introduced in Section 3.3.1. To explore whether the GJLS has significant effects on learners' learning behavior, learning performance, learning motivation, and immersive experience, this study chose suitable video materials according to the Japanese levels of research participants, suitable words in the video, related dictionaries for query words, and imported all of them into the GJLS and NGJLS. A total of 27 research participants were randomly assigned as the experimental group using the GJLS, whereas the remaining research participants were randomly assigned as the control group using the NGJLS. This study also tried to achieve a balanced group formation according to the number of males and females in both groups.

The experiment was conducted in the Spring of 2020. The overall experiment was implemented in the company and lasted about

Fig. 1. The learning interface of GJLS (left) and NGJLS (right).

Fig. 2. The test interface of GJLS (left) and NGJLS (right).

two weeks, including ten working days and two holidays, totaling twelve days. The research participants could freely decide the use of learning time, duration, and frequency during the experiment. In other words, the use of both systems was allowed during working hours, breaks, or after getting off work. During the experiment, the research participants would not be disturbed, allowing them to carry out self-directed and autonomous learning. Before the beginning of the experiment, the research participants of the two groups were invited to take a pre-test to assess initial Japanese vocabulary size. During the experiment, the learning behaviors of the two groups that clicked on learning functions while using GJLS and NGJLS were recorded into a database by a program coded in the PHP programming language for statistical analysis according to the number of learning behaviors. At the end of the experiment, the post-tests of Japanese vocabulary size, learning motivation, and immersion experience were performed, a semi-structured in-depth interview that randomly invited 4 learners in the experimental group was conducted two days later, and the delayed post-test of Japanese vocabulary size was conducted one month later.

3.2. Research participants

In this study, a total of 54 employees with Japanese proficiency ranging from N4 to N2 of JLPT, aged from 25 to 47 years old, 30 males and 24 females, and at least three years of working experience from the Taiwan branch of an international Japanese business company, mainly engaged in the development of online social games for smartphones and web platforms, were recruited as the research participants regardless of position. They are all native Mandarin speakers, and Japanese is their second language (L2).

3.3. Research tools

3.3.1. The implemented game-based Japanese learning system (GJLS)

In this research, the Octalysis gamification framework with eight core drives developed by Chou (2016) was applied to design the learning functions and gamification mechanisms of GJLS. Seven learning functions were designed in the GJLS, including adventure, a little nest, treasure chest, leaderboard, achievement, role collection, and chat room to correspond to the eight core drives (see Appendix for detailed descriptions of the interfaces and functions). Fig. 3 shows the relationships among the designed learning functions, adopted gamification mechanisms, and the corresponding core drives of the Octalysis gamification framework.

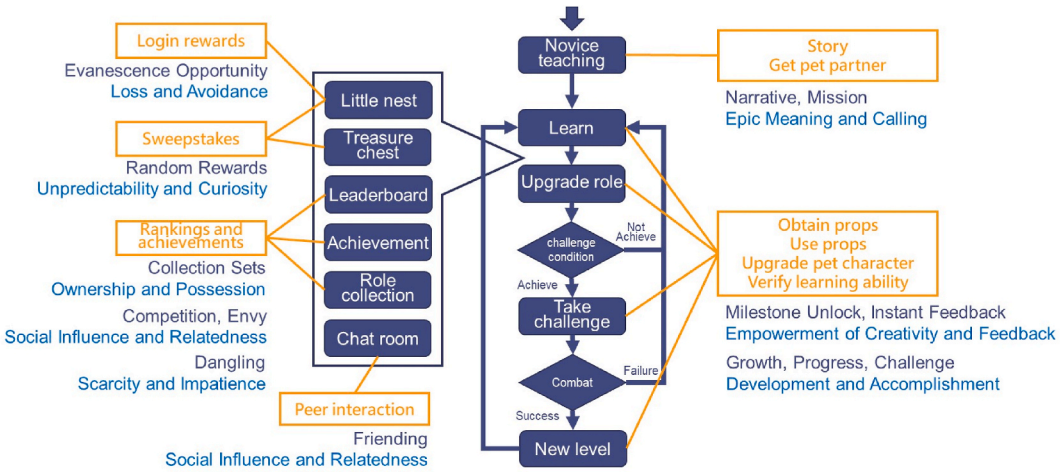

Fig. 3. The relationships among the designed game functions, learning mechanisms of GJLS, and the corresponding core drives of the Octalysis gamification framework.

As shown in Fig. 3, a learner who uses the GJLS for the first time will be guided by novice teaching, which mainly tells what the learning missions of the learner are during the learning process. At the beginning of the game, a learner can choose a pet partner to accompany herself/himself on the learning journey, and the story will be changed following the promotion of the learning stage. In this way, the game-based learning process can be expressed through story and narrative so that learners can experience the game's atmosphere, and the exciting stories of the little pets are helpful to encourage learners to produce emotional connections and cultivate a sense of responsibility, thereby creating a sense of immersion and adhesion of game learning. This design adopts common gamification mechanisms, narrative, and mission corresponding to the core drive of "epic meaning and calling."

After novice teaching, the learners start their vocabulary learning in the GJLS. The core learning procedures are shown in Fig. 4. The learners watch videos and vocabulary lists to learn Japanese words. They will get rewards during their learning process. The rewards can be used to upgrade their pet partners to fulfill the required levels to take challenge tests. Once the levels of their pets reach the requirement of the challenge they want to take, they can initiate a challenge and engage in fierce problem-solving battles of vocabulary. After successfully passing the challenge, they can unlock a new learning mission and learn more vocabulary. In this learning cycle, learners will get immediate feedback by obtaining props, using props, upgrading pet characters, verifying learning abilities, and unlocking new levels, thus driving them to continue learning. Spending resources and props can upgrade their pet's role step by step, watching pets become stronger day by day, thus raising learners to feel the fun of nurturing and promotion. In the challenge level of the test battle, through the difficulty level promoted step by step, different points and attack damage can be obtained according to the continuous answering and answering speed of test questions. Therefore, learners not only have to answer each test question accurately but also have to answer each test question quickly when proceeding with a test battle. This mechanism is a rigorous test assessing the learner's learning outcomes when learning vocabulary and will be very helpful in generating the flow experience. This learning cycle employs several common gamification mechanisms, including growth, progress, challenge, instant feedback, and milestone unlock. The first three mechanisms correspond to the core drive of "development and accomplishment," and the last two mechanisms correspond to the core drive of "empowerment of creativity and feedback," as shown in Fig. 3.

