



Understanding Factors that Affecting Continuance Usage Intention of Game-Based Learning in the Context of Collaborative Learning

Ya-Ming Shiue

Department of Applied Informatics and Multimedia, Chia-Nan University of Pharmacy of Science, Tainan, TAIWAN

Yu-Chiung Hsu

Department of Public Relations and Advertising, Kun-Shan University, Tainan, TAIWAN

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ABSTRACT

Due to the rapid progress of information technology and the Internet generation of students now on campus, game-based learning (GBL) has become an important issue with regard to education. In addition, in an increasingly competitive work environment, students need to cultivate not only their own abilities, but also the ability to collaborate with colleagues after graduation. However, such collaboration needs to be directed by appropriate guidance in order to demonstrate the expected results, and the rules of the related game guide can be applied to achieve this. Therefore, it is of interest to analyse students' learning processes in a digital game with a collaborative learning environment. In this study, we designed a digital history game providing collaboration opportunities for learners to solve problems. The partial least squares (PLS) approach was applied to analyse the effects of this collaboration on the attitude towards and willingness to use game learning, in order to validate our research model.

Keywords: game-based learning, collaborative learning, expectation confirmation model, technology acceptance model, social influence, continuance usage intention

INTRODUCTION

Rapid advances in computer technology have pushed educators and learners to pay increasing attention to the use of digital games, and many such games have been designed in several subject domains to supplement learning, such as mathematics, science and social studies (Dorji, Panjaburee & Srisawasdi, 2015). The increasing adoption of digital games has raised the question of how to take advantage of their potential for educational purposes (Plass, Homer & Kinzer, 2015). Watson, Mong and Harris (2010) examined educational computer games, and found that the use of game-based learning resulted in a shift from a traditional teacher-centered environment to a student-centered one, in which the learners were much more active and engaged. This may be because digital games allow learners to access educational contents in a more enjoyable and interactive way, attracting their curiosity and directing their learning paths (Papastergiou, 2009).

Game-based learning (GBL) is as a system in which learners are immersed in a set of interactive components and challenging activities based on a series of clear goals, agreed rules and constraints, and such issues are often discussed in the context of educational technology (Salen & Zimmerman, 2004). Applying games to

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Correspondence: Yu-Chiung Hsu, *Department of Public Relations and Advertising, Kun-Shan University, No.195, Dawan Rd., Yongkang Dist., Tainan City, Taiwan.*

✉ ychs@mail.ksu.edu.tw

Contribution of this paper to the literature

- This study found that satisfaction was the strongest predictor of learners' continued GBL usage intention, followed by social influence, usefulness and attitude to collaborative GBL; that is, users' continued GBL usage intention after the initial acceptance was determined by their satisfaction.
- This study confirmed that learner's confirmation and perceived usefulness were key determinants of their level of satisfaction, confirmation also had a significant impact on perceived usefulness, and confirmation had the dominant effect on satisfaction with collaborative GBL.
- This study confirmed a strong relationship between attitude and intention to use GBL, between usefulness and attitude, and between perceived ease of use and perceived usefulness, thus supporting the application of the TAM.

learning situation not only increases the enjoyment of students, but also enhances their learning motivation through the challenge and excitement of games. Indeed, several studies have shown that educational games can enhance students' learning motivation and learning performance. Regarding learning motivation, Chen (2017) suggested that students with high self-efficacy would have more elaborative problem-solving abilities, and that GBL could enhance students' learning motivation with a short time. Regarding learning performance, Kebritchi, Hirumi and Bai (2010) conducted a study to investigate the effects of GBL on students' mathematics performance. The results indicated that students with GBL saw greater gains in their mathematics skills than those with traditional instruction.

Due to these positive effects, digital games also provide opportunities for social engagement and contexts where peer and social interactions occur to enhance learning outcomes (Squire, 2006). Working collaboratively also provides opportunities for the development of group members' cognitive structures more creative positive attitudes toward the task and stronger task motivation compared to when working alone (O'Donnell & Kelly, 1994). Ke and Grabowski (2007) compared collaborative game play to competitive game play for learning mathematics, and the results showed that collaborative mechanics had more positive affective outcomes than competitive game play outcomes. Sung and Hwang (2013) compared collaborative and individual GBL, and found that learners' achievements in collaborative games were significantly better than in individual games. Although previous studies have investigated the positive influence of collaborative games, to the best of our knowledge there is little research on the factors affecting collaborative GBL. Therefore, the technology acceptance model (TAM) was applied in this study as a theoretical framework to examine the effects of collaboration in GBL.

