Exploring Game-Based Learning Based on Social Cognitive Theory in EFL class

Yu-Ting Fu[1(✉)], Pei-Hsuan Lin[2(✉)], Mu-Yen Chen[3(✉)], Chia-Chen Chen[1(✉)]

[1] Department of Management Information Systems, National Chung Hsing University, Taichung, Taiwan
kity19699@smail.nchu.edu.tw, emily@nchu.edu.tw

[2] Department of Information Communications, Chinese Culture University, Taipei, Taiwan
lpx4@ulive.pccu.edu.tw

[3] Department of Engineering Science, National Cheng Kung University, Tainan, Taiwan
mychen119@gs.ncku.edu.tw

Abstract. With the development of technology, using technology as a diverse learning channel has become a prominent trend in today's education and many online learning systems have emerged. In recent education, game-based learning is a common method used to support learning. Game-based learning combines game design and educational principles to provide an interactive and entertaining learning environment. However, traditional English course teaching methods no longer meet students' learning needs. Therefore, this study aims to develop a game-based English learning system, named "Happy English", which integrates course content into interactive game tasks. First, this study designs a role-playing game (RPG) with an immersive learning experience by incorporating tasks relevant to provide students with learning goals. Second, this study used pre-and post-test and scales as measurement tools to collect students' learning outcome data. Third, based on social cognitive theory, explores the impact of game-based learning on learning performances and investigates the mediating role of anxiety and cognitive load in different learning environments. The results showed significant improvements in learning performances for students using both learning methods. In contrast, learning in the game-based learning environment perceived better support and students were able to effectively reduce their anxiety and cognitive load compared to students taught with traditional instructional methods. In summary, the results indicated that when students perceived better learning support in the game-based learning environment, their anxiety and cognitive load decreased, subsequently leading to improved learning performance. Furthermore, this research can be used as a reference for designing English learning or game-based learning and provide more effective assistance to students.

Keywords: Game-based learning, Social cognitive theory, Cognitive load, Anxiety, English as foreign learning

1 Introduction

There have been several investigations into technology-enhanced learning, including computers, mobile devices, and augmented reality, which can help improve learning outcomes, attitudes, motivation, interest, and student engagement[1-4]. To increase students' motivation and interest in learning, more and more people are using game-based learning, allowing students to be more immersed in virtual game-based learning environments and acquire knowledge from them [5]. Furthermore, role-playing games are a way for students to control and play game roles themselves. Therefore, this approach increases the gaming experience and motivation for learning, allowing students to reflect and gain a deeper understanding of problems [6]. For example, the study by Lee, J[7] used mobile games to learn in foreign language learning.

Recently, English learning has become increasingly important for students of all ages, with more and more attention [8, 9]. The development of English learning has diversified into various applications no longer limited to traditional paper-based teachings, such as online learning platforms and social networking sites [10, 11]. During language learning, some students may feel anxiety and high anxiety may lead to lower learning performance [12, 13]. Cognitive load is also a factor that can cause lower learning performance, with relevant studies indicating that exceeding the working memory load limit can hinder learning performance [14].

Bandura [15] proposed the social cognitive theory that the environment, person, and behavior are interrelated. In educational settings, the principles of the social cognitive theory are often discussed, including in nursing education, science education, and mathematics curriculum [16, 17]. From this perspective, it has been found that in different learning environments, there is a negative relationship between anxiety and cognitive load and learning performance, and teaching methods and learning performance are moderated by cognitive load [18, 19].

In summary, game-based learning can help with learning and get better development. In English learning, students may have personal worries about the language, leading to increased anxiety and cognitive load. Therefore, based on the social cognitive theory, a game-based learning environment can help learners reduce anxiety and cognitive load and improve learning performances by allowing learners to choose tasks according to their learning progress and receive feedback after completing tasks. The study proposes the following research questions:

1. To investigate whether there is a difference in learning performances between students using game-based learning and those using online learning sheets.
2. To investigate whether there is a difference in cognitive load between students using game-based learning and those using online learning sheets.
3. To investigate whether there is a difference in anxiety between students using game-based learning and those using online learning sheets.
4. To investigate whether anxiety and cognitive load, based on the social cognitive theory, can serve as mediating variables between perceived learning support and learning performances.