Besides the primary learning cycle, several learning functions and gamification mechanisms were designed to promote learning outcomes. Learners can receive random rewards every 4 h in the "little nest." The "little nest" provides log-in rewards to the learners. The gamification mechanism of evanescence opportunity corresponding to the core drive of "loss and avoidance" was applied in this function. To avoid the loss of opportunities to get rewards, learners have to log in to the system every 4 h. Otherwise, they will get fewer resources than other competitors. This mechanism can increase the number of times that learners use the system to assist Japanese learning, increase retention and develop the habit of learning Japanese. In addition, random rewards are provided to attract learners using the core drive of "unpredictability and curiosity."

In addition to getting the regular random rewards in the "little nest," learners can use gold coins they earn from their learning activities to draw sweepstakes at any time in the "treasure chest". The "treasure chest" also adopts the exact gamification mechanism as the "little nest," that is, random reward. This mechanism can satisfy uncertainty and curiosity, which are the core drivers of the Octalysis gamification framework, allowing learners to be curious and expect the result of the sweepstakes. In general, learners are often more captivated by the unpredictability and fortuitousness of good luck rather than straightforward rewards. The presence of

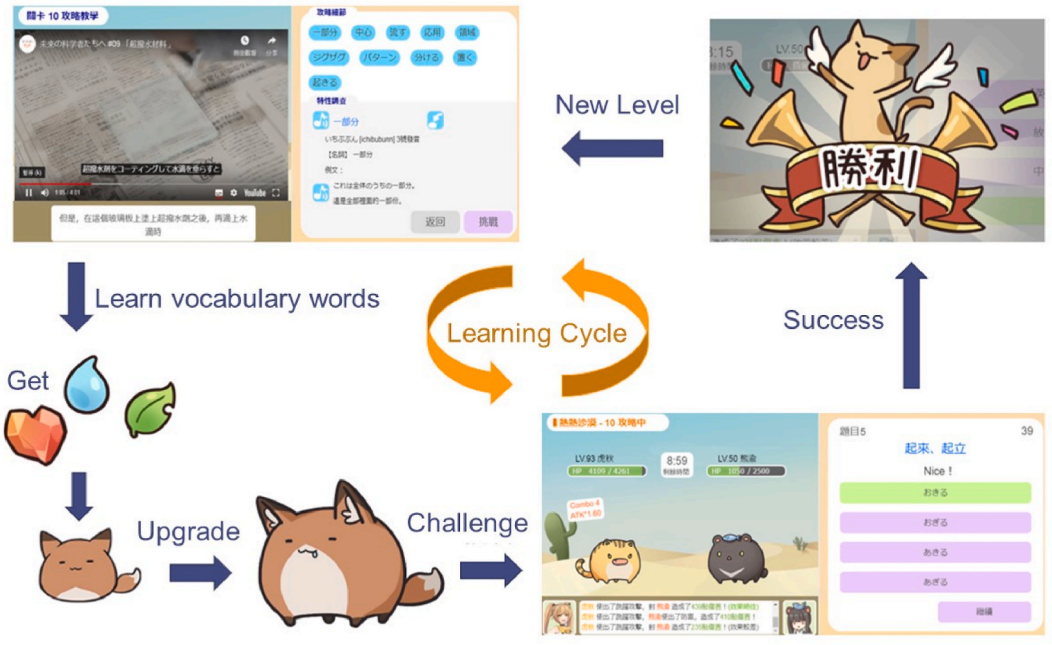

Fig. 4. The core learning procedures of the GJLS for Japanese learning.

lucky opportunities can significantly enhance learners' intrinsic motivation to learn.

The three functions of "leaderboard," "achievement," and "role collection" provide rankings and achievement information to induce learners to collect roles, envy other learners' rankings and achievements, thus generating competition among the participants. The core drives applied for these mechanisms are "ownership and possession," "social influence and relatedness," and "scarcity and impatience." These design elements make learners want to collect a complete set of pet roles, achieve high rankings, and obtain all achievement titles, so they have to take more time and effort to learn in the GJLS. Thus, their learning motivation is promoted.

The "chat room" function on the "homepage" provides a place for peer interaction where learners can make friends and chat. The friendly mechanism can trigger social influence and relatedness by exchanging learning experiences or requesting help when they encounter difficulties completing the learning mission. Therefore, the learners will not feel alone when learning with the GJLS. After the learners enhance their friendship with each other, they can also increase the frequency of using this system and increase learning motivation.

3.3.2. The motivated strategies for learning questionnaire (MSLQ)

This study used the "Motivated Strategies for Learning Questionnaire (MSLQ)" developed by Pintrich et al. (1991) to measure learners' learning motivation. The MSLQ has two sections, including a learning motivation section and a learning strategies section. The learning motivation section was used in this study to assess learners' learning goals and value beliefs, their beliefs about their skills to succeed, and their anxiety about tests in a learning activity. The scale has a total of 31 questions, divided into value, expectancy, and affective components, and six subscales, including intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety. Among them, intrinsic goal orientation means internal motivation; extrinsic goal orientation refers to external motivation; task value refers to the views held by learners due to their work; control of learning beliefs refers to whether learners think that learning outcomes are related to their effort; self-efficacy for learning and performance refers to the ability of the learner to complete the task; test anxiety is a test of the learner's emotional problems. Feiz, Hooman, and Kooshki (2013) conducted a study on the validity and reliability of this scale, randomly sampling 504 students as a sample. The overall reliability of the scale was 0.958, confirming that the MSLQ can effectively measure learners' learning motivation.

3.3.3. The immersion experience scale

This study used the immersion experience scale developed by Cheng et al. (2015) to analyze the immersion level of the learners and to examine whether the learners of the two groups have significant differences in immersion experience. This scale is divided into three subscales. The first subscale is "engagement" with 9 questions, and has a reliability of 0.76. The second subscale is "engrossment" with 7 questions, and has a reliability of 0.81. The third subscale is "total immersion," with 8 questions, and the subscale's reliability reaches 0.87.

3.3.4. The pre-test, post-test, and delayed post-test for assessing Japanese learning performance

The Japanese Language Proficiency Test (JLPT) was used in this study to assess learners' learning performance in terms of knowledge and listening comprehension of Japanese vocabulary. A total of 150 words with difficulty levels ranging from N4 to N2 of JLPT were selected from the video learning materials and designed to include six question types: Japanese vocabulary listening question, Japanese to Chinese vocabulary translation question, Chinese translation to match with Japanese katakana question, Japanese katakana to match with Chinese translation question, Japanese katakana similarity judgment question, and Japanese word fill-in-the-blank question. These 150 words correspond to six question types, so there are 900 questions in the test question bank. In this study, 50 questions were randomly selected by the GJLS from the test question bank as the pre-test, post-test, and delayed post-test questions for each learner. The order of the questions and answers was also randomly generated by the GJLS to avoid the memory effect. Therefore, language knowledge and skills that the participants learned in the experiment contain not only vocabulary knowledge but also vocabulary listening, translation, and sentence understanding abilities.

