A digital game for preserving food cultural heritage: design and evaluation of ThaiFoodAdventure game

Kannattha Chaisriya[1], Lester Gilbert[2], Ratchada Suwangerd[3], Sasithorn Rattanarungrot[1]
[1]Department of Multimedia Technology Animation and Game, School of Informatics, Walailak University, Nakhon Si Thammarat, Thailand
[2]Department of Electronics and Computer Science, University of Southampton, Southampton, United Kingdom
[3]Department of Accounting, School of Management, Walailak University, Nakhon Si Thammarat, Thailand

Article Info

ABSTRACT

Digital games are a powerful tool for the presentation of food cultural heritage. A digital game was designed and developed to raise and enhance young people's interest in and knowledge of Thai food cultural heritage, currently an under-researched field. The platform game was played on a mobile device and required the collection of food ingredients appropriate to popular cuisine in four Thai regions while overcoming obstacles. A sample (N=61) of young people (mean age=19 years) played the game, and the differences in their pre and post-test knowledge of and interest in Thai food and its cultural heritage were analyzed. The findings showed a highly significant increase in interest in and knowledge of Thai food cultural heritage, and did so despite the opinion of some participants that learning games were less interesting than conventional games, or that games were not a good way of raising interest in cultural heritage.

Corresponding Author:

Ratchada Suwangerd
Department of Accounting, School of Management, Walailak University
222 Thaiburi, Thasala district Nakhon Si Thammarat 80160, Thailand
Email: sratchad@mail.wu.ac.th

1. INTRODUCTION

Food cultural heritage is a highly valued and distinctive characteristic of a region which covers ingredients, preparation, cooking methods, and eating decorum [1], contributing to its recognition and reputation, and positively influencing its economy [2]. It may be part of a national ethos that brings people together and builds a nation's character [3]. Thailand is giving greater attention to preserving the tradition and authenticity of its food heritage. A four-year master plan to preserve authentic Thai cuisine from the increasing influence of foreign dishes is to be implemented between 2020 and 2024 [4]. However, food is an intangible cultural heritage that is harder to preserve than physical objects as it concerns the values, beliefs, behaviors, and rules of society. It may be lost if it is not appropriately recorded, preserved, and broadly promoted [3], and so increasing public interest and knowledge of food culture heritage is imperative.

One way to raise public interest in cultural heritage is through a digital game. Games have become a part of today's culture as much as books, movies, and other forms of media [5]–[7]. In his 1938 work Homo Ludens, Huizinga [8] noted that play is an essential component of all human culture. Generations of digital natives, immersed in the culture of computers and the internet, have grown up with video games and digital technology [9], [10]. Three out of every four people in the U.S. play video games and gamers average 14 hours per week playing video games, up from the 12 hours per week in 2018 [11]. Globally, the video game industry has grown extensively, with a market worth estimated at $138.4 billion in 2021 and a

demographically diverse audience with an even gender split [12]. When it comes to raising young people's awareness of culture heritage, this should be presented in an attractive and appealing way [13].

In their 2014 paper, Mortara *et al.* [14] investigated the usage of serious games for cultural heritage purposes. The authors divided serious games into the categories: i) cultural awareness, ii) historical reconstruction, and iii) heritage awareness. "ICURA" is a significant representation of games for heritage purposes [6]. It implemented an immersive 3D adventure game for educational use to understand contemporary Japanese culture and etiquette, either for pre-trip planning or for raising one's interest in another culture. Similarly, Huang and Huang [15] proposed "Papakwaqa" game for enhancing young people's interest in and knowledge of Taiwanese indigenous cultural heritage. This project deals with food cultural heritage that is not well researched. One example for preserving food cultural heritage was presented by Cao *et al.* [16] whose project researched the interaction design of a mobile game for providing a holistic experience of Chinese cooking home dishes. The authors mapped gravity and touch-screen sensors of the mobile device to the features of Chinese cooking culture to offer players realistic and lively experiences when cooking home dishes in the game. Similarly, Widjaja [17] used modern game mechanics such as loot boxes for raising player interest in a food heritage game.