Educational digital games, which typically require the use of logic, memory, problem-solving, and critical thinking skills, generate higher levels of student interest in the focal subject matters (Annetta, 2008). They can also provide a rich context allowing learners to reinforce and consolidate their knowledge through practice (Chen & Law, 2016), in ways that might force the students to process various type of information simultaneously (Kalyuga & Plass, 2009), although the use of too many (often unnecessary) learning elements would distract learners' attention and increase their cognitive load (Bartsch & Cobern, 2003). Moreover, not all learners have enough capabilities to overcome such problems when they arise, and thus increasing their initial acceptance of digital games is an important first step toward implementing GBL. In addition, successful educational applications of such games depend on their continued use, and the expectation confirmation model (ECM) (Bhattacharjee, 2001) was thus also incorporated in this study to investigate the factors affecting learners' intention to continue using GBL.

This study's structure is as follows. First, the next section reviews the relevant literature focusing on the applications of GBL and the theoretical framework of combining the ECM and TAM models, along with the research hypotheses. This study then describes the procedure used and explains the results. Finally, this study presents and discusses an interpretation of the results, the limitations of this work and the implications for future research.

LITERATURE REVIEW

In this paper, we synthesize the expectation–confirmation model, the technology acceptance model, and social influence to hypothesize a theoretical model to explain users’ intention to continue using GBL. We combine these theoretical perspectives for the following three reasons. First, although previous research has found ECM to be an essential model for continued information technology (IT) adoption (Bhattacharjee, 2001), it employs only three variables to explain behavioral intention: satisfaction, confirmation, and post-adoption expectations. However, user’s continued intention to use GBL is also affected by ease of use, perceived usefulness, and user attitude, which are the focuses of TAM (Davis, 1989). Finally, social influence is based on the idea of peer-driven participation, and thus we should take into account the social relationships related to game-based learning. Since each theory has distinct perspectives, we suggest that combining them can provide a more comprehensive understanding of continued usage in this context than each theory considered alone.

Expectation Confirmation Model (ECM)

The expectation confirmation model (ECM) was developed by Bhattacharjee (2001) based on expectation confirmation theory (Oliver, 1980), and includes three dimensions of user intention to continue using certain technologies: perceived usefulness, confirmation of expectations and satisfaction. The ECM posits that an individual’s intention to continue using information technology is dependent on three variables: the user’s level of satisfaction with the IT; the extent of that the user’s expectations are confirmed; and post-adoption expectations, in the form of perceived usefulness. The ECM is one of the most widely applied models in a variety of domains on continued information system (IS) usage (Kang, Hong, & Lee, 2009).

The ECM posits that users’ perceived usefulness of IT has a positive effect on their intentions to continue IT usage. The confirmation of expectations suggests that users obtained the expected benefits through their usage of the focal IT, and this has a positive effect on their satisfaction. In addition, users’ satisfaction is determined by the confirmation of expectations and the perceived usefulness of the IT (post-adoption expectations). Perceived usefulness of IT can be adjusted by confirmation experience, particularly when the users’ initial perceived usefulness is unclear due to the uncertainty over what to expect from using the IT (Bhattacharjee, 2001). The ECM has been widely applied to examine user attitudes toward information systems, such as e-learning (Lee, 2010), electronic textbooks (Stone & Baker-Eveleth, 2013), and web 2.0 usage (Chen, Yen & Hwang, 2012). Because GBL is a pedagogical application of IT, we thus posit that the following hypotheses:

- H1.** Confirmation of expectations is positively related to learners’ satisfaction with GBL.
- H2.** Confirmation of expectations is positively related to the perceived usefulness of GBL.
- H3.** Perceived usefulness of GBL is positively related to learners’ satisfaction with GBL.
- H4.** Perceived usefulness of GBL is positively related to learners’ continued GBL usage intention.
- H5.** Satisfaction with GBL is positively related to learner’ continued GBL usage intention.

Technology Acceptance Model (TAM)

The technology acceptance model (TAM) (Davis, 1989) is the most frequently cited and influential model for explaining technology acceptance and adoption. Davis (1989) first introduced the TAM as a theoretical extension of the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), and found that it could better explain user acceptance of a new technology. TAM proposes that two particular beliefs, perceived usefulness and perceived ease of use, are the primary drivers of technology acceptance. Perceived ease of use is defined as “the degree to which a person believes that using a particular system would be free of physical and mental effort”, while perceived usefulness is defined as “the degree to which a person believes that using a particular system would enhance his/her job performance” (Davis, 1989).