3.4. Data analysis

The "rule of thumb" suggesting that a sample size of 30 is needed for parametric tests is a general guideline but not an absolute requirement (Martinez-Abrain, 2014). The appropriateness of using parametric statistics depends on various factors, including the specific statistical test, the distribution of the data, and the assumptions of the test. A true experiment used in this study is widely regarded as the most accurate type of research method conducted by scientists because it supports some hypotheses, including random sample, normal distribution, etc. when using parametric statistical methods for data analysis. Therefore, parametric statistical methods were used to examine the research questions of this study.

In this study, four difference analyses and a correlation analysis were conducted to answer the research questions of this study. The independent samples *t*-tests were performed to compare the experimental and control group learners' learning behaviors, learning retention, learning motivation, and immersion experience. The ANCOVA was employed to compare the results of the Japanese learning performance of the two groups. Moreover, a correlation analysis was carried out to investigate the correlations between game-based learning functions and learning performance. The power analysis of the above statistical results was performed by using G*Power, which is a free-to-use software used to calculate statistical power (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007). In general, the higher the statistical power of a test, the lower the risk of making a Type II error. Power is usually set at 0.8 (Cohen, 1992).

4. Experimental results

4.1. Analysis of the difference in learning behavior, learning performance, learning motivation, and immersion experience between both groups

4.1.1. Analysis of the difference in learning behavior between both groups

In this study, the independent samples *t*-test was performed to examine the difference in the learning behaviors between both groups according to the gathered user behavior records. The results are shown in Table 2. The results showed that the learners of two groups in the number of using system ($t = 3.87$; $p = .000 < 0.05$; power = 0.967), the number of watching videos ($t = 5.03$; $p = .000 < 0.05$; power = 0.998), the number of learning ($t = 4.48$; $p = .000 < 0.05$; power = 0.993), and the number of reviews ($t = 2.33$; $p = .028 < 0.05$; power = 0.627) all reached significant differences, and learners in the experimental group were significantly more engaged than those of the control group. However, there was no significant difference between the two groups in the number of using the test.

4.1.2. Analysis of the difference in learning performance between both groups

To compare the difference in learning performance between the two groups, an analysis of covariance (ANCOVA) was conducted using pre-test scores as the covariate. Before performing ANCOVA, the homogeneity of the regression coefficient within the group was tested. The result showed that the homogeneity of the regression coefficient within the group was satisfied ($F = 1.65$; $p = .205 > 0.05$), and the ANCOVA could be applied. The results are shown in Table 3. The results showed that the learners of both groups had a significant difference in the post-test scores ($F = 4.57$; $p = .037 < 0.05$; power = 0.577), and the experimental group was significantly better than the control group. Besides, an independent samples *t*-test was performed on the improvement scores between the post-test and the delayed post-test (i.e., the delayed post-test score subtracts the post-test score) to examine the learning retention effect of both groups after one month of ending the experiment. Table 4 shows the results of the independent samples *t*-test of the improvement score difference between both groups. The results showed that the learners of both groups had no significant difference in learning retention ($t = 1.42$; $p = .161 > 0.05$; power = 0.285).

4.1.3. Analysis of the difference in learning motivation between both groups

Table 5 shows the results of the independent samples *t*-test of learning motivation difference between both groups. The results showed that learners in the two groups reached a significant difference in learning motivation ($t = 2.22$; $p = .031 < 0.05$; power = 0.556), and learners in the experimental group were significantly more motivated than those of the control group.

4.1.4. Analysis of the difference in immersion experience between both groups

Table 6 shows the results of the independent samples *t*-test of immersion experience difference between both groups. The results showed that learners in the two groups reached a significant difference in the immersion experience ($t = 3.71$;$p = .001 < 0.05$; power = 0.949), and learners in the experimental group were significantly more immersed than those of the control group.

4.2. Correlation analysis between learning performance and learning behaviors of learners in the experimental group

For understanding the impact of the various game-based learning mechanisms used in the GJLS on learning performance, this study divided the game-based learning functions in the system into attendance days, number of reading little animal stories, number of little animal upgrades, number of levels completed, number of levels challenged, number of feedback obtained, number of viewing achievements, number of achievements collected, number of little animals collected, number of viewing leaderboards, number of chat rooms used, the total score of the leaderboard, number of treasure chests used, and number of using the little nests to examine the correlations with the learning performance progress scores of learners in the experimental group. Those 14 game-based learning functions can correspond to the eight core drives for promoting learners' learning motivation according to the Octalysis gamification framework. Pearson product-moment correlation analysis was conducted to investigate the correlations between the learning

Table 2
The independent samples *t*-test results of learning behavior differences between both groups.

Item	Group	n	Mean	SD	*t*	*p* (two-tailed)	Power
The number of using the system	Experimental group	27	2386.07	1800.68	3.87***	0.000	0.967
	Control group	27	901.30	861.36			
The number of watching the videos	Experimental group	27	306.56	273.99	5.03***	0.000	0.998
	Control group	27	38.56	41.56			
The number of learning	Experimental group	27	961.44	697.91	4.48***	0.000	0.993
	Control group	27	310.96	286.48			
The number of reviews	Experimental group	27	91.00	187.78	2.33*	0.028	0.627
	Control group	27	6.89	7.27			
The number of using the test	Experimental group	27	406.96	357.46	0.75	0.456	0.114
	Control group	27	342.15	270.17			

*indicates $p < .05$; ***indicated $p < .001$.

Table 3
The ANCOVA results of the post-test score difference between both groups.

Item	Group	n	Pre-test		Post-test		*F*	*p* (two-tailed)	Power
			Mean	SD	Mean	SD			
Learning performance	Experimental group	27	85.63	9.01	90.44	6.16	4.57*	0.037	0.577
	Control group	27	85.04	10.89	86.67	9.46			

*indicates $p < .05$.

Table 4
The independent samples *t*-test results of the learning retention difference between both groups.

Item	Group	n	Mean	SD	*t*	*p* (two-tailed)	Power
Improvement scores between the post-test and delayed post-test	Experimental group	27	4.81	7.49	1.42	0.161	0.285
	Control group	27	2.15	6.25			

Table 5
The independent samples *t*-test results of learning motivation difference between both groups.

