Analysis of Gender Differences in Digital Game-Based Language Learning for Thai Language Learning Affection, Cognition and Progress Performance

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***Abstract*—This study aimed to use a Shaking Fun App with learning assessment and ranking learning as a teaching tool to allow Thai learning beginners to have digital game-style language learning, and to explore the gender differences in the perception of the cognitive and affective factors of the participants and the performance of gameplay progress based on the cognitive-affective theory of learning with media and embodying learning theory. In this study, a total of 246 Thai language learning beginners taking basic Thai (I) courses in 2 universities and 1 university of science and technology in northern Taiwan were invited to participate in the study. After those who dropped out were deducted and invalid data was deleted, there were 202 effective study participants including 82 males (40.6%) and 120 females (59.4%), and the effective recovery rate was 82.1%. After the reliability and validity analyses with SPSS 23.0, and the item analysis with AMOS 20.0, the gender differences were analyzed. The results showed that: there were indeed significant differences in participants of different genders in terms of gameplay flow, test anxiety and gameplay progress performance, but there was no significant difference in the continuance gameplay intention. In addition, using the Shaking Fun App for multiple weeks of DGBLL can indeed help learners to improve their game performance (Thai grammar).**

***Index Terms*—Continuance gameplay intention, gameplay flow, gameplay progress performance, test anxiety.**

I. Introduction

Language learning can be imagined as one of the most complex learning tasks [1], so there are many studies exploring how to help second language (L2) learners to truly master language skills, and perform effective learning tasks. The mastery of grammatical structures and skills is considered the foundation of learning a new language, so grammar teaching is considered the most important part of language education [2]. However, learning the grammatical structures of many L2s is a very difficult part, especially it is more difficult for those who start learning a L2 after they grow up [3], and some studies have found that, in some cases, even people who are proficient in L2 may not have good knowledge of L2 grammar [4]. As seen from the above, how to help learners learn L2 grammar effectively is an important topic.

In the era of rapid technological development, digital games based on emerging technologies have been proven to assist language learning [5], [6]. Digital game-based learning (DGBL) refers to the combination of learning content and digital games to help players learn certain topics [7], while games are believed to effectively stimulate learners' affections to increase learning experience [8], and can provide students with the learning environment with intrinsic motivation and input through the methods that traditional teaching cannot provide, which in turn has a positive impact on learning [9]. Therefore, DGBL is considered useful and attractive, because it can improve students' learning achievement, promote motivation and participation, and bring happy learning experience to learners [10], [11]. DGBL is proven to bring meaningful language learning experience to learners [12], [13], and more and more digital games are used as evaluation tools. Therefore, a formative evaluation game App with sorting characteristics was used as the grammar learning tool.

Although DGBL has many positive effects, not all learners can benefit from the support of DGBL due to the diversity of individual differences. For example, some research has found that gender differences were critical to the implementation of DGBL [14]. In the past 10 years, researchers have begun to explore the interaction between educational games and gender differences [15]. However, empirical research on gender in game-based learning is still limited [16], and in this generation, the influence of gender on GBL may be different from the results of different previous studies [17]. According to this, to explore whether learners of different genders have differences in cognition, affection and performance in the learning process will help expand the understanding of DGBL in the learning method based on DGBL.

Many studies focus on exploring the individual differences in K-12 students' cognition and affection in foreign language learning, but less attention is paid in the higher education stage, especially in the digital game-based foreign language learning. Therefore, the focus of this study was to incorporate game-based learning into our research and explore the gender differences in cognition and affection in Thai language learning in the context of game-based learning among university students.

Theoretically speaking, DGBL is based on the principle of multimedia learning for content design. Moreno proposed the cognitive-affective theory of learning with media (CATLM) [18], which believes that the learning process will be affected

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by cognitive and affective factors in the environment based on multimedia learning. According to this, CATLM is a good framework for explaining the results of DGBL, so this study used CATLM as the theoretical basis of this study.

