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The Development and Evaluation of the Platform for Online High-Level Cooperative Games

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Abstract: The design of educational games plays an increasingly important role in modern education. By combining learning with games, it can attract students' attention and making learning more interesting. This study describes the development of a platform designed specifically for the online high-level cooperative game in which students are encouraged to achieve their own goals as well as common goals to reach win-win situation. Technology Acceptance Model (TAM) was used to analyze students' overall perceptions of the platform. The results show that the design of the game platform had high perceived usefulness and perceived ease of use, and players also showed positive attitudes and usage intentions. Therefore, a good game platform should have interactivity, educational value, problem-solving settings, and usability to provide the best gaming experience and have a positive impact on learning.

Keywords: Game-Based Learning, Gaming Platform, System Development, High-Level Cooperative Games, Technology Acceptance Model

1. Introduction

1.1 Research goal

In traditional learning methods, students usually need to spend a lot of time and effort learning knowledge and skills, which can lead to learning fatigue and loss of interest. Today, some games are gradually integrating educational resources and elements to enhance students' learning effectiveness and interest. According to Petri and von Wangenheim (2017), incorporating interactive, exploratory, and problem-solving elements into games can enhance learning outcomes by boosting students' engagement, and motivation; resulting in better learning outcomes.

The design of educational game platforms can contribute to students' experience of the pleasure of success and sense of achievement in games. This, in turn, can enhance their learning motivation and interest. Therefore, this study involved the development of an online high-level cooperative game platform. The platform provides various game modules for resource sharing, trading, bargaining, and issue discussions among players. After the game, reflections and feedbacks were received using the TAM questionnaire to investigate students' learning attitudes and technology acceptance. Evaluation results help system designers to develop more effective online game systems and enable continuous improvements of the game system.

1.2 Research questions

This study aims to understand students' experiences, acceptance, and willingness to use the online high-level cooperative game system using the Technology Acceptance Model (TAM). The research question of this study is to investigate students' perceived usefulness, perceived ease of use, attitudes toward use, willingness to use, and overall feedback experience of using the game system.

2. Related work:

2.1 Game-Based Learning

Digital games have emerged as effective learning tools that can assist students in acquiring knowledge while playing. Gee (2003) argues that digital games can enhance students' problem-solving, analytical, and creative abilities, and even help them develop skills beyond the classroom. Originally conceived as entertainment, digital games have become widely used as a learning tool, thanks to the prevalence of 3C technology products. Digital games provide an entertaining environment that increases student engagement and motivation (Annetta et al., 2009). Laine and Lindberg (2020) have demonstrated that digital games possess powerful motivational factors that can spark learners' initiative. By providing an engaging and interactive setting that challenges and entertains, digital games facilitate learning and cultivate students' problem-solving, analytical, and creative skills. Given their significant motivational benefits, digital games have become a popular tool for learning and are anticipated to remain a crucial component of education.

2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was initially proposed by Davis Bagozzi, and Warshaw (1989) to investigate the factors influencing individuals' willingness to use new technology. TAM comprises of two fundamental elements that substantially influence a user's inclination towards adopting new technology and shaping their behavioral attitudes. Perceived usefulness pertains to the extent to which users deem that utilizing a system can boost work efficiency. Perceived ease of use denotes the user's subjective perception of the system's complexity or simplicity, which is closely associated with their level of information technology proficiency. In order to further explore the acceptance of other technologies, it is necessary to consider the attitude toward using, which includes the user's perception of factors such as interface environment and system quality, and how they influence the user's behavior. Behavioral intention is influenced by multiple variables and ultimately reflects the user's actual operational behavior. The TAM has been widely used in research on user acceptance of technology and is considered an established model for understanding technology acceptance (Gefen, Karahanna, & Straub, 2003). Examples of its application include e-learning systems (Nga et al., 2007), online courses (Landry et al., 2006), websites (Koufaris, 2002), and others. In addition, TAM can be further expanded by incorporating external variables and combining with other theories. Different external variables may be related to system, user, and task characteristics, which can be investigated in research.

3. Online High-Level Cooperative Games Platform Design

This study combines game-based learning and issue-based learning to develop a high-level collaborative game-based learning system. The system incorporates historical crisis events, and through game mechanics, players can solve game problems through trading and negotiation. The system design is based on the Great Voyage game developed by Hong, Shih, and Lu (2022), allowing players to negotiate and divide tasks among groups to resolve historical crises. Students are divided into five groups to role-play European countries: England, France, Portugal, Spain, and the Netherlands, each with their own tasks. In the game, players go through four stages of gaming process in every round. The first stage is internal affairs, in which countries generate strategic plans for crisis resolution. The second stage is diplomacy, every country negotiates to resolve conflicts. The third stage is declaration, in which country representatives state their stands and propose solutions to the crisis event. The final stage is settlement, in which the Pope assesses the situation of each country and makes judgments. The game ends when all events are effectively resolved.