Item	Group	n	Mean	SD	*t*	*p* (two-tailed)	Power
Learning motivation	Experimental group	27	3.63	0.33	2.22*	0.031	0.556
	Control group	27	3.39	0.48			

*indicates $p < .05$.

Table 6
The independent-sample *t*-test results of immersion experience difference between both groups.

Item	Group	n	Mean	SD	*t*	*p* (two-tailed)	Power
Immersion experience	Experimental group	27	3.23	0.42	3.71**	0.001	0.949
	Control group	27	2.72	0.59			

**indicates $p < .01$.

performance progress scores and the number of learning behaviors across the 14 game-based learning functions. The aim was to identify the game-based learning functions that exhibited significant correlations with improvement in learning performance. The results can offer valuable suggestions about how to train corporate employees in Japanese more effectively by using GJLS. Table 7

Table 7
The correlation analysis results between various learning behaviors and the learning performance progress scores in the experimental group (n = 27).

Game-based learning function	Core drives for learners' learning motivation according to the Octalysis gamification framework	Learning performance progress score		Power
		r	*p* (two-tailed)	
Attendance days	Epic meaning and calling	0.311	0.115	0.359
Number of reading little animal stories	Epic meaning and calling	0.637 ***	0.000	0.964
Number of little animal upgrades	Epic meaning and calling; Development and accomplishment	0.414 *	0.032	0.594
Number of levels completed	Development and accomplishment	0.381	0.050	0.516
Number of levels challenged	Empowerment of creativity and feedback	0.429 *	0.026	0.629
Number of feedback obtained	Empowerment of creativity and feedback	0.572 **	0.002	0.901
Number of viewing achievements	Ownership and possession; Social influence and relatedness	0.523 **	0.005	0.826
Number of achievements collected	Ownership and possession; Scarcity and impatience	0.326	0.097	0.391
Number of little animals collected	Ownership and possession; Scarcity and impatience	0.289	0.144	0.315
Number of viewing leaderboards	Social influence and relatedness	0.500 **	0.008	0.784
Number of chat rooms used	Social influence and relatedness	0.262	0.186	0.265
The total score of the leaderboard	Scarcity and impatience	0.546 **	0.003	0.865
Number of treasure chests used	Unpredictability and curiosity	0.623 **	0.001	0.954
Number of using thelittle nests	Unpredictability and curiosity; Loss and avoidance	0.474 *	0.013	0.730

*indicates $p < .05$; **indicates $p < .01$; *** indicates $p < .001$.

shows the correlation analysis results of various learning behaviors and the learning performance progress scores. The results showed that the number of reading little animal stories ($r = 0.637$, $p = .000 < 0.05$, power = 0.964), the number of little animal upgrades ($r = 0.414$, $p = .032 < 0.05$, power = 0.594), the number of levels challenged ($r = 0.429$, $p = .026 < 0.05$, power = 0.629), the number of feedback obtained ($r = 0.572$, $p = .002 < 0.05$, power = 0.901), the number of viewing achievements ($r = 0.523$, $p = .005 < 0.05$, power = 0.826), the number of viewing leaderboards ($r = 0.500$, $p = .008 < 0.05$, power = 0.784), the total score of the leaderboard ($r = 0.546$, p = .003 <0 .05, power = 0.865), the number of treasure chests used ($r = 0.623$, $p = .001 < 0.05$, power = 0.954), and the number of using the little nests ($r = 0.474$, $p = .013 < 0.05$, power = 0.730) are moderately positively correlated with learning performance improvement, but five learning behaviors including the number of attendance days, the number of levels completed, the number of achievement collected, the number of little animals collected, and the number of chat room used did not show significant correlations with learning performance improvement. It is worth noting that although the chat room was used by the learners of the experimental group, the number of chat rooms used did not show a significant correlation with learning performance improvement.

5. Discussion

The analytical results of differences in the learning behavior of learners showed that the learners in the experimental group who used the GJLS to assist Japanese learning had significantly more active learning behavior in terms of the number of using the system, the number of watching videos, the number of learning, and the number of reviews than those of the control group who used the NGJLS to assist Japanese learning. The results show that the game-based learning mechanisms designed in the GJLS could indeed promote the learners' willingness to use the system to facilitate Japanese learning during their daily lives. This result is consistent with many previous studies, indicating those game elements have positive effects on enhancing learning motivation or participation (Hew et al., 2016; van Roy & Zaman, 2018), and the game elements are the key to determining participation (de-Marcos et al., 2016; Domínguez et al., 2013).

The analytical results of differences in learning performance between the groups showed that the learners in the experimental group using the GJLS to assist Japanese learning had significantly better Japanese learning performance than those of the control group using the NGJLS. However, there was no significant difference between the learning retention of both groups. This experimental result confirms that game-based learning is helpful in promoting learners' short-term learning retention but still not helpful in long-term learning retention. This result is not the same as many previous studies (de-Marcos et al., 2016; Hanus & Fox, 2015; Chen, Li, & Chen, 2020), indicating that game elements sometimes have negative or no significant impacts on learning performance when learners might pay much more attention to the game mechanisms rather than the learning content. Chen et al. (2020) indicated that the weak connection between game mechanisms and learning content is the main factor affecting the effect of game mechanisms on learning performance. Furthermore, this result is also inconsistent with Kazu and Kuvvetli (2023) and Chen et al. (2019), suggesting that DGBLL and mobile game-based learning (MGBL) can be an effective strategy for promoting vocabulary retention in language learning due to the excellent effect of game mechanisms on learning content. The effect of the proposed GJLS on learning retention may be affected by the limited learning time; thus, there was no significant difference. Encouragingly, the game design of the proposed GJLS has been well connected with the language learning activities; it echoes that language learning with well-designed game incentive mechanisms to attract learners' learning participation will help improve learner-centered learning performance (Tsay et al., 2018). The research findings can be supported by the semi-structured interview, indicating that most interviewees agreed that GJLS is helpful for Japanese learning because of having user-friendly system functionality, lively and cute visuals, interesting teaching materials, and reward mechanisms, making it suitable for learning Japanese. Additionally, the GJLS's game incentive mechanisms help stimulate continuous repetition in their learning efforts, rewards facilitate the transition from being externally motivated to becoming self-directed learners, and integrating learning and testing contributes to enhancing the effectiveness of their learning.

The analytical results of the differences in learning motivation and immersive experience of the two groups showed that the learners in the experimental group using the GJLS to assist Japanese learning had significantly better learning motivation and immersive experience than those of the control group using NGJLS. This result is consistent with previous research (Huang & Huang, 2015; Zhou et al., 2017), indicating that the use of innovative game design based on the Octalysis gamification framework can help enhance learners' immersive experience, thereby positively influencing the language learning motivation. The research findings can also be supported by the semi-structured interview, indicating that most interviewees stated that the game incentive mechanisms, such as the growth of small animals, leveling up, learning feedback, treasure chest, and little nest, help generate motivation during the learning process and create a sense of happiness and enjoyment.