Digital games can present intangible cultural artifacts in interactive and dynamic ways, providing appeal and engagement for all user ages by integrating fun and learning [16], [18]–[21]. Playing digital games has proven benefits regarding cognitive, motivational, emotional, social, and behavioral skills of the player [22]. These benefits may make digital games a powerful tool for increasing knowledge of and interest in cultural heritage. Much effort has been put into recreating artifacts of tangible cultural heritage, such as ruins, cities, and monuments, and virtual environments and applications provide high level of user immersion [23]–[27]. However, the use of digital games to raise young people's interest in local food heritage is not well researched [18], [22]. The contributions of this study are: i) a mobile platform game for enhancing young people's knowledge in Thai food cultural heritage, ii) a mobile platform game for raising young people's interest in Thai food cultural heritage, and iii) a better understanding that:
- Participants who thought games were good for knowledge showed increased interest in the topic, apart from any increased knowledge.
- Participants who were unconvinced that games would raise interest in heritage nevertheless showed significantly increased interest in Thai heritage cuisine.
- The game resulted in a highly significant increase in interest in and knowledge of Thai food cultural heritage, and did so despite the opinion of some participants that learning games were less interesting than conventional games.

In this paper, we present the ThaiFoodAdvanture game, which raises young people's interest in and knowledge of Thai food cultural heritage. The remainder of this paper is organized. Section 2 gives a brief review of the related work. Section 3 outlines the design of ThaiFoodAdvanture Game. Section 4 presents the research method. Section 5 shows research results and discussion. Section 6 concludes the paper and suggests some future work.

2. DESIGN OF THAIFOODADVENTURE GAME
2.1. Game concept and game states

ThaiFoodAdventure game is a mobile platform game that is designed to stimulate a player's interest in Thai food cultural heritage and enhance young people's knowledge of their local food heritage. The game requires a player to maneuver their character across platforms to collect the food ingredients that are scattered over the game environment while avoiding non-player characters (NPCs) in order to gain Thai food cuisine items as rewards. ThaiFoodAdventure consists of three game states which are the initial state, the level selection state, and the play state. Figure 1 shows examples of ThaiFoodAdventure game scene. In the initial state, the opening scene presents the game's atmosphere of cooking as shown in Figure 1(a). The level selection state supports the players' recognition of Thai regional cuisines. A player selects a region from the region scene and the food from the food scene. The region scene consists of four Thai regional cuisines: northern, northeastern, central, and southern as shown in Figure 1(b). The food scene consists of three foods which are popular regional cuisines. For example, if the player selects the northeastern region, the food scene will show spicy minced pork salad (larb moo) and pork sour sausage (sai krok isan) as shown in Figure 1(c), and green papaya salad (somtam) as shown in Figure 1(d). In the play state, there are two scenes: the mission scene and the play scene. To win the game, the player must complete all the game levels. Figure 2 shows examples of the mission scene and the play scenes of the ThaiFoodAdventure game. The mission scene introduces the mission and the food ingredients. For example, if a player selects the green papaya salad, the mission scene shows the ingredients for cooking the green papaya salad which are sliced green papayas as shown in Figure 2(a), fermented fish as shown in Figure 2(b), fish sauce, chilies, palm sugar, lemon juice, sliced green eggplants, sliced tomatoes, garlic, and monosodium glutamate (MSG). The play scene asks a

player to collect food ingredients while avoiding NPCs. The play scene graphics differ according to the region to maintain player interest. For example, the southern Thailand region play scene presents sea-oriented graphics as shown in Figure 2(c) and crab NPCs as shown in Figure 2(d).