2 Literature Review

2.1 Game-based Learning

Game-based learning refers to combining educational objectives into games with clearly defined learning performance [5, 20]. It provides complex and challenging tasks that can attract students' attention and promote active learning, which is very helpful for students learning [21, 22].

In education, this learning approach is increasing attention. Role-Playing Game (RPG) is a learner-centered approach that allows learners to control game characters and immerse themselves. It can deeply understand and reflect on problems and solve them in an immersive learning environment. It also, enhances their learning experiences, motivation, and learning performance[23, 24].

There are some studies have found that role-playing games are very effective in helping students learn in different fields. Kusuma et al. [25] used role-playing games for history learning and found that they improved students' motivation and grades. In math courses, using role-playing games for learning has also been found to effectively improve students' learning outcomes and attitudes [26].

In addition, game-based learning is not only used in academic subjects, but it is also frequently applied in different fields. For example, Moro et al. [27] used a role-playing game developed for health science and medicine to review the content of physiology and anatomy in game-based learning.

Therefore, this study uses game-based learning, integrating learning content into games, allowing learners to immerse themselves in the game by freely exploring maps, completing game tasks, experiencing games, and engaging in learning.

2.2 Social Cognitive Theory

Bandura [15] proposed Social Cognitive Theory (SCT), which means that environment, person, and behavior are three factors that influence each other. When learning in a social setting, the thoughts of others can influence the overall environment, leading to different actions. In turn, the environment changes based on the thoughts and behaviors of others. Different behaviors will also bring about changes in the overall environment and thinking [15, 28].

Environmental factors refer to external influences that affect behavior, including feedback from peers and teachers [19]. Many studies on online learning environments have pointed out that there is a corresponding relationship between students' perceived learning impact and learning performance. This includes factors such as well-designed courses, support from teachers and peers, and technological support. Additionally, providing appropriate support to students within the learning environment can enhance their satisfaction, learning motivation, and performance [29, 30].

Personal factors refer to all internal factors that can cause psychological influences, such as feelings of anxiety, cognitive load, and self-regulation [18]. In the learning process, anxiety refers to the psychological experience of feeling depressed, worried, or stressed, and it generally has a negative impact on learning performance [31]. Cognitive

load theory refers to the working memory resources required during learning [32, 33]. When working memory is overloaded, it can hinder learning performance [34].

Behavioral factors refer to influenced by the external environment, personal internal factors, and behavioral feedback [15]. In this study, perceived learning support within the environmental factors may vary due to differences in teacher support and technological support, thus affecting students' learning performance. Within the personal factors, students' anxiety and cognitive load may differ, leading to variations in each student's learning performance.

In education, SCT is frequently employed to investigate how various internal and external factors influence different learning behaviors in diverse learning environments, including the impact of online learning environments on learning performance and continued usage intention. Factors such as learners' confidence and cognitive load during the learning process are crucial in affecting learning performance [18, 35].

Therefore, this study aims to investigate the correlation between students' anxiety and cognitive load and their learning performances in an English learning environment, based on SCT, as shown in Figure 1. Environmental factors include different instructional strategies, game-based learning, and online learning sheets. Personal factors include anxiety and cognitive load, while behavioral factors focus on learning performance.