A. Gameplay Flow

Flow experience means that a person is completely immersed in an activity and shows a high degree of enjoyment in this activity [19]. Therefore, when people are in a flow state, they will indulge in their own activities, making it impossible for them to feel changes in the surrounding environment [20], [21]. Therefore, flow experience is regarded as a driving force for continuous activity, prompting people to choose higher challenges to obtain flow experience again [22]. Flow experience has been proven to be an effective measurement standard that can be used to help understand the user's experience perception in the context of computer intervention [23]. Most game players indicate that they have obtained a pleasant and fascinating experience in the game, so quantifying this positive experience is the goal pursued by industry and academia [24]. Therefore, exploring the flow experience of learners using digital games for learning helps to understand the impact of DGBL on affections. In this study, gameplay flow refers to the state of deep immersion and high enjoyment that participants have when they play the Shaking Fun APP for Thai grammar learning.

B. Test Anxiety

Test anxiety is described as the negative affective or cognitive response that people have when they are being evaluated or measured [25]. Therefore, test anxiety is defined as the negative psychological, emotional, physiological and behavioral response that people produce when they are in a test situation [26]. Research suggests that test anxiety may make the true ability of students concealed in the context of the test [27], and the L2 test is considered to be a stressful thing [28]. The context of test style-based sorting games can also make learners feel test anxiety. Therefore, exploring the level of test anxiety of learners in the context of DGBLL can help expand our knowledge on the cognitive influence of this type of game. Thus, this study used the test anxiety variable to understand learners' anxiety about playing Shaking Fun App. In this study, test anxiety refers to the anxious feelings such as tension or restlessness that participants generate when they play Shaking Fun App for Thai grammar learning.

C. Continuance Gameplay Intention

People only take actions voluntarily when they are intentional, so the concept of intention in voluntary action is very important [29]. Hence, intention is regarded as an important variable in the technology acceptance model (TAM) [30]. The intention to continue using is defined as the user's intention to continue using the product or service currently being used [31], [32]. In digital learning, the continuance intention is defined as the individual's subjective idea that the individual will continue to perform digital learning [33]. Researchers defined the continuance gameplay intention as the player's intention to continue or want to play the game again in the near future [34]. Based on this, this study used the continuance gameplay intention to understand whether learners want to continue using this game for language learning after playing the Shaking Fun App. In this study, the continuance gameplay intention means that participants still want to continue using this game to learn Thai grammar after playing the Shaking Fun App.

D. Gameplay Progress Performance

Learning games are defined as a kind of entertainment activity, which consists of rules with quantifiable results (such as winning status and scores), and takes educational purposes (such as knowledge acquisition) as the user's goal [35]. Therefore, gamification is considered to be able to provide more effective, accurate and timely information on learning process or results [36]. In the field of language learning, DGBL has been widely adopted, and by integrating the learning advantages of digital games, most studies have shown that DGBL can help learners achieve positive results [37]. Past studies have found that students' game performance will increase as they play games [38]. Accordingly, exploring the progress of participants' game performance can understand the effectiveness of DGBL. So, this study analyzed the progress of participants in Shaking Fun App in game-based learning. In this study, gameplay progress performance refers to the comparison between the progress in the last time one plays Shaking Fun APP from his or her play for the first time.

II. Research Design and Implementation

A. Research Questions

There seem to be important gender differences in games [39]. For example, it is pointed out that males show more interest in digital games than females do, so males may be more likely to accept game-based learning than females [40]. Another study indicated that because of diversified differences in individuals, not all learners can benefit from the support of DGBL [14]. Therefore, this study explored past research to understand the possible gender differences in DGBL, and then proposed 3 research questions.

The purpose of this study was to examine the flow experience of university students in game-based learning, test anxiety, continuance gameplay intention, and gameplay progress performance. At the same time, this study also further investigated whether there were differences in the flow experience, test anxiety, continuance gameplay intention, and gameplay progress performance of males and females in game-based learning situations. The research questions raised in this study include:

1) What are the degree of perception of flow experience, test anxiety, and continuance gameplay intention among university students in game-based learning?
2) What is the progress performance of grammar games in the game-based learning?
3) Is there a difference between male and female students in the flow experience, test anxiety and continuance gameplay intention of game-based learning?