Figure 1. Examples of ThaiFoodAdventure game scene for (a) the opening scene, (b) the region scene, (c) the food scene: pork sour sausage, and (d) the food scene: green papaya salad

Figure 2. Examples of the mission scene and the play scenes of the ThaiFoodAdvanture game for (a) Mission scene: sliced green papayas, (b) mission scene: fermented fish, (c) the southern Thailand region play scene, and (d) the crab NPCs

2.2. Game characters and game items

Game characters consist of two parts: player's avatar, and non-player character (NPC). The Figure 3 shows examples of game characters and game items of ThaiFoodAdventure game. The player's avatar is based on a Thai male chef named Khao Oat. The chef's costume consists of a chef's hat, a chef's shirt, and the traditional Thai chef's red loincloth pants as shown in Figure 3(a). Non-player characters consist of the four NPCs of boar, crab, chicken, and gecko are based on animals that live in Thailand, as shown in Figure 3(b). NPCs are placed as obstacles to impede player progression. When the player moves close to NPC, the player loses 1 health point from the three they start with, as shown in Figure 3(c). When the player plays ThaiFoodAdventure game, the player collects two game item types: food ingredients and Thai food

cuisine. Food ingredient images illustrate their color, shape, and texture as shown in Figure 3(d), and Figure 3(e) shows Thai food cuisine items as a reward for a player when they complete the game level for the region, as shown in Figure 3(f).

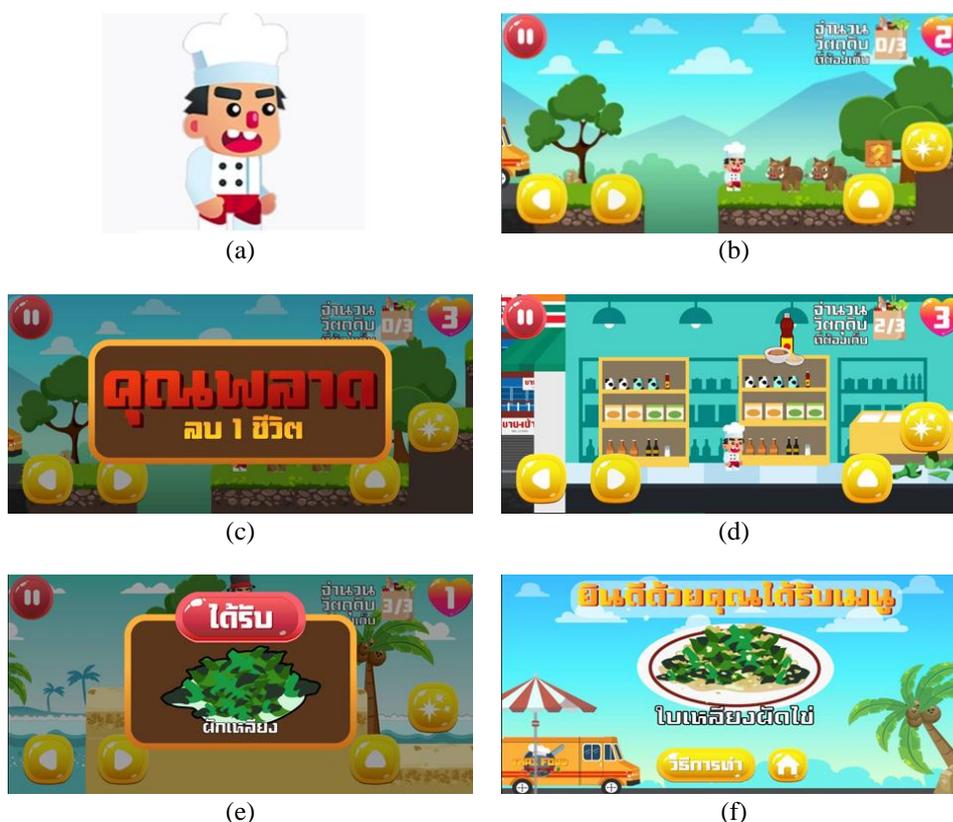| (a) | (b) |
| (c) | (d) |
| (e) | (f) |

Figure 3. Examples of game characters and game items of ThaiFoodAdventure game for
(a) the player's avatar, (b) example of the boar NPCs, (c) the game feedback when players lose a health point,
(d) food ingredients in the game scene, (e) the feedback when a player collects a food ingredient item, and
(f) an example of the game reward when a game level is completed

3. METHOD

Students at Walailak University were asked to participate in the experiment which was granted ethics approval (reference WUEC-21-118-01). At the start, demographic data and information about the participant's mobile usage and game experience were collected. A pre-test assessment measured the participant's knowledge of Thailand's regional cuisines. Participants then played the game for approximately 1 hour. They then completed a post-test assessment of knowledge consisting of the same questions as in the pre-test and a final questionnaire concerning their experiences and opinions of the game, their learning process, and the game user interface.