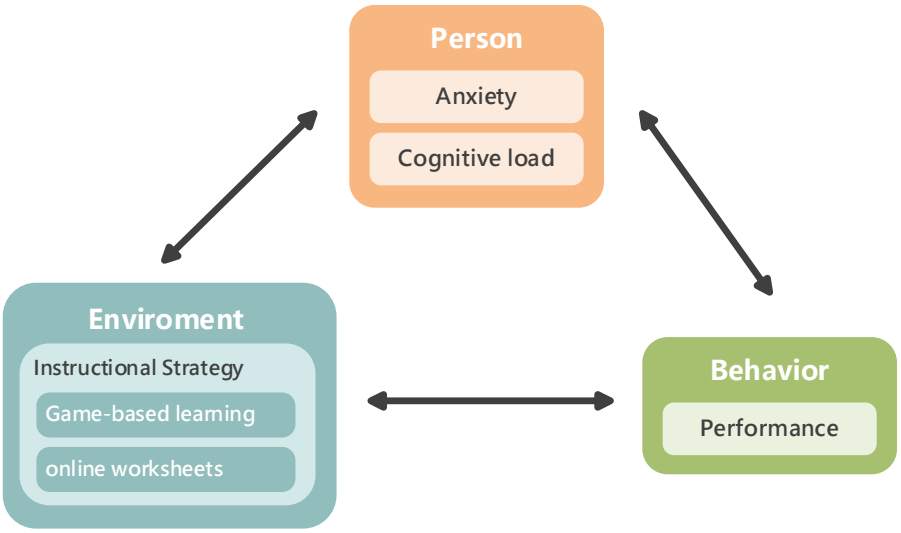

Fig. 1. Research model based on SCT

3 Research Method

3.1 System Design

This study develops a gamified English learning system, "Happy English", which utilizes task activities for after-class practice and review. The instructional content is designed according to the content of elementary school textbooks. The system is divided

into four sections: vocabulary, sentence, conversation, and weekly tasks, as shown in Figure 2.

The design of this system primarily focuses on conversation-based interactions within the game. In the vocabulary and sentence structure practice function, through a combination of images and text, along with simple quizzes. In the weekly tasks, there is a repetition of similar sentence patterns and vocabulary to enhance students' memory. Students are also able to self-assess their learning progress and practice according to their conditions, as shown in Figure 3.

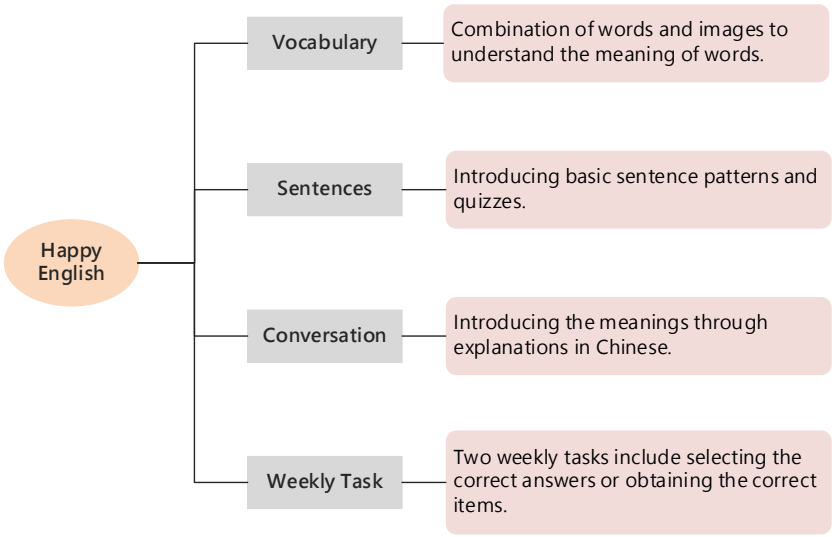

Fig. 2. System structure

Fig. 3. System screenshots

3.2 Participants

The participants were fourth-grade students from two schools in Taiwan. There were an experimental group and a control group, each consisting of 40 students. The

experimental group used a game-based learning system, while the control group used online learning sheets. The learning content was the same for both groups. Before the experiment, students took an English test to ensure there were no differences in their abilities, and then the learning activities and analysis were conducted.

3.3 Experimental Procedure

Figure 4 illustrates the experimental procedure of this study. The duration of the experiment was 6 weeks. In the first week, both groups of students completed an English Reading Anxiety Scale and a pretest. From the second week to the fifth week, the experimental group engaged in 20-minute learning activities after the course, to complete 2 tasks each week. As for the control group, they need to complete two online learning sheets, which had the same content as the experimental group. Then, in the sixth week, the two groups of students took the post-test and the Foreign Language Reading Anxiety Scale (FLRAS), and the Perceived Learning Support Scale and Cognitive Load Scale. In addition, the experimental group students also filled out a scale about their game experience.