The analytical results of the correlations between the learning performance and the use of game-based learning functions show that learning progress has significant positive correlations with several key game-based learning functions provided by the GJLS. The research findings of this study echo Chen et al. (2019), confirming that the involvement of gamified functions was positively correlated with vocabulary learning performance. Additionally, 6 out of 7 learning functions that applied intrinsic motivators showed significantly positive correlations with learners' learning progress. In comparison, only 3 out of 6 learning functions that adopted extrinsic motivators show significantly positive correlations with learning progress (see Table 7). These findings suggest that the design of learning functions that provoke intrinsic motivation in the GJLS might be more beneficial than those of eliciting extrinsic motivation in promoting learning effectiveness. Among the three useful learning functions corresponding to extrinsic motivators, "the number of viewing achievements" was driven by both intrinsic (i.e., social influence and relatedness) and extrinsic (i.e., ownership and possession) motivators. The other two learning functions are "the total score of the leaderboard" and "the number of little animal upgrades." Moreover, in discussing the correlation results corresponding to positive and negative motivators stated by Chou (2016), 4 out of 6 learning functions using "White Hat Mechanisms" (i.e., the number of reading little animal stories, the number of little animal

upgrades, the number of levels challenged, and the number of feedback obtained), and 3 out of 5 learning functions using "Black Hat Mechanisms" (i.e., the total score of the leaderboard, the number of treasure chests used, and the number of using the little nests) resulted in significant positive correlations with learning progress. It should be noted that since the "little nest" allows learners to get random rewards every 4 h, one might be concerned about whether learners would be affected to have undesirable actions, such as setting an alarm clock to wake up at midnight to get the rewards. According to the log file, only about half of the learners (15 out of 27) ever got to the little nest twice or three times a day for log-in rewards, and all of them did this behavior during the daytime or no later than 9 p.m. except one learner. For the learner who logged in to the game in the middle of the night, it is evident that she did this not because of the design of the 4-h interval reward mechanism. For the days she logged in to the game at midnight to check the little nest, the last time to check before midnight was either around 2:00 p.m. or 5:00 p.m.; the interval was far more than 4 h. It might be just because she was used to going to sleep late that she would get on the game again to get the reward before going to sleep at midnight. Therefore, all four positive and three negative motivators in the Octalysis gamification framework applied to design learning functions are suggested to be helpful in promoting learning without side effects. Therefore, this study makes an excellent design to properly use positive and negative motivators to facilitate Japanese learning in a game-based language learning system.

Among those game-based learning functions that were moderately positively correlated with learning performance, the top three are "the number of reading little animal stories," "the number of the treasure chest used," and "the number of learning feedback obtained." "The number of reading little animal stories" corresponds to the core drive of "epic meaning and calling" (i.e., primary mission goals and mission call), which is regarded as a positive motivator from the psychological perspective (Chou, 2016). Learners could look up the little animal stories at the beginning of the game and, in the process, slowly learn about the game. The storyline, featuring little animals taking risks from the heart, deeply resonated with learners, convincing them they were part of something fascinating and meaningful. As a result, learners were highly motivated to engage in Japanese language learning. Furthermore, "the number of the treasure chest used" corresponds to the core drive of "unpredictability and curiosity" (i.e., learners' learning motivation of uncertainty and curiosity), which is regarded as an intrinsic and negative motivator (Chou, 2016). Learners would be rewarded with gold coins during the adventurous learning process and then could use the gold coins in exchange for the opportunity to draw a treasure chest. The randomness of the reward made learners feel curious about unpredictable results. Many psychologists pointed out that people will be fascinated by the experience of uncertainty and opportunity, and attention can be increased to achieve an immersive effect (Chou, 2016). Lastly, "the number of learning feedback obtained" corresponds to the core drive of "empowerment of creativity and feedback," which is regarded as an intrinsic and positive motivator (Chou, 2016). Govender and Arnedo-Moreno (2021) indicated that the most common game element was a feedback system, which was featured in 96% of the games. Giving feedback to students is an essential part of language acquisition and has shown positive results in computer-assisted language learning. In addition, the research findings of Saad Mohamed's study (2020) indicated under the Random-Effects (RE) model that feedback in computer-assisted language learning (CALL) has a significant moderate effect size on student language learning outcomes ($g = 0.56$). The results of this study confirm the findings of previous research and provide further insight into how to use the Octalysis gamification framework to design an effective game-based language learning system with the mechanisms and learning functions corresponding to intrinsic and extrinsic as well as positive and negative motivators.

This study obtains several valuable research findings, but there still has a limitation in that learner behaviors and affective states before the treatment may have an influence on learning behaviors, learning motivation, and immersion experience during the treatment (Wang, Liu, Stein, & Xia, 2019). Although a true experimental design was used in this study, it is possible to assume that there are no significant differences in the learner behaviors and affective states of the two groups before the experiment. However, this assumption is complicated to prove because learner behaviors and affective states often undergo changes over time, making them very difficult to measure. To make the analytical results of this study more accurate, learner behaviors and affective states before the treatment can be potent covariates for the questionnaire results on learning behaviors, learning motivation, and immersion experience. However, measuring learner behaviors and affective states before the treatment presents significant challenges. This has been considered a research limitation of this study.

6. Conclusions and future works

This study employed the Octalysis gamification framework to develop the gaming and learning functions of the GJLS for promoting corporate employees' Japanese learning and examined the effectiveness of the system on learning behaviors, learning performance, learning motivation, and immersion experience. The correlations between the learners' use of game-based learning functions and their learning performance were also analyzed. By conducting a true experiment, the results of this study show that the learners who used the GJLS to assist Japanese learning had significantly more active learning behaviors than those with NGJLS. This result indicates that the game-based learning mechanisms developed in the GJLS could enhance learners' willingness and learning motivation to use the system. Moreover, the experimental results of this study show that the learning performance of the learners using the GJLS is significantly better than that of learners using the NGJLS, but there is no significant difference in learning retention between the two groups. This result shows that the game-based learning mechanisms developed in the GJLS can effectively improve learners' short-term learning performance. Predictably, it can potentially enhance learners' long-term learning performance if the learning period can be prolonged. Also, the experimental results of this study show that the learning motivation and immersive experience of the learners who used the GJLS were significantly better than those who used the NGJLS. This result shows that the game-based learning mechanisms developed in the GJLS could enhance learners' learning motivation and immersive experience. Finally, the results of the correlation analysis between the number of using the game-based learning functions and learning performance showed that the top three game-based learning functions, including the times of reading little animal stories, the times of treasure chests used, and the times of learning

