




www.ijte.net


Engaging Students in the Learning Process with Game-Based Learning: The Fundamental Concepts

Surattana Adipat 
Ramkhamhaeng University, Thailand

Kittisak Laksana 
Ramkhamhaeng University, Thailand

Kanrawee Busayanon 
Ramkhamhaeng University, Thailand

Alongkorn Asawasowan 
Ramkhamhaeng University, Thailand

Boonlit Adipat 
Ministry of Digital Economy and Society, Thailand

To cite this article:

Adipat, S., Laksana, K., Busayanon, K., Asawasowan, A., & Adipat, B. (2021). Engaging students in the learning process with game-based learning: The fundamental concepts. *International Journal of Technology in Education (IJTE)*, 4(3), 542-552. <https://doi.org/10.46328/ijte.169>

The International Journal of Technology in Education (IJTE) is a peer-reviewed scholarly online journal. This article may be used for research, teaching, and private study purposes. Authors alone are responsible for the contents of their articles. The journal owns the copyright of the articles. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of the research material. All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations regarding the submitted work.



This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.



International Journal of Technology in Education (IJTE) is affiliated with
[International Society for Technology, Education, and Science \(ISTES\): www.istes.org](http://www.istes.org)

Engaging Students in the Learning Process with Game-Based Learning: The Fundamental Concepts

Surattana Adipat, Kittisak Laksana, Kanrawee Busayanon, Alongkorn Asawasowan, Boonlit Adipat

Article Info

Article History

Received:

02 February 2021

Accepted:

25 June 2021

Keywords

Game-based learning

Digital games

Technology

Collaborative learning

Abstract

A new approach to learning in the form of educational games has been adopted in recent years, especially in English language teaching. The educational game learning approach used to teach English to non-native English-speakers who use English as a second or foreign language has recorded great success. This study provides an innovative framework for the adoption of the educational games learning approach at university. This is done to ensure lifelong learning and interdisciplinary learning opportunities for students. The study introduces social skills and knowledge training to address topics of gaming and learning. It describes the point at which learning is expected to occur and the role that game elements play in relation to student engagement and educational gaming content interaction. The study further describes the principles governing collaborative learning which are the key pillars for acquiring cognitive and social skills. The contribution of game-based learning is further linked with mindset improvement and growth. The study further examines three theories that are essential to the development of the game-based learning approach: narrative-centered learning theory, problem-solving theory, and engagement theory. Upon providing the theoretical underpinnings, teachers' perceptions towards the game-based learning approach are further addressed in the paper. The advantages and disadvantages of game-based learning are also discussed.

Introduction

Game-based learning is a method of obtaining new concepts and skills through the use of digital and non-digital games (Grace, 2019). The application of games in education can foster notable improvements in both learning and education outcomes (Kula, 2021; Syaffi, 2021). According to Boctor (2013), the process by which the game-based learning approach supports learning comprises two steps: First, games can motivate students to combine knowledge from various disciplines and utilize it in decision-making processes; and second, students can test how game outcomes change based on the choices and decisions they make. It also allows students to communicate with other participants and discuss game-related moves; this increases coordination which, in turn, improves social association skills.

Problem-solving skills are essential for adaptation to society, and game-based learning has emerged as the best method of improving such skills; for instance, Han (2015) found that learning through interactive sessions helps students learn more and improves their problem-solving cognitive abilities. Game-based learning, by coordinating several capabilities into the learning process, is also considered to have the ability to increase students' engagement. Moreover, students who play educational games show, when compared to students who do not play such games, better educational gains in various subjects, including in regard to understanding the English language (Boctor, 2013). Thus, integrating learning with a game-based approach can be an effective means of harmonizing teachers' and students' preferences. In short, game-based learning contributes to improving students' engagement, coordination, and creativity.