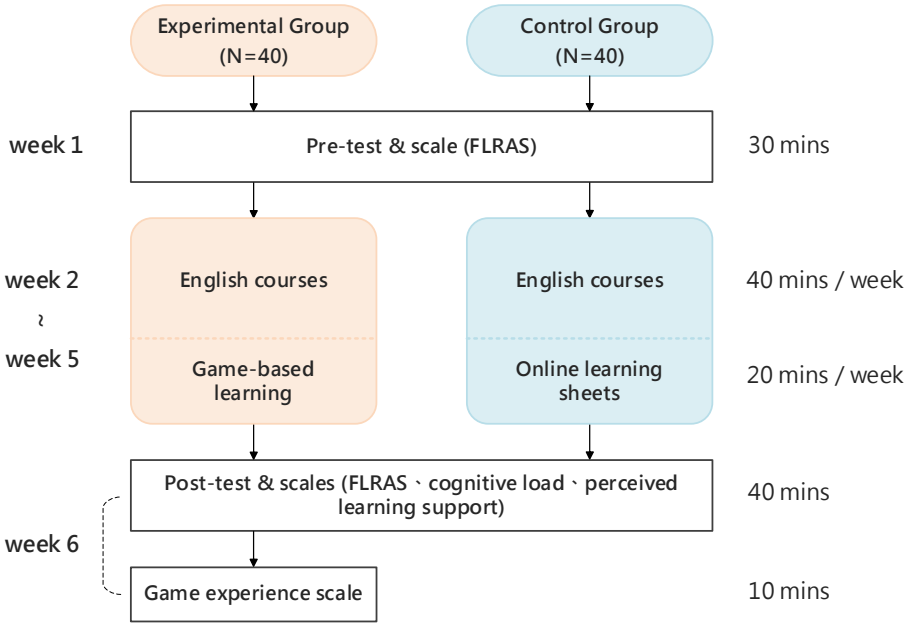

Fig.4. Experimental procedure

3.4 Materials and Methods

This study uses pre-and post-test and scales as measurement tools. Scales include Perceived Learning Support, FLRAS, Cognitive Load, and game experience.

The pre-and post-test was designed based on the content of Unit 1 and Unit 2 of the English curriculum for fourth-grade elementary students. They consisted of multiple-

choice questions, including 8 vocabulary items, 5 sentence structure and grammar items, and 3 reading comprehension items, with a total score of 100. The content and difficulty of the test questions were evaluated and confirmed by three English experts.

All the scales were measured using a 5-point Likert scale. The Perceived Learning Support Scale was adapted from the Paechter et al. [36] and Lee et al. [29], consisting of 5 items. Such as "The course provided resources relevant to this course." The FLRAS was adapted from Saito et al. [37], consisting of 13 items. Such as "When I'm reading English, I get so confused I can't remember what I'm reading." The Cognitive Load Scale was adapted from Leppink et al. [38] and Klepsch et al. [39], consisting of 5 items. Such as "For this task, many things needed to be kept in mind simultaneously." The game experience scale was adapted from Petri et al. [40] and Wu [41], consisting of 8 items. Such as "I prefer learning with this game to learning through other ways."

4 Expected Results

This study is still in progress and is expected to be completed in June. In English courses and compares the use of a game-based learning system with online learning sheets as two different learning methods. The study involves pre-and post-test assessments as well as scale measurements. Furthermore, the study explores these aspects based on the principles of social cognitive theory.

1. In terms of learning performance, it is expected that students using the game-based learning system will achieve higher learning performance compared to those using the online learning sheets.
2. In terms of cognitive load, students using the game-based learning system are expected to experience lower cognitive load compared to those using the online learning sheets. This is due to the more relaxed and personalized learning experience provided by the game-based approach.
3. In terms of anxiety, it is expected that students using the game-based learning system can reduce their more anxiety than students who use online learning sheets. Through the way of games, students are more interested in learning, so they show lower reading anxiety in English.
4. Based on the social cognitive theory model, it is expected that anxiety and cognitive load can mediate the relationship between perceived learning support in different learning environments and learning performances. Students using the game-based learning system are expected to feel higher learning support, thereby reducing learning anxiety and cognitive load, and learning effectiveness will also be improved.