B. Teaching Tools

Multimedia learning refers to learning from the text and pictures in animations, computers, graphics, and slides [41], so DGBL is a kind of multimedia learning. Among the many multimedia learning theories, the cognitive-affective theory

of learning with media (CATLM) proposed by Moreno [18] has been widely used in DGBL. This theory is used to explain the cognitive and affectional processes in DGBL. Therefore, in this study, CATLM was one of the important theories to explain the teaching tool.

In addition, the embodying learning theory (ELT) believes that body movements will promote people's cognition, so supporters of ELT deem that body movements and perception have a core influence on people's cognitive development [42], and the embodied theories of language (ETL) based on ELT consider that the concept of language is rooted in the perceptual activities of the brain, so the perceptual experience through movement can affect the cognitive system of the language system [43]. Therefore, ETL was also one of the important theories used to explain the teaching tool in this study.

The name of the teaching tool in this study is Shaking Fun App, which is a sorting game based on the cognitive-affective theory of learning with media (CATLM) and embodying learning theory (ELT), and also an educational game with a quiz nature, developed by Digital Game-based Learning Laboratory of National Taiwan Normal University. This game uses the words provided by the options to arrange and combine the sentences according to the correct grammar rules. After the arrangement is completed, the answer is sent out through the Shaking action to stimulate the activeness of the brain area in a somatosensory way, thereby increasing the user's cognitive generation to achieve a better learning effect, shown in the Fig. 1.

Fig. 1. Shaking fun game screen.

C. Implementation Steps

This study adopted a purposive sampling method, and a total of 246 beginners of Thai language learning in two universities and a university of science and technology in northern Taiwan, who took basic Thai (I) courses, were invited to participate in the study. The experimental time of this study was 15 weeks of teaching experiments. During the 15 weeks, the participants were asked to play for 20 minutes at the beginning of the class as a review of the course content of the previous week.

D. Research Participants

The number of participants in this study (who returned questionnaires) was 246, and a total of 44 invalid data were deleted, so there were 202 valid study participants, and the effective recovery rate was 82.1%, including 82 male participants (40.6%), and 120 participants (59.4%); 30 students (14.9%) in the freshmen year, 56 (27.7%) in the sophomore year, 69 (34.2%) in the junior year, and 47 (23.2%) in the senior year. There were 114 participants (56.4%) with the habit of playing games and 88 (43.6%) without the habit of playing games; the average age of the participants was 20.35 years old, and the standard deviation was 2.36 years old.

E. Measurement Tools

1) Gameplay flow

Flow experience means that a person is completely immersed in an activity and shows a high degree of enjoyment in this activity [19]. Therefore, according to this definition, this study referred to and revised the flow experience scale of Hong et al. [44], including "I am too concentrated that I have no feeling at all when time passes", to measure participants' perception of flow experience during the course of playing Shaking Fun.

2) Test anxiety

Test anxiety is defined as the negative psychological, affectional, physical, and behavioral reactions that people produce when they are in a test situation [26]. Therefore, according to this definition, this study compiled a test anxiety scale, including "In this test game, I will still worry about answering the questions smoothly in the game even I am very attentive in class" to measure the anxiety of the participants about the way of answering questions in the game.

3) Continuance gameplay intention

The continuance gameplay intention is defined as the player's intention to continue or want to play the game again in the near future [34]. Therefore, according to this definition, this study referred to and revised the intention to continue participation scale designed by Hong et al. [32], including "I hope to be able to learn more Thai grammar through Shaking fun App" to measure the participants' intention to continue using Shaking Fun App as a learning tool after the course.

4) Gameplay progress performance

The game performance of students will increase with the increase in the number of games they play [38]. In order to evaluate the performance of students' gameplay progress, we used the game history of participants to play the Shaking Fun App as a pre-test result (1st week performance) and the post-test result (15th week performance), both of which

contained 10 sentence sorting questions with the same difficulty of the game. The 15-week DGBLL learning content was reviewed with the assistance of 2 Thai teachers.