Perceived ease of use theorized as a direct determinant of user attitude. In addition, researchers have found support for the indirect impact of perceived usefulness on user attitude through perceived ease of use. Both perceived ease of use and perceived usefulness thus influence an individual's attitude toward using a system. Pivec and Kearney (2007) pointed out that the integration of games with multimedia can provide greater motivation for learners, which makes learning more efficient. Learning with the integration of digital games allows learners to learn in a lively and vivid environment, and this is especially true if the system is easy to use (Chang et al., 2017). When learners think that a digital game is easy to use, they will be more willing to use it, which will make them have a positive attitude towards GBL. Many empirical studies have supported these arguments (Pando-Garcia et al., 2016; Hwang et al., 2016), and thus we posit the following hypotheses:

- H6.** Perceived usefulness is positively related to learners' attitude toward GBL.
- H7.** Perceived ease of use is positively related to learners' perceived usefulness with regard to GBL
- H8.** Perceived ease of use is positively related to learners' attitude toward GBL.

The purpose of this study is to examine the kind of situated social interactions occurring between students in the context of game play, focusing on how they encourage engagement and learning. In the context of GBL, collaboration allows learners to carry out deliberate practice of elaborating learning materials and constructing formal semantic knowledge (Sánchez & Olivares, 2011). In addition, such collaboration facilitates the development of a new theoretical understanding of GBL that shows how complex forms of social interaction can occur, as well as fostering diverse opportunities for engagement and interaction between these constructs (Vasalou et al., 2017). Therefore, collaboration should enhance the learners' learning attitudes to the game as well as increased continued usage intention with regard to GBL. We thus posit the following:

- H9.** Attitude is positively related to learners' continued GBL usage intention.

Social Influence

There are some discrepancies that naturally occur in collaborative learning, as in some groups the interactions among members contain high levels of reasoning and collective thinking, resulting in learning gains for all students, while in other groups although the quality of group members' interactions and learning is disappointing (Barron, 2003). A possible explanation is that these results might due to factors such as group effectiveness and social skills. It is also likely due to the complex interactions among features of the task, students, and groups (Kirschner et al., 2009).

Several researchers have examined how social influence can generate favorable learning results for group members (Lin & Huang, 2015). Social influence profoundly affects user behavior (Ajzen, 1991; Lee, 2006), and thus users' decision to adopt a specific IT may often be influenced by the suggestions of group members. Ito et al. (2008) indicated that learners are greatly influenced by social interactions in multimedia learning environments. When learners perceive that their important referents think they should use GBL, they are likely to incorporate this idea into their own beliefs, simply because their friends are users of GBL, and have recommended it to them. We thus propose the following hypothesis:

- H10.** Social influence is positively related to learners' continued GBL usage intention.

RESEARCH MODEL AND HYPOTHESES

The research framework is constructed according to the relevant literature, as shown in **Figure 1**. Based on the theoretical background and 10 postulated hypotheses, the variables examined in this work include confirmation, satisfaction, usefulness, ease of use, attitude, social influence, and continued intention to use the GBL.