Games and Learning

Game-based learning is designed to balance theoretical content and learning through the use of games. Game-based learning allows students to explore rigorous learning environments and concepts and targeted learning outcomes (Chen et al., 2018); this is especially effective in the context of the English-language learning environment (Mozelius & Hettiarachchi, 2017). Games should be designed to ensure that the students can repeat the cycles within the game context without becoming bored. Further, a good educational game should, during such states of repetition, elicit desirable behaviors in students; this can be achieved through fostering certain emotional and cognitive reactions to interactions with and feedback received from the game (Boctor, 2013). Between games, a debriefing process and a review of learning outcomes should be implemented (Mozelius & Hettiarachchi, 2017). Post-game debriefings allow the teacher to establish a connection between the game and the real world. It also creates an association between occurrences within the game and those of real life, thereby connecting the students' understanding of the game to education (Bundick et al., 2014).

Game-based learning programs should provide students with the capacity to be involved in their education, and to reflect on, understand, and apply the acquired knowledge in real life (Boctor, 2013). The adoption of an adventure approach in educational games can be effective in this regard. Educational adventure games are purposefully designed to provide "edutainment" (a mix of education and entertainment); such games are generally complex and feature clear demonstrations of deterministic problems (Bundick et al., 2014). For instance, in adventure games, problems are often part of the game, and players must find solutions to these problems in order to advance in the game. Thus, players' in-game decisions can have direct consequences on the game's progression, meaning the player is in control of the game. In adventure games, the puzzles can be difficult to solve, but it is not difficult to try different possible solutions (Bundick et al., 2014). Importantly, Boctor (2013) noted that the learning process associated with adventure games can improve players' general ability to identify solutions to problems.

Whether a game qualifies as educational depends on several aspects. According to Plass et al. (2015), the characteristics of an educational game are essentially determined by its interactivity aspects, while others, such as Boctor (2013), provide a more specific definition, suggesting that dynamic visuals, regulations, objectives, and interaction features are the defining characteristics of educational games. Hwang et al. (2016) further argued

that educational computer games are anchored on the aspects of fantasy, curiosity, challenge, and control. Here, fantasy represents the scenarios in which the games are set. The fantasy aspect creates greater interest among students and increases their learning efficiency (Hwang et al., 2016). Regarding curiosity, along with the games' non-deterministic outcomes, the continuous introduction of new information can sustain students' interest in the game. Regarding challenge, the games should be timed and played under specific confines. Finally, for control, as in real life, participants must adhere to certain rules, whether they are the system rules that define the game world, or procedural rules that relate to possible actions. In this way, educational games create second-order reality for participants.

Pho and Dinscore (2015) stated that game-based learning is not superior to other learning approaches in terms of educational potential, but that it has a greater potential to enhance motivation and increase student interest in the subject matter. Contrasting with this assertion, other researchers have established that students are better able to retain knowledge learned through game-based approaches than that encountered through other learning approaches, but that this is dependent on the domain in question; interdisciplinary topics that require skills such as critical thinking, interpersonal communication, and debating are those that are associated with the greatest game-based learning advantage (Kucher, 2021).

Games and Collaborative Learning

According to Dichev and Dicheva (2017), collaborative learning is an established component of the learning process, and the game-based education approach is the most effective method of ensuring collaborative learning among students. Collaborative learning involves students obtaining knowledge through sharing information with the class community, and the use of technology in learning is known to encourage students to be more interactive and less passive during learning sessions. Game-based learning also provides a constructivist learning environment in which students utilize existing skills to solve problems relating to the subject matter in question; game-based learning can also help students process and decode essential information for understanding learning materials. Thus, game-based learning affords students opportunities and structures to engage more strongly with the education process. Through game-based learning, students can exchange information and ideas with each other, and collaboratively perform simple tasks and solve challenges. Moreover, Boctor (2013) pointed out that game-based learning converts teachers into participants in and teachers of the learning process; this contrasts with the traditional method of imparting a repository of information to passive students who may often be uninterested and inattentive.

Games and Growth Mindset

Kühn et al. (2019) suggested that the keys to triumphing in video games are determination, resourcefulness, and problem-solving skills. When players begin to play a game, they fully expect to make some mistakes and to require perseverance to negotiate difficult levels, perhaps needing to replay levels repeatedly before successfully progressing beyond them. This ability to retry levels creates a sense that there is no such thing as failure in video games (Schaaf & Mohan, 2016). When comparing this with basic classroom learning, it is notable that students

require the same kind of resolve to learn how to solve class-based problems. Determination and tenacity could be considered the foundations of a progressive mindset, which is based on cognitive flexibility, problem-solving, and pattern recognition.