feedback obtained had shown their high relevance with learning performance. Besides, six game-based learning functions, including the total score of the leaderboard, the number of viewing achievements, the number of viewing leaderboards, the number of using the little nests, the number of levels challenged, and the number of little animal upgrades, are also moderately positively correlated with the learning performance. These results indicate that the use of core drives regarded as intrinsic motivators in the Octalysis gamification framework to design the GJLS learning functions can more often contribute to positive learning performance, and the use of positive and negative motivators can benefit learning performance. In conclusion, the GJLS was successfully applied to facilitate corporate employees' Japanese learning in this study. This study not only confirms the effectiveness of DGBLL on second language learning as employees' professional development but also conducts an experimental analysis to explore whether these different game-based learning functions and mechanisms were related to learning performance. This may provide a valuable example to apply the learner-centered Octalysis gamification framework in designing DGBLL systems and help future studies modify the game-based learning functions to better use the Octalysis gamification framework for promoting adult second language learning.

The implications of this study for future design and implementation of DGBLL systems are that the strong connection between game mechanisms and learning content should be considered to avoid designing game mechanisms that may disturb learning performance. Apparently, the GJLS learning functions strongly connected with learning content and corresponding test challenge mechanisms contribute to the main benefits of promoting learners' learning behaviors and performance. Furthermore, most DGBLLs developed were considered to adopt positive motivators to design game mechanisms, but negative motivators often were neglected. However, this study confirms that the use of positive and negative motivators in the Octalysis gamification framework to design the GJLS learning functions can benefit learning performance; thus, a balanced mix of positive and negative motivators to optimize the learning performance of DGBLL systems should be considered. Finally, it is beneficial to focus on designing intrinsic motivators in the Octalysis gamification framework for the design and implementation of DGBLL systems because this study confirms that they more often contribute to positive learning performance than extrinsic motivators.

Several suggestions are provided for future research. First, this research was unable to conduct a long-term experimental observation and data collection due to the time limit of the research participants. If the experiment can be conducted for a more extended period, then the effects of the proposed GJLS on learning behaviors, learning performance, learning retention, learning motivation, and immersive experience can be explored more deeply. Therefore, future research can extend the experimental period to several months or longer and explore the long-term impact of GJLS on learners' learning influence in more depth. In addition, in this study, only the number of using games and learning features were compared between the experiment and control groups and used to investigate the correlations between learning behaviors in the game and learning performance. Since the game mechanisms were designed to motivate learners to use the system, it was expected that frequent use of these features or accomplishing more goals could lead to spending more time in the game to learn and making more learning progress. How these designs could promote learning times and whether the amount of time spent on the learning features of the game is positively correlated with learning performance will need more investigation in future studies. Moreover, this study uses Japanese as the auxiliary learning target and the employees of an international Japanese company as the research participants. Whether the results of this study can be inferred from the employees' Japanese language training to other languages requires further investigation. Therefore, future research can apply this system as an assisted tool to learn other languages, such as English, Mandarin, Southeast Asian languages, etc., to explore the influence of the game-based learning mechanisms based on the Octalysis gamification framework in this research on other language learning performance. Finally, in addition to continuing to develop and investigate the effects of DGBLL on the learning performance, behaviors, and motivation of second language learning, future studies also need to be concerned about whether the game incentive mechanisms that were designed to attract learners to stay engaged in learning and spend a tremendous amount of time on the game would cause adverse effects on their physical or mental health such as game addiction or eye-sight damage as reminded by Melo et al. (2020). In this study, even though the learners were adult employees, they might be more aware of their psychological and physical status in using the game; the design of the gamified mechanisms might still bring negative experiences if the use of the game affects their working or daily life schedule. There is a need to investigate the good or bad experiences of learners in-game learning using interviews more in-depth or other measurements.

Credit author statement

Chih-Ming Chen: Conceptualization, Methodology, Supervision, Writing- Original draft preparation, Writing- Reviewing and Editing, Ming-Chaun Li: Supervision, Writing- Revised draft preparation, Chih-Po Kuo: Software, Data curation, Investigation, Validation.

Data availability

Data will be made available on request.

Appendix. The User Interfaces and Functions of GJLS

The GJLS is mainly built with seven functions: the homepage, role, little nest, adventure, ranking, treasure chest, and achievement, respectively. The user interface of the "homepage" after log-in is shown in Figure App.1. This user interface will display information such as user name, role photo, learning level, etc., at the upper side of the user interface. The learner can interact with other learners through the chat room. Once a learner clicks on the "role" function, it will display detailed information about user's role in the game-

based learning process. Learners can upgrade the role by consuming resources, and each upgrade will improve the corresponding ability of the role. After reaching a certain level, the character can evolve to a higher level, and the character's appearance will be changed accordingly, as shown in Figure App.2. The right side of Figure App.2 is the collection book of roles. At present, the system provides a total of 20 roles for learners to collect. Every time a new role is obtained, it will appear in the collection book.

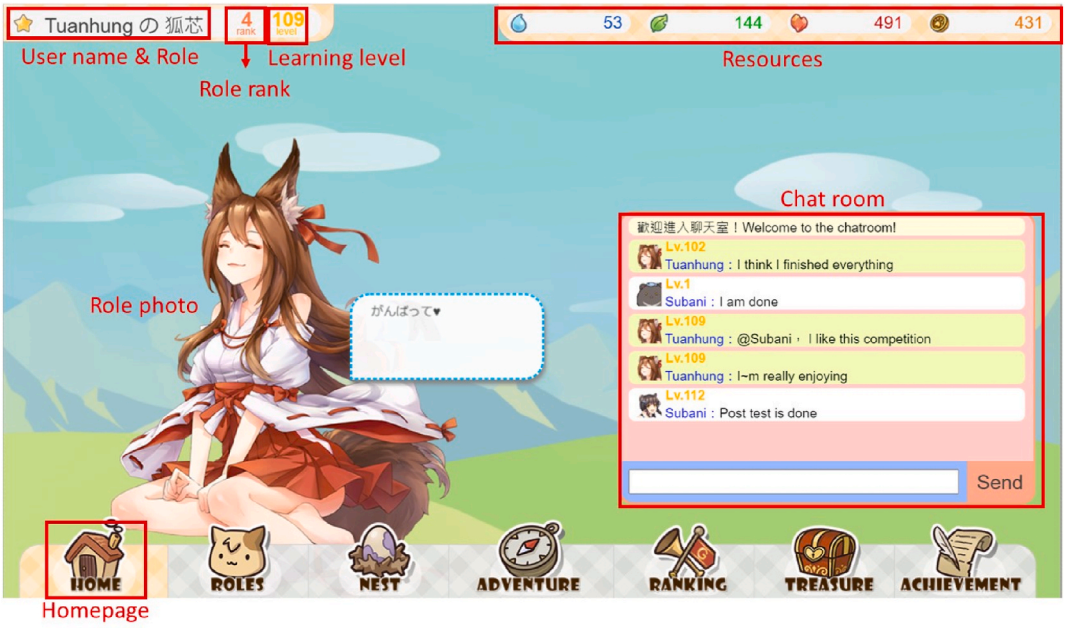

Fig. App.1. The user interface of the "homepage" of the GJLS after a learner logs in