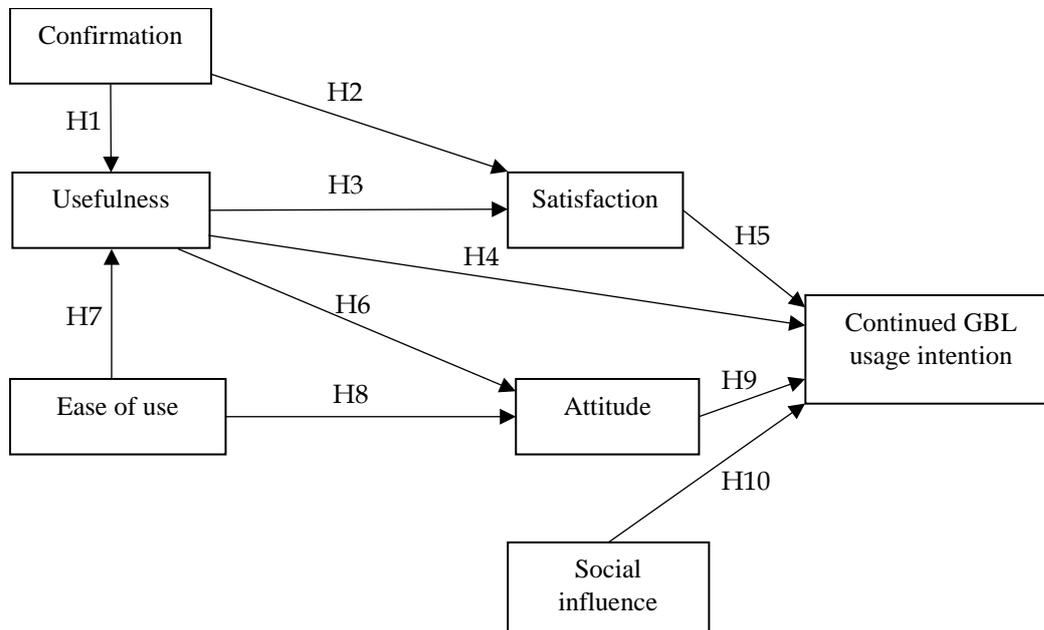


Figure 1. Research model

Experiential Educational Game for History Course

The learning content was adapted from an elementary history course and related to 16th century An-Ping (an area of Tainan, Taiwan). The digital game was developed based on Gerrig's (1993) two principles of cognitive processing in a narrative learning environment. First, learners are transported to a specific place and time in a manner that is so compelling it seems to be presenting the real scenes. Second, learners actively draw inferences and experience emotions based on their interactions with digital games. When embedding learning contents into digital games, an appropriate design of the gaming contexts, including the storyline and learning tasks, is important (Hwang, Chiu, & Chen, 2015). A good game design would not only enhance the playing experience, but could also increase the depth and scope of understanding in the learning context.

In this study, learners are connected with the daily life of An-Ping in the 16th century, and the digital game provides virtual scenes with scenarios and contexts, allowing the students to have the feeling of virtually being there. **Figure 2** shows the collaborative GBL environment used in this study. There are several tasks that the students must collaborate to achieve, and tasks that are used to attract students' attention and guide them through the process of problem solving. For example, the first mission was to search with the aid of various clues for Chi-Kan Tower, which was once the center of power in An-Ping. Once the students had obtained all the related data, they were allowed to proceed to the next level of the game. Using digital games can bring to life historical scenes and, more importantly for elementary school students, providing the opportunity to play a historical character is transformative and interesting.



Figure 2. Digital game setting

Participants

The participants in the experiment were four classes of fifth graders at an elementary school in southern Taiwan. A total 153 students participated in this study, 54.3% were boys ($n = 83$) and 45.7% were girls ($n = 70$). The students were taught by two instructors who had taught history for more than 10 years. The role of the instructor was to provide learning guidance. Monitor the students' learning progress, and solve any learning problems that arose. The students learned with the digital game collaboratively, by playing the role-playing game in a group of four or five to complete the learning tasks embedded in it.

Procedure

The study was conducted in four consecutive weeks of an elementary history course in southern Taiwan. The students used a desktop in a computer lab to play the game and participate in the learning. All participants first listened to a 10-minute training session to familiarize themselves with the game environment. Before entering the main page of the game, a short video was played to enhance the students' motivation. The students had to accomplish the learning tasks to successfully complete the game. The students started at the first level, where they interacted with characters provided by the game and could discuss things with team members to collaboratively complete the learning tasks. After the learning activities, the students completed a questionnaire to assess their learning experience with GBL.

Measurement

The questionnaire was divided into three sections. The first comprised questions about the demographic details of the respondents. The second part of the instrument was a nine-item questionnaire that examined three factors, confirmation, satisfaction, and continued intention, as revised from Bhattacharjee (2001). The final part of instrument was a nine-item questionnaire examining three factors: ease of use, usefulness, and attitude, as revised from Davis (1989). The social influence questionnaire was revised from Taylor and Todd (1995). All items, except

Table 1. The convergent validity and reliability of the measures in the measurement model

Construct	Convergence validity		Reliability	
	AVE	Composite reliability	Cronbach's α	
Confirmation	0.83	0.92	0.91	
Satisfaction	0.82	0.91	0.88	
Usefulness	0.88	0.93	0.92	
Ease of use	0.81	0.86	0.85	
Attitude	0.78	0.88	0.87	
Social influence	0.77	0.91	0.82	
Continued GBL usage intention	0.82	0.92	0.85	

Table 2. The discriminant validity of the measurement model

Construct	Discriminant validity						
	Latent variable correlations						
	1	2	3	4	5	6	7
1. Confirmation	0.89						
2. Satisfaction	0.82	0.91					
3. Usefulness	0.73	0.72	0.88				
4. Ease of use	0.78	0.74	0.81	0.85			
5. Attitude	0.81	0.78	0.73	0.82	0.83		
6. Social influence	0.77	0.71	0.69	0.81	0.82	0.88	
7. Continued GBL usage intention	0.73	0.66	0.65	0.82	0.77	0.87	0.91

for those in the first section, were answered based on a 5-point Likert scale, ranging from 1-strongly disagree to 5-strongly agree.