Wu (2015) reported that most youths play digital and/or non-digital games outside the classroom. Wu (2015) also reported that almost 94% of teenage girls and 99% of teenage boys spend an estimated 7–15 hours per week playing video games. The popularity of such games among children and youths has led to game-based learning being proposed as a learning tool for educating young people and developing their growth mindset (Boctor, 2013). A growth mindset develops when students who have experienced failure are encouraged to persist and do better (Dostál, 2015). Students with a growth mindset are, therefore, willing to attempt a task repeatedly until they achieve the desired outcome. Such benefits of game-based learning further incentivize the incorporation of digital and/or non-digital game elements into classroom learning environments.

Unlike studying, games are primarily designed to be enjoyable and to encourage players to continue playing. The principal structure of many games is based on interchanging disappointment and victory. For this reason, game-based learning can represent a practical tool for developing a growth mindset. Games retain students' interest and develop their commitment because the activities are fun, which helps students remain positive even if they are unsuccessful (Rowe et al., 2011; Taub et al., 2017). Students may not achieve their final desired objective immediately, but since they can identify the progress they have made in the game, they are encouraged to try again in an attempt to improve their performance.

When integrating game-based learning in a class, the games must be structured and employed appropriately; otherwise, they will not have the anticipated effect. For example, some games might include calculation aspects but not necessarily be educational (Pho & Dinscore, 2015). It is the teacher's responsibility to select suitable games that feature the correct concepts for their students; for instance, games employed to help students complete mathematical problems must have sufficient accuracy in terms of calculation solutions. Moreover, for game-based learning to have the intended learning impacts, teachers must choose easy-to-follow and straightforward games (Li, 2017). From the author's perspective, the common attitude that, when playing games, repeated attempts may be necessary to complete levels implies that failure in game-based learning is not treated with the same negativity that accompanies failure in classroom tests. The games can also impart a belief to students that any challenge can be accomplished.

Theoretical Underpinnings

Three theories are essential to the development of a game-based learning approach model: narrative-centered learning theory, problem-solving theory, and engagement theory.

Narrative-Centered Learning Theory

Rowe et al. (2015) proposed that the game-based educational approach is dependent on the ideology, which

concerns intellectual procedures for the formation of narratives. The major principle is the assimilation process, in which the students are moved to a different environment and time in such a highly compelling form that it appears real. The students then perform the narrative. By simulating the characters in the game, students actively make deductions and enjoy impassioned involvement through their interactions with the narrative text (Kühn et al., 2019). Just as readers employ several perspectives to determine the meaning of a text or reading material, game players can also employ diverse perspectives to better understand and interact with the game and attain success in the game. Narrative-centered learning games are educational settings that afford active interchange between the characters and the plot (Lester et al., 2014). The narrative can represent a dynamic tool for game-based education, as it relates to the creation of meaning and to students' engagement in exploring the structure and learning processes. Narrative-centered theory also asserts that educational games can help create meaning regarding the disciplinary content of situations that have personal importance for students.

Problem-Solving Theory

Problem-solving abilities are essential in today's dynamic world. Problem-solving skills increase one's value to employers, thereby providing an advantage in the labor market. According to Dostál (2015), solving properly structured problems is a linear process that comprises two stages: 1) generating a problem space, and 2) devising a resolution by operating through the problematic space. However, solving problems in a properly structured space is easier than solving problems that may occur in real-life. For instance, workplace problems are generally ill-defined and not easy to solve by applying classroom approaches. As a result, creating an environment where students can solve unstructured problems can increase their ability to solve real-world problems once they leave school and enter the workplace. Educational games seek to bridge the gap between classroom problems and real-world challenges. The game-based learning approach helps build problem-solving skills by first providing a multiple-avenue approach for finding solutions, then assessing students' problem-solving abilities through posing ill-defined challenges, and finally allowing students to work collaboratively to solve the challenges.