III. Reliability and Validity Analysis

A. Item Analysis

The first-order confirmatory factor analysis was adopted for item analysis of this study. Related scholars suggest that the value of χ^2/ df should be less than 5; RMSEA should be less than 0.1; GFI and adjusted AGFI should be higher than .8; and the items whose factor loading (FL) value is not higher than .5 should be deleted from the original questionnaire [45,46] , shown in the table 1. The result of the deletion was that the number of items for gameplay flow was deleted from 9 to 5; the number of items for test anxiety was deleted from 9 to 6; and the number of items for continuance gameplay intention was changed from 5 to 4.

TABLE I: Confirmatory Factor Analysis of Each Construct

Index	χ^2	df	χ^2/df	RMSEA	GFI	AGFI
Threshold value	---	---	< 5	<.1	>.8	>.8
gameplay flow	14.4	5	2.88	.097	.973	.920
test anxiety	19.3	9	2.144	.076	.968	.926
continuance gameplay intention	.5	2	.25	.000	.999	.993

This study used the measurement of the external validity of the items to determine the scope of interpretation of the study [47]. The values of all participants for each item were divided into the first 27% and the last 27% for the *t* test; and if the t value was greater than 3 (***p <.001), it was considered that the external validity has reached a significant level. The *t* value of each item in this study was above 9.285 (***p < .001), which means that all items in this study have external validity [48].

B. Reliability and Validity Analysis

Reliability: This study used Cronbach's α and composite reliability (CR) to test the reliability. Hair et al. recommended Cronbach's α higher than .7 as an acceptable standard [45], and the values of Cronbach's α in this study were between .844 and .851, shown in the table 2; Hair et al. suggested that the CR value should exceed the standard of .7 [45], and the CR values were between .846 and .852. So, the results of both tests met the recommended standards, shown in the Table II.

Convergence validity: Convergence validity is confirmed by FL value and averaging variance extracted (AVE). Hair et al. pointed out that FL value should be higher than .5, and the item should be deleted if it is lower than this value [45], and the items retained in this study all met the standards suggested by scholars. Among them, the FL values of gameplay flow ranged from .706 to .778, and the FL values of test anxiety ranged from .643 to .776, and the FL values of the continuance gameplay intention ranged from .788 to .801; Hair et al. suggested that the AVE value must be greater than .5 to indicate that the construct has convergent validity [49], while the AVE values of this study were between .511 to .642, shown in the Table II.

TABLE II: Reliability and Validity Analysis

Index	*M*	*SD*	α	CR	AVE
Threshold	---	---	> .7	> .7	>.5
gameplay flow	3.406	.514	.851	.852	.536
test anxiety	2.515	.515	.860	.856	.511
continuance gameplay intention	3.545	.586	.589	.878	.642

IV. Research Results

A. Analysis of Gameplay Progress Performance

Research analysis showed that the participants' gameplay progress performance ranged from the lowest 1 point to the highest 8 points, but the average progress was 2.98 points. The standard deviation was 1.457 points, and the average mean was 3 points, shown in the Table III.

TABLE III: Analysis of Gameplay Progress Performance

Constructs	Min	Max	M	SD	Mdn.
gameplay progress performance	1	8	2.98	1.457	3

B. Difference Analysis

The analysis results of the *t*-test showed that participants of different genders did have significant differences in gameplay flow, test anxiety, and gameplay progress performance. In the gameplay flow part, the average feeling of female participants was significantly higher than that of male participants. The same was true for the improvement performance part. Female participants had more progress in the gameplay than male participants; but in the test anxiety part, the anxiety of male participants was higher than that of female participants. In addition, the gender difference in the continuance gameplay intention was small, which was not of statistical academic interpretation significance, shown in the Table IV.