DATA ANALYSIS AND RESULTS

The partial least squares (PLS) approach was used to analyze the questionnaire data, as it is more suitable than using structural equation modeling (Chin & Newsted, 1999). The SmartPLS 2.0 software package was used to assess the measurements and structural model. In analysing the collected data, we followed the two-step procedure suggested by Anderson and Gerbing (1988). First, we examined the measurement model to assess convergent and discriminant validity. Convergent validity (see [Table 1](#)) was measured with two metrics: average variance extracted (AVE) and composite reliability (CR). All of the convergent validity metrics clearly exceeded a minimum standard of 0.5. The reliability of the measurements was examined through the use of composite reliability and Cronbach's alpha. In general, the minimum acceptable value of composite reliability is 0.7, and the minimum acceptable value of Cronbach's alpha is 0.6 (Hair et al., 2006).

The discriminant validity was assessed by using the square root of the average variance extracted and latent variable correlations (see [Table 2](#)). The square root of the average variance extracted of each construct should exceed the correlation shared among constructs, as this implies that constructs have good discriminant validity. In summary, the results of the tests of the measurement model, including of its convergent and discriminant validity measures, were satisfactory.

Structural Model

We then examined the structural model to verify the hypotheses based on the path coefficients and R² values (Chin & Newsted, 1999). The R² values were used to assess the ability of the model to explain the variance in the dependent variables. The path coefficients were used to assess the statistical significance of the hypotheses. [Figure 3](#) shows the results of the structural model, and it can be seen that the model explains 55% of the variation in usefulness, 67% of that in satisfaction, 62% of that in attitude, and 70% of that in continued use intention.