Engagement Theory

Engagement theory argues that students are better able to retain the concepts they learn if they are afforded greater involvement in the approach. Engagement refers to a student's awareness of the qualities of a subject, as well as their motivation and interest in the subject (Whitton, 2011). Students are asked to select tasks based on their competencies, and they then initiate actions when allowed; as a result, they become wholly involved in the completion of assigned tasks. Depending on the educational gaming dimensions involved, student engagement can be identified by determining the dynamic, behavioral, and/or cognitive engagement aspects they exhibit. Therefore, game-based learning can increase students' engagement in the learning process. According to Whitton (2011), engagement theory proposes three concepts for ensuring effective student engagement in the learning process: First, the learning process should focus on the collaborative aspects between students. Second, the learning process should be tailored to project-based activities and assignments. Third, authentic, relevant, and meaningful out-of-classroom work should be assigned to foster effective student engagement.

Teacher's Perceptions of Game-Based Learning

The main reason for adopting learning-supportive technology is to support and improve students' educational outcomes. Therefore, combining traditional and technology-based approaches (in the form of game-based learning) is highly important for improving students' motivation to engage with educational material (Wu, 2015). Application of the game-based educational strategy is facilitated by the increasing accessibility of technology and the increased time students spend playing video games, which has resulted in a gaming culture that ought to be capitalized upon by the education sector (Wu, 2015).

According to Wu (2015), children exhibit increased levels of contentment when they learn through a mode that is interactive and fully utilizes their problem-solving cognitive abilities. This implies that applying a technological approach is the optimal means of achieving classroom contentment. However, most teachers are not fully abreast of gaming-based approaches to education and, thus, have little appreciation of its potential. Many teachers exhibit reservations regarding the use of games and, when adapting them for class activities, do so with little understanding of the game-based learning approach itself. However, this situation is improving following extensive research indicating the increase in academic performance afforded by gamification in learning. According to Wu (2015), teachers play a vibrant role in implementing game-based education tactics. Therefore, it is critical to understand teachers' attitudes toward the gamification of learning.

Teachers' primary concern regarding the introduction of technology relates to its interruptive nature, with some teachers encountering obstacles in this regard when implementing some gaming aspects during classroom activities (Li, 2017). In addition, some teachers have no prior experience of gaming, which hinders their ability to adapt it for educational purposes. These two issues result in mixed reactions to adopting educational games in college-level English education. According to Wu (2015), an individual's attitude (which reflects their personal perception) can influence the attitudes individuals with whom they interact. Consequently, understanding teachers' attitudes towards technology-based learning is essential for determining their willingness to implement and adopt gamification in education. To understand these attitudes, one must examine schools' levels of acceptance of such technologies (Marti-Parreno et al., 2016).

The implementation of gamification in learning is directly dependent upon school administration, and if a school's policy does not allow it, the teachers should not be blamed. Additionally, teachers' sex can play a role in their attitude toward learning and gamification. Marti-Parreno et al. (2016) suggested that male teachers exhibit more positive attitudes toward game-based learning approaches than do their female counterparts. Teachers' age is another factor that can determine their attitude toward the gamification of learning; according to Li (2017), older teachers exhibit reservations regarding using games in education, while younger teachers are generally enthusiastic regarding its implementation. Can and Cagiltay (2006) examined attitudes toward game-based learning among teachers in Turkey, and established that most teachers felt that gamification enhanced students' cognitive abilities. The study also reported that the students exhibited greater interest in studies that employed the use of games. This indicates that teachers should seek to employ gamification in most of their lessons. Despite the positive attitudes exhibited by teachers, however, most opt to use the games as a

supplementary approach rather than the main teaching model (Wu, 2015). Nevertheless, the Wu's (2015) participants unanimously agreed that gamification in learning helps improve student interest and educational experiences. Meanwhile, despite enhancing students' literacy, some video games can trigger violent actions in students due to gratification ideology among players. According to Kühn et al. (2019), increases in school shootings and killings can be attributed to violent video games. It is, therefore, the duty of teachers and parents to decide which video games are suitable for educational purposes.