TABLE IV: Analysis of Gender Difference

Construct	Gender	N	M	SD	*t*	*d*
gameplay flow	Male	82	3.244	.530	-3.748***	.523
	Female	120	3.517	.474		
test anxiety	Male	82	2.683	.577	3.768***	.554
	Female	120	2.400	.435		
continuance gameplay intention	Male	82	3.576	.554	.634	.007
	Female	120	3.523	.608		
gameplay progress performance	Male	82	2.660	1.298	-2.669**	.374
	Female	120	3.190	1.525		

*p < .05, **p < .01, ***p < .001

V. Research Discussion

Flow experience means that a person is fully immersed in an activity and presents a state of high enjoyment in this activity [19]; the research results of this study showed that the participants had positive gameplay flow (*M* = 3.406, *SD* = .514). Test anxiety is defined as negative psychological, affectional, physical, and behavioral reactions when people are in a test situation [26]; the research results of this study showed that participants felt low-level test anxiety (*M* = 2.515, *SD* =.515). The continuance gameplay intention is defined as the player's intention to continue or want to play the game again in the near future [34]; the research results of

this study showed that participants had a positive continuance gameplay intention (M = 3.545, SD = .586). The student's game performance will improve with the increase in the number of games they play [38]; the research results of this study showed that the participants had good gameplay progress performance (M = 2.98, SD = 1.457).

A. Gender Differences in Gameplay Flow

Past studies have shown that the interaction between gender and the game system had a significant impact on students' gameplay flow, and the analysis results showed that male participants' gameplay flow was better than that of female participants on average [50]. However, it was pointed out in another study that compared with male students, female students had rich flow experience in small educational games [17]. Yang and Quadir also supported this view. They found that female students' gameplay flow was significantly higher than that of male students [14]. In the analysis of this study, it was found that in the Thai grammar learning based on Shaking Fun App, the feeling of gameplay flow of female participants was significantly higher than that of male participants.

B. Gender Differences in Test Anxiety

Past studies have shown that there were moderate gender differences in the worry and tension components of test anxiety, and the proportion of female students (22.5%) with anxiety perception was significantly higher than that of male students (10.3%) [51]. The results of Zaheri et al. supported this point of view. That study found that the incidence of test anxiety among female students was significantly higher than that of male students [52]. The results of a study of Iranian university students showed that female students had a higher level of test anxiety compared with male students. [53]. A study conducted on university students in Turkey found that in foreign language anxiety, the average scores of female students' perception of test anxiety were higher than those of male students [54]. Obviously, females have higher test anxiety in most of cases for the gender differences in text anxiety. However, in the analysis of this study, it was found that in the DGBLL-based Thai grammar learning, male participants' feelings of test anxiety were significantly higher than male participants'.

C. Gender Differences in Continuance Gameplay Intention

Although there are not many papers discussing gender differences in digital learning, most of them point out that male students are usually more willing to use computers for learning than female students [55]. A study conducted on students of different ages in Taiwan indicated that male students were more willing to use game-based learning than female students [56]. However, another study conducted on German university students revealed that although male students showed a higher degree of recognition for the intention to use game-based learning, there was no statistical significance in the analysis of gender differences [57]. The analysis of this study found that in the learning activities based on DGBLL, the gender differences in the intention of participants to continue playing Shaking Fun App were small, and had no statistically explanatory significance.

D. Gender Differences in Gameplay Progress Performance

Gender differences play an important role in the DGBL method. For example, it can affect learning outcomes [15]. Past studies have shown that female students got higher scores in small educational games than male students [17]. A study of game-based learning for science education showed that the application of GBL did not have the same effect on all students, because female participants outperformed male participants in terms of learning outcomes [16].

However, there are studies that hold different views. Papastergiou stated that although males like computer games, play computer games more often than females, and have rich experience in computer games, male and females have no significant difference in the effect of learning through games [16]. Nietfeld et al. proposed a similar same view, suggesting that the performance of female subjects in games is similar to that of male subjects [58]. In this study, it was found that female participants' performance in gameplay progress was significantly higher than male participants, in other words, female participants made more progress in Thai grammar in the game than male participants.