Overall, this study is expected to demonstrate the potential advantages of game-based learning in reducing anxiety and cognitive load while enhancing learning performances. It also seeks to gain a deeper understanding of the interplay between learning environments, personal factors, and behavioral factors. These findings can contribute to a better understanding of the application and theoretical foundations of game-based learning in English education, and provide more engaging and effective learning methods, which can also be used for research in other fields.

Acknowledge

The authors wish to thank the National Science and Technology Council of the Republic of China for financially supporting this research under Contract Grants No. 111-2410-H-005-022-MY3 & 111-2410-H-005-022-MY3 & 111-2410-H-005-023-.

References

1. Huizenga, J., et al., Mobile game-based learning in secondary education: engagement, motivation and learning in a mobile city game. Journal of Computer Assisted Learning, 2009. 25(4): p. 332-344.
2. Martin, F. and J. Ertzberger, Here and now mobile learning: An experimental study on the use of mobile technology. Computers & Education, 2013. 68: p. 76-85.
3. Su, C.H. and C.H. Cheng, A mobile gamification learning system for improving the learning motivation and achievements. Journal of Computer Assisted Learning, 2015. 31(3): p. 268-286.
4. Yu, S.-J., J.C.-Y. Sun, and O.T.-C. Chen, Effect of AR-based online wearable guides on university students' situational interest and learning performance. Universal Access in the Information Society, 2019. 18: p. 287-299.
5. Qian, M. and K.R. Clark, Game-based Learning and 21st century skills: A review of recent research. Computers in human behavior, 2016. 63: p. 50-58.
6. Zhong, L., Investigating students' engagement patterns and supporting game features in a personalized computerized role-playing game environment. Journal of Educational Computing Research, 2022: p. 07356331221125946.
7. Lee, J., Problem-based gaming via an augmented reality mobile game and a printed game in foreign language education. Education and Information Technologies, 2022. 27(1): p. 743-771.
8. Ikegashira, A., Y. Matsumoto, and Y. Morita, English education in Japan: From kindergarten to university. Into the next decade with (2nd) FL teaching, 2009: p. 16-40.
9. Nguyen, T.M.N., Effects of Using Computer-Based Activities in Teaching English Speaking at a High School in Ho Chi Minh City, Vietnam. International Journal of TESOL & Education, 2022. 2(1): p. 190-212.
10. Klimova, B. and M. Pikhart, Cognitive and applied linguistics aspects of using social media: the impact of the use of Facebook on developing writing skills in learning English as a foreign language. European Journal of Investigation in Health, Psychology and Education, 2019. 10(1): p. 110-118.
11. Putri, E. and E. Education, An impact of the use Instagram application towards students vocabulary. Pustakailmu. id, 2022. 2(2): p. 1-10.
12. Hu, X., X. Zhang, and S. McGeown, Foreign language anxiety and achievement: A study of primary school students learning English in China. Language Teaching Research, 2021: p. 13621688211032332.
13. Russell, V., Language anxiety and the online learner. Foreign Language Annals, 2020. 53(2): p. 338-352.
14. 14. Buchner, J., K. Buntins, and M. Kerres, The impact of augmented reality on cognitive load and performance: A systematic review. Journal of Computer Assisted Learning, 2022. 38(1): p. 285-303.