4. RESULTS AND DISCUSSION
4.1. Results of pre-questionnaire

A total of 61 players completed the experiment of which 39 were male and 22 were female. On average they were 19 years old (M=19.26; SD=2.62). Fifty-five participants (90%) considered themselves beginners or advanced video gamers, and 6 considered themselves experts. Most participants reported spending between one and three hours per day playing video games. All participants reported playing digital games daily, mainly on PCs and mobile phones. Participants were asked to rate their opinion using a 5-point Likert scale (1 strongly disagree, 5 strongly agree) on: whether they considered learning games as interesting as conventional games, where they showed moderate agreement (M=3.26; SD=0.97); whether games are a good tool for communicating knowledge, where they showed agreement (M=4.49; SD=0.88); and whether games can raise people's interest in cultural heritage, where they showed agreement (M=4.15; SD=1.01).

4.2. Results of post-questionnaire

After playing the ThaiFoodAdventure game and the post-test, participants completed a final questionnaire. They moderately agreed that that they enjoyed learning using the ThaiFoodAdventure game, (M=3.61, SD=1.05), and moderately agreed that they enjoyed learning about ingredients for cooking Thailand's regional cuisines (M=3.81, SD=1.04). The participants agreed they enjoyed the gameplay (M=4.11, SD=1.09), user interface (M=4.05, SD=1.09), and landscape (M=3.97, SD=1.11). However, they reported neutral agreement on their use of the virtual player controller (M=3.00, SD=1.09).

4.2.1. Game effectiveness

The pre-test and post-test consisted of the same 8 questions of knowledge. Four questions dealt with Thailand's regional dishes and 4 with ingredients. Before and after playing the game, participants rated their interest in Thai regional dishes and associated ingredients using a 5-point Likert scale (1 strongly uninterested, 5 strongly interested). The two interest ratings were added to give an overall interest score.

A multivariate repeated measures analysis was conducted [28] to compare the effect of playing the ThaiFoodAdventure game on participants' knowledge of and interest in Thai food cultural heritage. The multivariate test comparing the pre-game and post-game measures of knowledge and interest was statistically significant (Pillai's Trace=0.59, F=42.2, df=2 and 59, p<.001). Univariate tests were then conducted on the measures of knowledge and interest separately. The average post-test knowledge score was significantly higher than the pre-test average (F=47.6, df=1 and 61, p<.001), as was the average post-game interest score (F=38.9, df=1 and 60, p<0.001). Figure 4 shows the profile graph of the pre- and post-test for Figure 4(a) the changes in knowledge and Figure 4(b) the changes in interest.
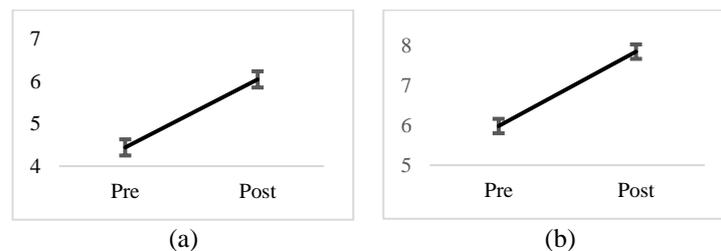

Figure 4. The profile graph of the pre- and post-test for (a) the pre- and post-game scores of knowledges and (b) the pre and post-game scores of interests in Thai food cultural heritage (error bar ±1SE)