In respond to this game process, this study designed four functional modules in the system. Provide players with a good gaming experience, this system with simple user

interface, clear game information, and obvious text and icons to guide students to complete game tasks smoothly and foster their learning motivation. The design of each module is introduced and explained below:

(1) Information Model (Figure 1):

The Information Model interface not only displays relevant information about the player's own country in the game, but also allows for comparison through the intelligence information screen after each crisis is resolved. By comparing the total assets and trends shown in the initial information and current status, players can obtain valuable information about their own country and make wiser decisions to achieve victory. This transparency of information can help players better understand the situation of their own country, optimize their resource allocation, and effectively respond to crisis challenges. This feature enhances the fun and challenge of the game, while also giving players a sense of self-improvement.

(2) Negotiation Model (Figure 2):

In the Negotiation Model interface, players can freely choose different strategy behaviors, moods, message recipients, and discussion topics to better meet their needs and negotiation goals. This allows players to participate more comprehensively in negotiation topics and dialogue processes, fosters cooperation and communication, and increases player involvement in resolving crises. During the negotiation process, text messages can be displayed in real-time, allowing players to conveniently understand the negotiation process and results; the different colors of the dialogue box can distinguish messages from different countries, further enhancing the visual effects and user experience. This interface design enhances the freedom and fun of player participation in negotiation and dialogue, while also strengthening the realism and interactivity of the negotiation process, enabling players to better experience and learn negotiation skills and strategies.

Figure 1. Information model interface

Figure 2. Negotiation model interface

(3) Trading Model (Figure 3):

The Trading Model provides multiple options and trading methods, allowing players to easily select different trading modes, resource items, commodity categories, trading partners, trading items, and trading commodities, thereby increasing the flexibility and options of resource trading for players. This interface design not only enhances the freedom and fun of players' participation in resource trading but also strengthens their decision-making ability and strategic thinking in resource trading. Players can flexibly choose different trading methods and commodity categories based on their own needs and goals, in order to achieve maximum economic benefits and game objectives, helping players to understand the essence and rules of resource trading.

(4) Auction Mode (Figure 4):

The Auction Model interface provides players to participate freely in product auctions and transactions, and to list their own products, conduct auctions, and choose to buy spices and other goods, as well as query transaction records after completion. Through these operations, players can effectively understand the general process of the transaction and thus enhance their understanding and comprehension of the transaction. At the same time, it can also help players improve their trading skills and strategic abilities, thereby gaining more economic benefits in the game. More importantly, this platform allows players to gain more freedom and fun in participating in auctions and transactions, while also enhancing their understanding and mastery of trading skills and strategies in the game.

Figure 3. Trading model interface

Figure 4. Auction model interface

4. Research design

4.1 Research Framework

This study recruited fifteen Taiwanese graduate players to participate, who were randomly assigned into five groups. The research procedure, commenced with an explanation of the game rules and the system's operation before the game's commencement. The gaming activities were then documented in the game system. During the game (Figure 5), all players engage in online domestic discussions and diplomatic negotiations to solve problems and achieve the assigned tasks. The system supports students to tackle multiple crisis events which are supported by the system with various functional modules. Subsequently, upon completion of the game, the students were guided to complete a feedback questionnaire concerning the game system.

Figure 5. Players' gameplay process

4.2 Research Tools

The questionnaire design of this study is based on the TAM proposed by Davis et al., In the TAM, the external variables of perceived usefulness and perceived ease of use are explored. This study focuses on "computer self-efficacy" as the main factor to examine whether players have the ability to use information systems to complete tasks.

Therefore, the game content was taken into consideration; appropriate design and adjustments were made with the results of a questionnaire. The questionnaire was divided into five dimensions, including computer self-efficacy, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use. Each dimension includes five questions to understand players' acceptance and satisfaction with the system platform. Further evaluation of the system performance was done in terms of technology acceptance.

5. Results

Players' perceptions using online high-level cooperative games platform was analyzed with TAM (Table 1). According to the data results, it can be observed that the average value of each dimension is higher than the medium score of 3.00 of the five-point likert scale. These high ratings reflect the students' positive attitude towards the game, and their willingness to using it in the future. They believe that the game can make it easier for them to learn.