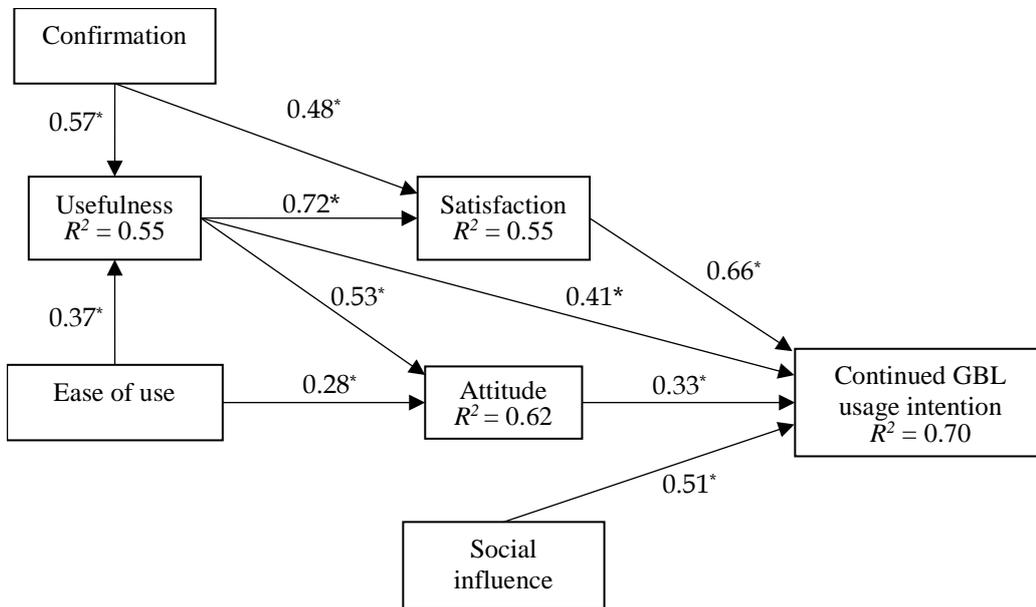


Figure 3. The results of structural model

The direct effects between the variables in the path model are shown in **Figure 3**. With regard to hypotheses H2 and H3, related to the effects of confirmation and usefulness on satisfaction, both hypotheses were supported. The path coefficient between confirmation and satisfaction was 0.48*, and 0.72* between usefulness and satisfaction. Regarding hypotheses H1 and H7, related to the effects of confirmation and ease of use on usefulness, both hypotheses were supported. The path coefficient between confirmation and usefulness was 0.57*, and 0.37* between ease of use and usefulness. With respect to hypotheses H6 and H8, pertaining to the effects of usefulness and ease of use on attitude, both hypotheses were supported. The path coefficient between usefulness and attitude was 0.53*, and 0.28* between ease of use and attitude. Finally, the hypotheses (H4, H5, H9, and H10) related to the effects of satisfaction, usefulness, attitude and social influence on continued GBL usage intention were all supported. The effects of satisfaction on continued GBL usage intention was higher than that of the other variables. However, social influence did play a significant part in affecting continued GBL usage intention.

DISCUSSION

In this study, we applied the concept of the ECM, TAM, and social influence to examine continued GBL usage intention in a collaborative learning environment. First, the results of the study showed that satisfaction is the strongest predictor of learners' continued GBL usage intention, followed by social influence, usefulness and attitude. The satisfaction-intention connection has previously been validated in an e-learning context (Lee, 2010). Oghuma et al. (2016) examined the factors that impact users' continued intention to use mobile instant messaging, and the results showed that users' satisfaction affects continued intention to use this technology. Therefore, satisfaction may be the primary factor to explain the acceptance-continued link; that is, users' continued GBL usage intention after the initial acceptance is determined by their satisfaction.

Secondly, this study confirmed that confirmation of the learners' expectations and perceived usefulness were key determinants of their levels of satisfaction, and this confirmation also had a significant impact on perceived usefulness, as well as the dominant effect on satisfaction. The results of this study thus strongly supported the ECM (Bhattacharjee, 2001). It is also in line with Stone and Baker-Eveleth's (2013) study on the adoption of electronic textbooks, which showed that confirmation of expectations influences perceived usefulness and satisfaction, consequently influences electronic textbook continued intention. In the digital game environment,

Riemer and Schrader (2015) suggested that such games are more likely to foster learning or to support positive attitudes toward perceived usefulness, resulting in more generally positive attitudes and further usage intention.

Third, the results of this study confirm strong relationships between attitude and intention to use GBL, between usefulness and attitude, and between perceived ease of use and perceived usefulness, thus supporting the application of the TAM (Davis, 1989) in the context of GBL. These findings are similar to those of other studies examining the acceptance of educational games (Bourgonjon et al., 2010), as well as supporting Garcia et al.'s (2016) research on a web-based business game-training program, which found that perceived usefulness has a very strong effect on intention to use such games.

In this study, we also examined social influence in a GBL environment, and found it was a strong predictor of continued usage intention. Asking students to collaboratively tackle a digital game challenges them to establish common frames of reference, work to resolve discrepancies in understanding, and so come to a shared understanding of the situation. Collaborative digital games often lead to positive learning outcomes and a higher level of abstract thinking through bridging multiple different perspectives (Echeverría et al., 2012). Collaboration in games can increase students' discussions and reflections on their arguments, which can foster knowledge co-construction and provide opportunities to cultivate a positive attitude and so enhance learning.

IMPLICATIONS

For academic researchers, this study proposed a theoretical framework to understand the factors affecting the continued GBL usage intention in a collaborative learning environment. Our research contributes a new theoretical understanding of the factors affecting the continued GBL usage intention in a collaborative learning environment. This study demonstrated the importance of two important variables with regard to fostering continued GBL usage intention, social influence and satisfaction, which together explained much of the variance in this intention. Collaboration in the digital game provided students with opportunities to achieve common goals and establish a sense of community through social interactions, and this increased their motivation for learning. In general, collaboration itself can be used as potential strategies for developing more effective educational digital games.

LIMITATIONS AND FUTURE RESEARCH

We incorporated the ECM, TAM, and social influence when examining the GBL environment in the context of collaborative learning, and the findings suggest that these factors have a significant impact on continued usage intention. The proposed model was verified and found to be valid in terms of explaining and predicting continued GBL usage intention in the context of a collaborative digital game. However, several limitations of this work should be addressed in future research. First, it should be noted that a bias exists because the sample was self-selected. Second, the other difficulty is the limited generalizability of this work. Since satisfaction, attitude, and social influence are additional antecedents of continued usage intention, it is impossible to generalize the findings to other collaborative digital games. Finally, the results of this study suggest that the researchers should investigate how emotional constructs, such as intrinsic motivation and flow, influence continued usage intention, and so provide a broader framework for the analysis of GBL.

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