4.2.2. Predicting game effectiveness

A change score was calculated for each participant's knowledge and interest as the difference between their post-game and pre-game scores. These change scores were then regressed against predictors: the demographic variables of sex, hours per week playing video games (TotHrs), and reported Skill; the pre-game opinions of whether learning games were as interesting as conventional (LearnConv), whether games were a good tool for communicating knowledge (GoodTool), and whether games can raise interest in cultural heritage (RaiseInt); and the pre-game scores of knowledge (pre_Know) and interest (Pre_Int_CI). Backward regression of these variables against change in knowledge showed two significant predictors (R=0.6, F=16.6, df=2 and 58, p<.001) of Pre-Know (beta=-.55, t=-5.3, p<.001) and LearnConv (beta=-.25, t=-2.4, p=.02), and against change in interest showed three significant predictors (R=0.89, F=72.6, df=3 and 57, p<.001) of Pre_Int_CI (beta=-.91, t=-14.7, p<.001), RaiseInt (beta=-.26, t=-3.0, p=.004), and GoodTool (beta=.2, t=2.7, p=.009).

5. CONCLUSION

Participants who played the ThaiFoodAdventure game showed highly significant increases, on average, in their knowledge of, and interest in, Thai cuisine. Regression analysis showed that these increases were limited by a ceiling effect. Greater increases were shown by participants with lower pre-game scores suggesting that participants with higher pre-game scores already possessed good knowledge and interest and were limited in their ability to show any marked increase. This ceiling effect suggests that future instruments for measuring knowledge and interest should be designed with more room for participants to show increases, but does not affect the main findings of the study. Regression analysis showed that, of the other variables measured, most were not significant predictors of increased knowledge or increased interest following

playing the game. Increased knowledge of Thai cuisine was associated only with the opinion that learning games were less interesting than conventional games. This is a somewhat surprising finding, but also a welcome finding, in that participant who were unconvinced of the benefits of learning games nevertheless showed significant learning gains after playing the ThaiFoodAdventure game.

Increased interest in Thai cuisine was associated with the opinion that games were a good tool for communicating knowledge, but also with the opinion that games would not raise people's interest in cultural heritage. The first finding is interesting in that participants who thought games were good for knowledge showed increased interest in the topic, apart from any increased knowledge. The second finding is, as previously, somewhat surprising but also welcome, in that participant who were unconvinced that games would raise interest in heritage nevertheless showed significantly increased interest in Thai heritage cuisine. The ThaiFoodAdventure game successfully enhanced young people's knowledge of and raised their interest in Thai food heritage Thai regional cuisines and did so despite the opinion of some participants that learning games were less interesting than conventional games, or that games were not a good way of raising interest in cultural heritage. Future research with the game should provide for an improved introduction to the game mechanics to address some comments which were made about the user interface, and the measures of knowledge and interest should be made less sensitive to ceiling effects to address the issue that participants with already good knowledge and interest were restricted in their ability to demonstrate further increases.