Advantages and Disadvantages of Digital Game-Based Learning

In the past, game-based learning was based on the use of board games, Lego, and card games; however, technological advancements have led to the employment of digital games in classrooms worldwide, which in turn, has affected students both positively and negatively (Lester et al., 2017). As the overseers of digital game-based learning, teachers should apply the best teaching practices to amplify the positive effects of digital-game-based learning and diminish its adverse effects. According to Bundick et al. (2014), although many people in modern society view video games as idle activities, studies have revealed that digital-game-based learning has many positive qualities. Schaaf and Mohan (2016) also ascertained that digital forms of play are as crucial as physical play in regard to developing students' socio-cultural, cognitive, and physical growth. However, there are also adverse effects, especially in relation to playing virtual games. It is advised that teachers strive to minimize the negative effects while maximizing the positive effects.

Advantages

1) Student Motivation and Engagement

Student motivation and engagement are perhaps the clearest and most powerful reasons for integrating digital games in the classroom. The games use images, sounds, and colors to foster responsiveness in players; further, the games are structured to obtain maximum user attention.

2) Teamwork

Personal computers have become increasingly prevalent in the past few decades. Nowadays, almost all students can afford a tablet or a laptop in class, thereby enabling the employment of widespread digital game-based learning (Dichev & Dicheva, 2017). The advancement of Internet technologies has also afforded the integration of devices in institutions, allowing teachers to remotely control students' devices. This has enabled teachers to assign complex games to groups of students in which the students can work together over an online medium to solve the problems and puzzles in question. Playing online demands that students apply teamwork skills, such as communication and negotiation, to find the best solution to a given challenge.

3) Quick Feedback and Progress Record

Schaaf and Mohan (2017) established that technology used for educational purposes can also provide important

data for student progress reports. For instance, a language game such as Duolingo can report scores and progress throughout the game. These games give students instant feedback and reports on their progress, and also allow them to return to completed levels to improve their scores/results.

4) Creativity and Lateral Thinking

According to Li (2017), despite the common belief among parents and guardians that playing games is a waste of time for youths, youths perform copious creative decision-making in modern gameplay. The best example of games that foster such decision-making is sandbox games, in which the player controls an avatar that can freely explore a virtual world and make decisions (Hwang et al., 2015). These games build a sense of adventure in the game and allow the player to make independent decisions; thus, players can learn from bad decisions and avoid repeating them in the future. To promote resourcefulness and imagination, tutors can set guidelines on how students should play these games.

5) Risk-taking and Experimentation

Learning through computer-simulated worlds allows students to envision the real-world feasibility of certain choices, ideas, and structures. For instance, some computer-simulation software allows users to create bridges, houses, and other structures. Such environments allow students to take risks when designing these simulated structures, as there is no danger of incurring significant negative effects. If a decision does not work as anticipated, the student can simply use the “undo” tool or reset the design. This gives the student the opportunity to take risks and experiment, and also allows them to learn from their mistakes (Marti-Parreno et al., 2016). It is recommended, however, that the teacher balance computer simulations and reality to avoid twisting students’ perceptions of genuine elements and unrealistic elements.

6) Preparation for Future Jobs

Computer knowledge and computer literacy have gradually become fundamental requirements for many jobs. To be able to successfully perform such roles, students must be trained in the use of technology (Li, 2017). Moreover, providing students with good technological knowledge can have a positive influence on the likelihood of future technological advancement. Providing students with access to technology can allow them to work, study, and research whenever they need to. The Internet has made high-quality resources available to everyone with the knowledge and ability to access them. This can help students maintain their curiosity in technology-related ideas as they advance through learning institutions into college and, finally, into the professional world.

Disadvantages

1) Hindrance of Physical Play

One criticism of digital game-based learning is that it could contribute to a lack of physical exercise. While

digital games can present many mental exercises, they fail to provide physical exercise. Playing video games is a largely passive activity, unlike physical playing (Li, 2017). Therefore, teachers and parents should limit the time students spend playing video games to a maximum of 1–2 hours per day. They should also ensure that physical play and sports remain the core of students' activities (Boctor, 2013); in the long term, this can prevent health complications associated with physical inactivity.