15. Bandura, A., Health promotion from the perspective of social cognitive theory. Psychology and health, 1998. 13(4): p. 623-649.
16. Burke, H. and L. Mancuso, Social cognitive theory, metacognition, and simulation learning in nursing education. Journal of Nursing Education, 2012. 51(10): p. 543-548.
17. Czerniak, C. and L. Chiarelott, Teacher education for effective science instruction—A social cognitive perspective. Journal of Teacher Education, 1990. 41(1): p. 49-58.
18. Rosenberg-Kima, R.B., et al., Explicit instruction in the context of whole-tasks: the effectiveness of the task-centered instructional strategy in computer science education. Educational technology research and development, 2022. 70(5): p. 1627-1655.
19. Wang, S.L. and S.S. Lin, The application of social cognitive theory to web-based learning through NetPorts. British Journal of Educational Technology, 2007. 38(4): p. 600-612.
20. Plass, J.L., B.D. Homer, and C.K. Kinzer, Foundations of game-based learning. Educational psychologist, 2015. 50(4): p. 258-283.
21. Prensky, M., Digital game-based learning. Computers in Entertainment (CIE), 2003. 1(1): p. 21-21.
22. Wendel, V., et al., Designing collaborative multiplayer serious games: Escape from Wilson Island—A multiplayer 3D serious game for collaborative learning in teams. Education and Information Technologies, 2013. 18: p. 287-308.
23. Chen, H.-L. and C.-T. Wu, A digital role-playing game for learning: Effects on critical thinking and motivation. Interactive Learning Environments, 2021: p. 1-13.
24. Nadolny, L., et al., Examining the characteristics of game-based learning: A content analysis and design framework. Computers & Education, 2020. 156: p. 103936.
25. Kusuma, G.P., et al., Enhancing historical learning using role-playing game on mobile platform. Procedia Computer Science, 2021. 179: p. 886-893.
26. Chiu, F.-Y. and M.-L. Hsieh, Role-playing game based assessment to fractional concept in second grade mathematics. Eurasia Journal of Mathematics, Science and Technology Education, 2017. 13(4): p. 1075-1083.
27. Moro, C., C. Phelps, and J. Birt, Improving serious games by crowdsourcing feedback from the STEAM online gaming community. The Internet and Higher Education, 2022. 55: p. 100874.
28. Schunk, D.H. and M.K. DiBenedetto, Motivation and social cognitive theory. Contemporary Educational Psychology, 2020. 60: p. 101832.
29. Lee, S.J., et al., Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. The internet and higher education, 2011. 14(3): p. 158-163.
30. Wei, X., N. Saab, and W. Admiraal, Do learners share the same perceived learning outcomes in MOOCs? Identifying the role of motivation, perceived learning support, learning engagement, and self-regulated learning strategies. The Internet and Higher Education, 2023. 56: p. 100880.
31. Li, R., Foreign language reading anxiety and its correlates: A meta-analysis. Reading and Writing, 2022. 35(4): p. 995-1018.
32. Kirschner, P.A., et al., From cognitive load theory to collaborative cognitive load theory. International Journal of Computer-Supported Collaborative Learning, 2018. 13: p. 213-233.
33. Seufert, T., The interplay between self-regulation in learning and cognitive load. Educational Research Review, 2018. 24: p. 116-129.
34. De Jong, T., Cognitive load theory, educational research, and instructional design: Some food for thought. Instructional science, 2010. 38(2): p. 105-134.

35. Wang, W.-T. and Y.-L. Lin, The relationships among students' personal innovativeness, compatibility, and learning performance. Educational Technology & Society, 2021. 24(2): p. 14-27.
36. Paechter, M., B. Maier, and D. Macher, Students' expectations of, and experiences in e-learning: Their relation to learning achievements and course satisfaction. Computers & education, 2010. 54(1): p. 222-229.
37. Saito, Y., T.J. Garza, and E.K. Horwitz, Foreign language reading anxiety. The modern language journal, 1999. 83(2): p. 202-218.
38. Leppink, J., et al., Development of an instrument for measuring different types of cognitive load. Behavior research methods, 2013. 45: p. 1058-1072.
39. Klepsch, M., F. Schmitz, and T. Seufert, Development and validation of two instruments measuring intrinsic, extraneous, and germane cognitive load. Frontiers in psychology, 2017. 8: p. 1997.
40. Petri, G., C.G. von Wangenheim, and A.F. Borgatto, MEEGA+: a method for the evaluation of educational games for computing education. INCoD–Brazilian Institute for Digital Convergence, 2018: p. 1-47.
41. Wu, T.T., Improving the effectiveness of English vocabulary review by integrating ARCS with mobile game-based learning. Journal of Computer Assisted Learning, 2018. 34(3): p. 315-323.