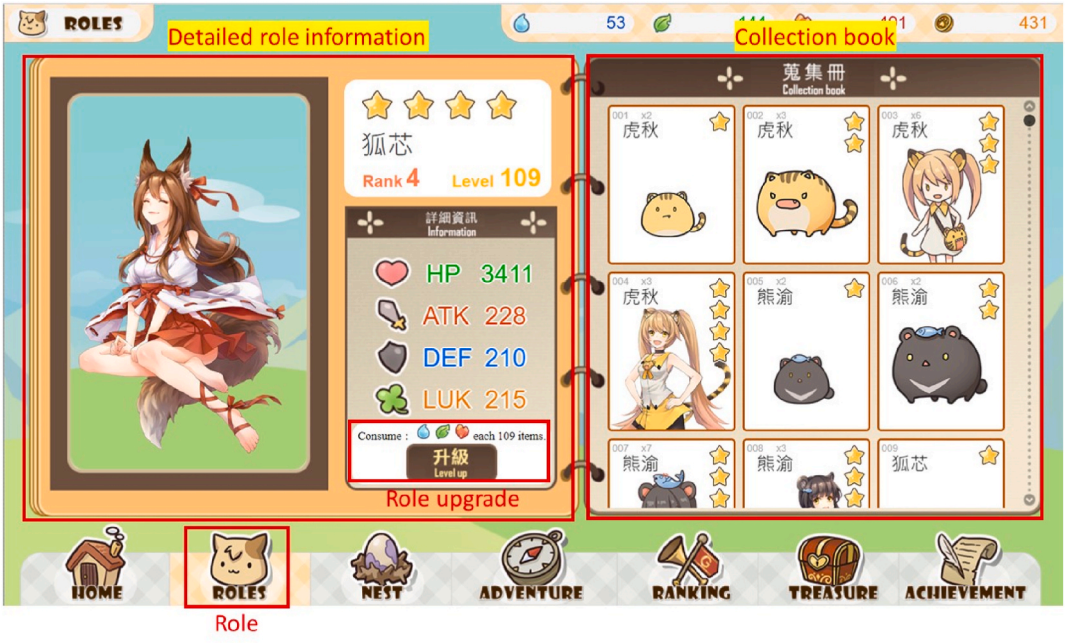

Fig. App.2. The user interface of "role"

The "little nest" is the third function of the GJLS. This function is the place where the learner can collect pet items. Each check has a chance to randomly obtain resource items, pet characters, and achievement titles. It can be rechecked every 4 h. The user interface of "little nest" is shown in Figure App.3.

Fig. App.3. The user interface of "little nest"

"Adventure" is the fourth function of the GJLS. It provides learners with vocabulary learning, testing, and reviewing functions. During the learning process, learners can obtain resource items and unlock the new levels of challenge tests to get more game points. There are two major parts in this function, the "main adventure" and the "review ground." In the user interface of the "main adventure," shown in Figure App.4, learners can learn vocabulary through the left-side video with Japanese subtitles. The right side of the user interface is the list of key vocabularies selected from the Japanese subtitles of the video for individual learning. After clicking on a vocabulary button, the dictionary query result of the vocabulary will be displayed below, including hiragana, Roman pinyin, part of speech, vocabulary's Chinese translation, Japanese example sentence, and example sentence translation information. When learners press the blue note button in front of a vocabulary and example sentence, the system will read the vocabulary and the pronunciation of the example sentence, which is convenient for learners to learn the pronunciation of this vocabulary. By clicking the blue button associated with a vocabulary, learners can navigate the video on the left-hand side to the specific moment when that word appears. This functionality allows learners to repeatedly listen to the relevant video section, effectively improving their learning performance related to the vocabulary.

Fig. App.4. The user interface of "main adventure"

Every time learners learn the vocabularies through videos, they can get resource props, which can be used to upgrade their virtual

character competence. Until the virtual character competence cultivated by the individual learner during learning processes reaches the conditions of a challenge test, the learner can challenge the test by fighting with the virtual opponent. The left side of the user interface of the challenge test shows the virtual character's combat status, including the status bar, the health bar of both sides, countdown time, and other information. The right side of the user interface of the challenge test shows the test question. Each challenge test will randomly generate the testing vocabularies with six types of test questions, including Japanese vocabulary listening question, Japanese to Chinese vocabulary translation question, Chinese translation to match with Japanese katakana question, Japanese katakana to match with Chinese translation question, Japanese katakana similarity judgment question, and Japanese word fill-in-the-blank question. When a learner's answer to a test question is correct, the learner can attack the virtual opponent. If a learner's answer to a test question is incorrect, the learner will be attacked by the virtual opponent. If the learner defeats the virtual opponent within a limited time, she/he will win the game. In contrast, if the learner's health bar or the remaining time return to zero, the challenge is a failure. The user interface of the "challenge test" is shown in Figure App.5.