ACKNOWLEDGEMENTS

REFERENCES

[1]   J. Bessiere, "Local development and heritage: traditional food and cuisine as tourist attractions in rural areas," *Sociologia Ruralis*, vol. 38, no. 1, pp. 21–34, Apr. 1998, doi: 10.1111/1467-9523.00061.
[2]   R. Takaki, *Strangers from a different shore Kindle Edition*. Ward and Balkin Agency, Inc., 2012.
[3]   A. M. Ramli, M. S. M. Zahari, M. Z. Suhaimi, and F. Faat, "Knowledge and awareness on the food heritage: A gendered view," in *Heritage, Culture and Society: Research agenda and best practices in the hospitality and tourism industry-Proceedings of the 3rd International Hospitality and Tourism Conference, IHTC 2016 and 2nd International Seminar on Tourism, ISOT 2016*, 2016, pp. 625–630. doi: 10.1201/9781315386980-110.
[4]   S.-A. Seubsman, M. Kelly, P. Yuthapornpinit, and A. Sleigh, "Cultural resistance to fast-food consumption? A study of youth in North Eastern Thailand," *International Journal of Consumer Studies*, vol. 33, no. 6, pp. 669–675, Nov. 2009, doi: 10.1111/j.1470-6431.2009.00795.x.
[5]   M. Ćosović and B. R. Brkić, "Game-based learning in museums-cultural heritage applications," *Information*, vol. 11, no. 1, 22, Dec. 2019, doi: 10.3390/info11010022.
[6]   J. Froschauer, I. Seidel, M. Gartner, H. Berger, and D. Merkl, "Design and evaluation of a serious game for immersive cultural training," in *16th Int. Conference on Virtual Systems and Multimedia*, 2010, pp. 253–260. doi: 10.1109/VSMM.2010.5665978.
[7]   J. Froschauer, M. Arends, D. Goldfarb, and D. Merkl, "A serious heritage game for art history: Design and evaluation of ThIATRO," in *18th Int. Conference on Virtual Systems and Multimedia*, 2012, pp. 283–290. doi: 10.1109/VSMM.2012.6365936.
[8]   J. Huizinga, *Homo ludens Ils 86*. New York: Routledge, 2014. doi: 10.4324/9781315824161.
[9]   H. C. Davies and R. Eynon, "Is digital upskilling the next generation our 'pipeline to prosperity'?," *New Media and Society*, vol. 20, no. 11, pp. 3961–3979, Nov. 2018, doi: 10.1177/1461444818783102.
[10]   A. J. Moshayedi, Z. Chen, L. Liao, and S. Li, "Kinect based virtual referee for table tennis game: TTV (table tennis var system)," in *Proc. 6th Int. Conf. on Inform. Science and Control Engineering*, 2019, pp. 354–359. doi: 10.1109/ICISCE48695.2019.00077.
[11]   The NPD Group, "There is a general trend towards more significant gaming engagement overall in the midst of COVID-19." 2020. Accessed: Jul. 01, 2021. [Online]. Available: https://online.lovetoknow.com/how-many-people-play-video-games
[12]   J. Clement, "Value of the global video games market from 2012 to 2021," *Statista*, 2021.
[13]   R. Wojciechowski, K. Walczak, M. White, and W. Cellary, "Building virtual and augmented reality museum exhibitions," in *Proceedings of the ninth international conference on 3D Web technology-Web3D '04*, 2004, p. 135. doi: 10.1145/985040.985060.
[14]   M. Mortara, C. E. Catalano, F. Bellotti, G. Fiucci, M. Houry-Panchetti, and P. Petridis, "Learning cultural heritage by serious games," *Journal of Cultural Heritage*, vol. 15, no. 3, pp. 318–325, May 2014, doi: 10.1016/j.culher.2013.04.004.
[15]   C.-H. Huang and Y.-T. Huang, "An annales school-based serious game creation framework for taiwanese indigenous cultural heritage," *Journal on Computing and Cultural Heritage*, vol. 6, no. 2, pp. 1–31, May 2013, doi: 10.1145/2460376.2460380.
[16]   S. Cao, D. Han, and X. Han, "Research on interaction design of chinese cooking game based on handheld mobile devices," in *2014 Sixth International Conference on Intelligent Human-Machine Systems and Cybernetics*, Aug. 2014, vol. 1, pp. 164–167. doi: 10.1109/IHMSC.2014.48.
[17]   J. J. Widjaja, "Dishcover Indonesia: android cooking game on Indonesian cuisine," *Journal of Games, Game Art, and Gamification*, vol. 3, no. 2, pp. 43–49, Oct. 2021, doi: 10.21512/jggag.v3i2.7254.
[18]   B. Bontchev, "Serious games for and as cultural heritage," in *Digital Presentation and Preservation of Cultural and Scientific Heritage*, 2017, vol. 5, pp. 43–58.
[19]   F. L. Khaleel, N. S. Ashaari, and T. S. M. Tengku Wook, "The impact of gamification on students learning engagement," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 10, no. 5, pp. 4965–4972, Oct. 2020, doi: 10.11591/ijece.v10i5.pp4965-4972.
[20]   Y. Udjaja, V. S. Guizot, and N. Chandra, "Gamification for elementary mathematics learning in Indonesia," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 8, no. 5, pp. 3860–3865, Oct. 2018, doi: 10.11591/ijece.v8i5.pp3860-3865.