2) *High Equipment Costs*

Although digital technology has become increasingly affordable in recent years, it still costs a lot of money. A school's ability to afford digital equipment depends on its financial resources. This can create a digital divide, with some students from financially poorer institutions lacking access to technological equipment that students at wealthier institutions can afford. Through this, a technological skill difference can grow between students from different institutions. Students from better-off schools can consequently be better prepared for future technology-related jobs than those from poorer schools, such as schools in developing nations. This digital divide could even be present among students in the same classroom.

Conclusion

It could be concluded that the advantages of adding game-based learning to the classroom far outweighs its disadvantages, which is in complete agreement with Marti-Parreno et al. (2016). For games to be educational and aid students, they must focus on the content to emphasize hypothetical models and should therefore be developed by scholars and teachers and be based on good academic philosophies. Teachers must also monitor game-based learning classes and ensure that when the students fail in a game or lose in a level, the student is not adversely affected but instead encouraged to do better in future. It is also upon the teachers to teach their students that succeeding in a game is not the ultimate goal and that they should not look down on their opponents who lose. The teacher should ensure that the game-based learning engages and motivates students while also developing a growth mindset.

References


- Boctor, L. (2013). Active-learning strategies: The use of a game to reinforce learning in nursing education. A case study. *Nurse education in practice*, 13(2), 96-100. <https://doi.org/10.1016/j.nepr.2012.07.010>
- Bundick, M., Quaglia, R., Corso, M., & Haywood, D. (2014). Promoting student engagement in the classroom. *Teachers College Record*, 116(4). <https://eric.ed.gov/?id=EJ1020319>
- Can, G., & Cagiltay, K. (2006). Turkish prospective teachers' perceptions regarding the use of computer games with educational features. *Educational Technology & Society*, 9(1), 308-321. <https://eric.ed.gov/?id=EJ836713>
- Chen, C., Liu, J., & Shou, W. (2018). How competition in a game-based science learning environment influences students' learning achievement, flow experience, and learning behavioral patterns. *Journal of Educational Technology & Society*, 21(2), 164-176. <http://www.jstor.org/stable/26388392>

- Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review? *International Journal of Education Technology in Higher Education*, 14(1), 9. <https://doi.org/10.1186/s41239-017-0042-5>
- Dostál, J. (2015). Theory of problem-solving. *Procedia-Social and Behavioral Sciences*, 174, 2798-2805. <https://doi.org/10.1016/j.sbspro.2015.01.970>
- Grace, L. (2019). *Doing things with games: Social impact through play*. Routledge.
- Hwang, G. J., Wu, P. H., Chen, C. C., & Tu, N. T. (2016). Effects of an augmented reality-based, educational game on students' learning achievements and attitudes in real-world observations. *Interactive Learning Environments*, 24(8), 1895-1906. <https://doi.org/10.1080/10494820.2015.1057747>
- Kucher, T. (2021). Principles and best practices of designing digital game-based learning environments. *International Journal of Technology in Education and Science (IJTES)*, 5(2), 213-223. <https://doi.org/10.46328/ijtes.190>
- Kühn, S., Kugler, D. T., Schmalen, K., Weichenberger, M., Witt, C., & Gallinat, J. (2018). Does playing violent video games cause aggression? *A Longitudinal Intervention Study. Molecular Psychiatry*, 1-15. <https://doi.org/10.1038/s41380-018-0031-7>
- Kula, S. S. (2021). Mind games with the views of classroom teachers. *International Journal of Research in Education and Science (IJRES)*, 7(3), 747-766. <https://doi.org/10.46328/ijres.1471>
- Lester, J. C., Spires, H. A., Nietfeld, J. L., Minogue, J., Mott, B. W., & Lobene, E. V. (2014). Designing game-based learning environments for elementary science education: A narrative-centered learning perspective. *Information Sciences*, 264, 4-18. <http://doi.org/10.1016/j.ins.2013.09.005>
- Li, C. (2017). *Attitudes towards digital game-based learning of Chinese primary school English teachers*. British Council, 1-118.
- Marti-Parreno, J., Segui-Mas, D., & Segui-Mas, D. (2016). Teachers' attitude towards and actual use of gamification. *Procedia - Social and Behavioral Sciences*, 228, 682 – 688. <http://doi.org/10.1016/j.sbspro.2016.07.104>
- Mozelius, P., & Hettiarachchi, E. (2017). Critical factors for implementing blended learning in higher education. *International Journal of Information and Communication Technologies in Education*, 6(2), 37-51. <https://doi.org/10.1515/ijicte-2017-0010>
- Pho, A., & Dinscore, A. (2015). *Game-based learning*. Tips and trends.
- Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. *Educational Psychologist*, 50(4), 258-283. <http://doi.org/10.1080/00461520.2015.1122533>
- Rowe, J. P., Shores, L. R., Mott, B. W., & Lester, J. C. (2011). Integrating learning, problem solving, and engagement in narrative-centered learning environments. *International Journal of Artificial Intelligence in Education*, 21(1-2), 115-133. <https://doi.org/10.3233/JAI-2011-019>
- Rowe J. P., & Lester J. C. (2015). Improving student problem solving in narrative-centered learning environments: A modular reinforcement learning framework. In C. Conati, N. Heffernan, A. Mitrovic, & M. Verdejo (Eds.), *AIED 2015: Artificial Intelligence in Education* (pp. 419-428). Springer, Cham. https://doi.org/10.1007/978-3-319-19773-9_42
- Schaaf, R., & Mohan, N. (2016). *Game on: Using digital games for 21st-century teaching, learning, and assessment*. Solution Tree Press.