VI. Conclusion and Suggestions

A. Conclusion

Although educational games have become very popular in recent studies, only a few studies have focused on the effectiveness of these games, and few studies have focused on the effects of using gamification for evaluation, resulting in the emergence of knowledge gap in literature. This study was based on the cognitive-affective theory of learning with media (CATLM) and embodying learning theory (ELT), and proposed three research questions, namely (1) university student's perception of flow experience, test anxiety and continuance gameplay intention in game-based learning; (2) the degree of progress of grammatical games of university students in game-based learning; (3) whether there are differences in the flow experience, test anxiety and continuance gameplay intention between male and female students in game-based learning.

This study used a sorting game with learning evaluation characteristics as a teaching tool, and explored the perception of the affective and cognitive factors of the participants and the performance of the gameplay progress. The experimental teaching results showed that: (1) participants in this study had a positive perception in flow experience and the continuance gameplay intention, but had a lower perception of test anxiety; (2) this study also found that using the Shaking Fun App for multiple weeks of DGBLL can indeed help learners improve game performance (Thai grammar proficiency); (3) in the gender difference part, participants of different genders did have significant differences in gameplay flow, test anxiety, and gameplay progress performance, but there was no significant difference in the part of the continuance gameplay intention.

For a long time, people have always believed that the individual differences of learners in foreign language or second language courses have an important influence on learners' achievement or performance. Therefore, the results of this study help to expand the understanding of the

utilization of applying DGBL or DGBLL, and explain the influence of gender differences on DGBLL. In addition, the Shaking Fun App used in this study stimulates learners' cognitive process through the "shaking" embodying learning method, which in turn improves cognitive performance.

B. Implications

Past studies have found that students' game performance will increase with the increase in the number of times they play games [38], and the results of this study also confirmed this view. Using Shaking Fun APP for multiple weeks of DGBLL can indeed help learners improve game performance, which also means that playing games can obviously help learners improve their ability to use Thai grammar correctly. Therefore, it is recommended that teachers of other languages should use DGBLL to assist language learners in the cultivation of basic skills such as grammar applications.

In addition, according to the viewpoint of flow theory, flow experience is equivalent to a fun experience. By maintaining a balance between personal abilities and perceived task challenges, the person can ideally realize the fun experience in task execution [59]. The game aims to make players have a positive impact so that learners can achieve successful and attractive results when the game gives a flow experience [60]. However, in this study, although the participants' gameplay flow showed positive feelings, there still was obvious room for improvement. On the whole, because participants had low levels of test anxiety, it may be that the difficulty of the game's learning content can be further increased. Therefore, it is recommended that game designers can improve the difficulty of the game content when designing game topics to allow learners to get more sense of challenge to increase their gameplay flow.

C. Limitations and Future Studies

As a component of L2 learning motivation, L2 self-confidence has been proved to be an important predictor of language ability [61], and many studies have confirmed that there are individual differences in self-confidence [62]. In this study, the degree of language confidence in DGBLL was not explored, and whether there are individual differences in language confidence was not discussed either. So, such parts can be explored in follow-up research.

The use of games for learning has increased in teaching practice, but there are only a few studies on the use of digital games to help learners develop language learning functions and improve learning outcomes [63]. Although in this study, the use of Shaking Fun APP by the participants to improve the performance of grammar learning was discussed, but the relationship between game performance and learning achievement during the test was not explored. Therefore, the relationship between game performance and learning achievement can be explored in follow-up research.

Qualitative research is based on constructivist epistemology. Through observation and interviews, the phenomenon is described in depth from the perspective of research participants, and people can use interviews to clarify how they understand the world around them and their experiences [64]. Therefore, for the analysis results found in this study, interviews can be used to gain a deeper understanding of the factors that have produced the results and expand the understanding of the DGBLL practice field.

Conflict of Interest

The authors declare no conflict of interest.

Interest and Author Contribution

First and second author conducted the research and collected data; third and fourth author analyzed the data; all authors wrote the paper; all authors had approved the version.

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