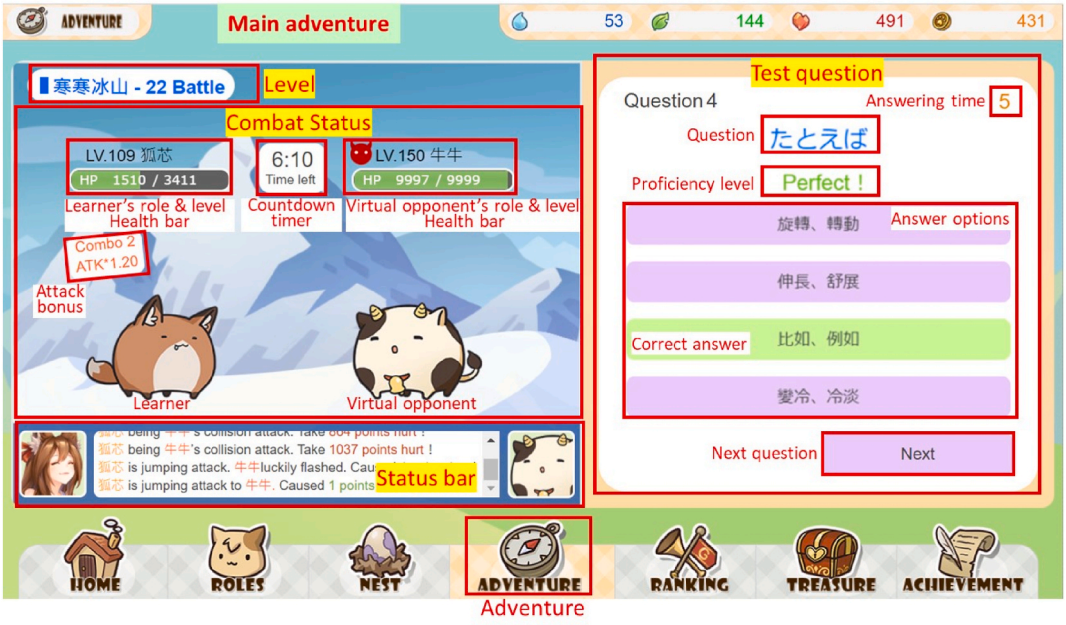

Fig. App.5. The user interface of the "challenge test"

When the learner challenges the vocabulary test question with a wrong answer, the answer will be marked in red, and the system will display the correct answer in green. At this time, the learner can press the survey button below to view the dictionary information of this vocabulary for real-time learning. The user interface for learning the vocabulary with a wrong answer is shown in Figure App.6.

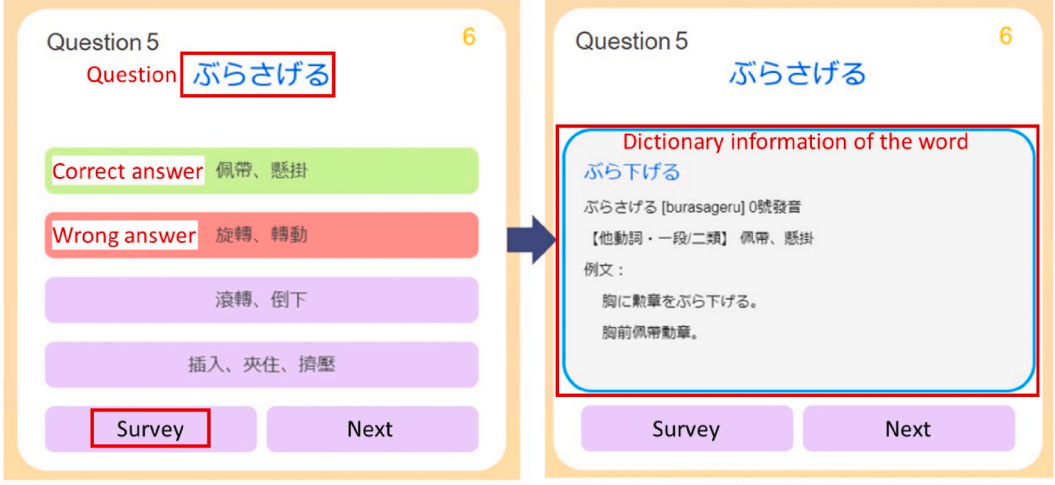

Fig. App.6. The user interface of learning the vocabulary with a wrong answer

During the answering process, the GJLS will distinguish the answer proficiency according to the individual learner's answering speed and divide the learner into five proficiency levels, perfect, great, good, nice, and bad, and record the number of answers and

points for each level of challenge test. The game points for answering the challenge test with different proficiency levels are respectively considered with different weights of 10, 5, 2, 1, and −5 when computing the getting game points. Besides, the remaining time during the answering process can also get extra game points. The user interface of passing a challenge test is shown in Figure App.7.

Fig. App.7. The user interface of passing a challenge test

After a challenge test is successful, the learner can see the accumulated game points, the current ranking, and the number of stars obtained at the challenge test. As the challenge test is passed, the difficulty of the next challenge test will be increased. Learners must continue to learn vocabularies by watching and listening to other videos to obtain resources and props further so that they can continue to challenge the next level of the challenge test. There are 22 levels of challenge tests in total in the GJLS, and the last level (i.e., the 22th level) is the general review that includes all the vocabularies used in the GJLS. The user interface of showing all the levels of challenge tests is shown in Figure App.8.

Fig. App.8. The user interface of showing all the levels of challenge tests

The second main function of the "adventure" is to review the vocabularies that individual learners learned from the videos and had the wrong answer. The GJLS will record the test questions with the wrong answer. The left side of the user interface of "review" can

show these vocabularies with the wrong answer and the number of wrong answers in total. When a learner clicks on a vocabulary, the pronunciation and translation of this vocabulary will be shown on the right side of the user interface. The user interface of "review" is shown in Figure App.9.

Fig. App.9. The user interface of "review"

"Leaderboard" is another function of the GJLS. This function can list the usage records of all learners in the system, including rankings, brave names, levels, roles collected, achievements, level stars, learning times, and total learning scores. The ranking will be displayed with all learners' total score for their reference. The ranking of the learner herself/himself will be marked in orange, as shown in Figure App.10.

1 排名 No.	2 勇者 Player	3 等級 Level	4 圖鑑 Collection	5 成就 Achievement	6 關卡星星 Stars	7 學習次數 Times	8 學習總分 Scores
	Tuanhung	109	20	30	66	1451	5119524
	Subani	112	9	24	66	1869	5098741
	James	97	20	30	66	1344	1059055
4	LuitzDary	31	9	11	17	473	26973
5	Dorothy	17	2	5	7	272	18787
6	Gabriel	11	4	6	3	132	9464
7	Dokota	1	0	0	0	0	0

Fig. App.10. The user interface of the "leaderboard"

"Treasure chest" is another function of the GJLS. This function can spend the gold coins collected in the "adventure" to draw a lottery. After a learner presses the purchase, a three-choice card button will appear to let learners click one of them to get a reward. Rewards can randomly obtain resource items, pet roles, and achievement titles, as shown in Figure App.11.

Fig. App.11. The user interface of the "treasure chest"

"Achievement" is another function of the GJLS. This function presents a list of achievements that individual learners have achieved, including the number of vocabulary learning times, the number of level stars obtained, learning scores, character illustrations, special achievements, etc., a total of 30 achievements. The completed achievements will be marked in orange, as shown in Figure App.12.

Fig. App.12. The user interface of "achievement"

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