- Syafii, M. L., Kusnawan, W., & Syukroni, A. (2020). Enhancing listening skills using games. *International Journal on Studies in Education (IJonSE)*, 2(2), 78-107. <https://doi.org/10.46328/ijonse.21>
- Taub, M., Mudrick, N. V., Azevedo, R., Millar, G. C., Rowe, J., & Lester, J. (2017). Using multi-channel data with multi-level modeling to assess in-game performance during gameplay with Crystal Island. *Computers in Human Behavior*, 76, 641-655. <http://doi.org/10.1016/j.chb.2017.01.038>
- Whitton, N. (2011). Game engagement theory and adult learning. *Simulation & Gaming*, 42(5), 596-609. <https://doi.org/10.1177%2F1046878110378587>
- Wu, M. L. (2015). Teachers' experiences, attitudes, self-efficacy, and perceived barriers to the use of digital game-based learning: A survey study through the lens of a typology of educational digital games. *Michigan State University*, 1-152.

Author Information

Assistant Professor Surattana Adipat, Ph.D.

 <https://orcid.org/0000-0002-2433-1547>

Ramkhamhaeng University

Faculty of Education


2086 Ramkhamhaeng Road, Huamak

Bangkapi, Bangkok 10240

Thailand

Contact e-mail: ajsurattana@gmail.com

Assistant Professor Kittisak Laksana, Ph.D.

 <https://orcid.org/0000-0001-6002-6841>

Ramkhamhaeng University


Faculty of Education

2086 Ramkhamhaeng Road, Huamak

Bangkapi, Bangkok 10240

Thailand

Assistant Professor Kanrawee Busayanon, Ph.D.

 <https://orcid.org/0000-0002-4971-6064>

Ramkhamhaeng University


Faculty of Education

2086 Ramkhamhaeng Road, Huamak

Bangkapi, Bangkok 10240

Thailand

Alongkorn Ausawasowan

 <https://orcid.org/0000-0002-7456-2773>

Ramkhamhaeng University


Faculty of Education

2086 Ramkhamhaeng Road, Huamak

Bangkapi, Bangkok 10240

Thailand

Boonlit Adipat, Ph.D.

 <https://orcid.org/0000-0003-2083-1920>

Ministry of Digital Economy and Society

120 Moo 3, The Government Complex

Building B 6 Floor, Chaeng Watthana Road

Laksi, Bangkok 10210

Thailand