Table 1. *TAM evaluation to the game platform*

Dimension	Mean	S.D.
Self-Efficacy for Computer	3.73	1.02
Perceived usefulness	3.76	0.73
Perceived Ease of Use	3.32	0.84
Attitude towards Use	3.92	0.71
Behavioral intention	3.81	0.67

In the players' self-efficacy for computer dimension, the overall mean score is 3.73 (SD=1.02). The various sub-dimensions have average scores ranging from 4.33 to 3.13. Among them, the highest score is for Q1 "I often use computer devices to aid in my learning" (m=4.33), indicating that players who frequently use computer devices to assist learning. However, the lower scores are seen in Q2 "I often use computer devices to play online games" (m=3.73), suggesting that players use computer devices less often to play online games. This shows that players have a higher acceptance of using computers to play online games, indicating that they are better able to cope with the challenges and problems in various computer games, and have confidence and ability in using the platform.

In the players' perceived usefulness for computer dimension, the overall mean score is 3.6 (SD=0.73), with the mean values of sub-dimensions ranging from 3.93 to 3.53. The values indicate that most players have a high level of agreement with the "high-level collaborative online game platform". The highest score is seen in Q10 "Overall, using a 'high-level collaborative online game platform' is beneficial for me" (m=3.93), suggesting that players find the platform highly beneficial. However, in Q8 "The 'high-level collaborative online game platform' saves me a lot of time and effort when I am learning" (m=3.53), the lower score indicates that players perceive the platform to be limited in terms of time-saving and effort-saving during learning. The overall result shows that players still perceive the game system as assisting them in achieving their gaming or learning goals.

In the players' perceived ease of use dimension, the overall mean score is 3.32 (SD=0.84), and the mean values of each sub-dimension range from 3.47 to 3.20. The highest score is seen in Q15 "Overall, I find the 'high-level collaborative online game platform' to be easy to use" (m=3.47), indicating that players find the platform easy to operate, with clear and concise functions that allow for easy learning and quicker mastery of the system's features. However, the lower score is observed in Q13 "I am proficient in using the 'high-level collaborative online game platform'" (m=3.20), suggesting that players may find it difficult to become familiar with the platform's use due to the complexity of the game's mechanisms. Overall, players perceive the game platform as easy to use, with clear and concise functions that enable them to learn and master the system quickly.

In the players' attitude towards use dimension, the overall mean score is 3.92 (SD=0.71), and the average scores of each sub-dimension range from 4.07 to 3.67, indicating that players are highly satisfied with the overall experience of the system. The highest scores are observed in Q18 "I think that the 'high-level collaborative online game platform' is an attractive learning tool" and Q20 "Overall, I think that using the 'high-level collaborative online game platform' is a good idea" (m=4.07), suggesting that players believe the game promotes learning and cooperation. Players find the platform easy to use and appreciate its practicality, which helps them achieve game objectives and effective learning.

In the players' behavioral intention to use dimension, the overall average score is 3.81 (SD=0.67), with average scores ranging from 3.87 to 3.80 in each sub-dimension, indicating a high willingness to use the system among the participants. Among them, in Q24 “I expect to continue using the "high-level collaborative online game platform" in the future” (m= 3.87) is the highest score for the expectation that they will continue to use. This indicates that learners have a high willingness to use the system, are willing to spend time and effort using the game for learning, and are satisfied with its good experience and functionality, providing an excellent learning environment.

6. Conclusion

This study developed an online gaming platform with high-level cooperation, providing various system functional modules to assist players in effective communication, collaboration, conflict resolution, issue discussion, and reflection during the game. After the game, the TAM model was used to evaluate the game, and the questionnaire design was appropriately adjusted based on the game content to understand players' technology acceptance and satisfaction with the system platform. The results showed that players had positive evaluations of the various system functional modules, which helped them achieve their learning goals and provided a good gaming experience. It also stimulated their learning interest and motivation, met their gaming needs and expectations.

According to research findings, a good gaming platform should have interactivity, educational value, problem setting, and ease of use to provide players with the best gaming experience and play a positive role in learning. Interactivity promotes player interaction and communication with other players and enhances team collaboration awareness. Setting challenges and problems in the game allows students to learn through problem-solving and further stimulates their learning motivation and interest. Ease of use is also essential; simple operation and a good user experience allow players to easily immerse themselves in the game. By designing games in this way, it can not only improve students' problem-solving skills and creativity but also promote communication and interaction among students, enhancing their social skills and teamwork spirit.

The ongoing system development seeks to tailor the platform for global educational endeavors, with the goal of investigating how participants from diverse cultural backgrounds interpret and engage with the various in-game roles. Anticipating cross-cultural comparisons is part of this endeavor.

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