[21] D. Kuswardhana, S. Hasegawa, and J. Juhanaini, "The instructional thematic game for children with mild mental retardation: for enhancement of left-right recognition skill," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 7, no. 1, pp. 469–478, Feb. 2017, doi: 10.11591/ijece.v7i1.pp469-478.

[22] I. Granic, A. Lobel, and R. C. M. E. Engels, "The benefits of playing video games," *American Psychologist*, vol. 69, no. 1, pp. 66–78, Jan. 2014, doi: 10.1037/a0034857.

[23] H. Granström, "Elements in games for virtual heritage," University of Skövde, 2013.

[24] N. Ibrahim, N. Mohamad Ali, and N. F. Mohd Yatim, "Cultural learning in virtual heritage: an overview," in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, vol. 7067 LNCS, no. PART 2, 2011, pp. 273–283. doi: 10.1007/978-3-642-25200-6_26.

[25] C. Yang, D. Peng, and S. Sun, "Creating a virtual activity for the intangible culture heritage," in *16th International Conference on Artificial Reality and Telexistence-Workshops (ICAT'06)*, 2006, pp. 636–641. doi: 10.1109/ICAT.2006.52.

[26] E. F. Anderson, L. McLoughlin, F. Liarokapis, C. Peters, P. Petridis, and S. de Freitas, "Developing serious games for cultural heritage: a state-of-the-art review," *Virtual Reality*, vol. 14, no. 4, pp. 255–275, Dec. 2010, doi: 10.1007/s10055-010-0177-3.

[27] A. Gaitatzes, D. Christopoulos, and G. Papaioannou, "The ancient olympic games: being part of the experience," *Proceedings of the 5th International Symposium on Virtual Reality, Archaeology and Intelligent Cultural Heritage (VAST)*, pp. 1–10, 2004, doi: 10.2312/VAST/VAST04/019-028.

[28] IBM, "IBM SPSS advanced statistics 24," *IBM*, 184, 2016.

BIOGRAPHIES OF AUTHORS

Kannattha Chaisriya ⓘ 🔍 SC Ⓟ received a PhD in Computer Science in University of Southampton, United Kingdom, in 2016. She is a lecturer at Department of Multimedia Technology Animation and game, School of Informatics, Walailak University, Nakhon Si Thammarat, Thailand. Her expertise is doing research in the field of digital games, multimedia technology, mobile applications, and web technology. She can be contacted at email: csomjit@wu.ac.th.

Lester Gilbert ⓘ 🔍 SC Ⓟ is an Associate Professor at the University of Southampton, United Kingdom. He lectures on e-Learning and Technology Enhanced Learning at the University of Southampton, Southampton, United Kingdom. His book (co-authored with Veronica Gale) "Principles of e-Learning Systems Engineering" (Chandos, 2008) integrates his practical experience of information systems and multimedia and computer aided instruction development. He can be contacted at email: lg11@soton.ac.uk.

Ratchada Suwangerd ⓘ 🔍 SC Ⓟ is an Assistant Professor at Walailak University, Thailand. She is a lecturer at Department of Accounting, School of Management, Walailak University, Nakhon Si Thammarat, Thailand. Her expertise is doing research in the field of accounting and taxation, the game application for teaching accounting. She can be contacted at email: sratchad@wu.ac.th.

Sasithorn Rattanarungrot ⓘ 🔍 SC Ⓟ received a PhD in Informatics (Multimedia and Animation) at University of Sussex, United Kingdom, in 2016. She is a lecturer at Department of Multimedia Technology Animation and game, School of Informatics, Walailak University, Nakhon Si Thammarat, Thailand. Her discipline is related to augmented reality (AR), mobile AR systems, service-oriented architecture (SOA) frameworks and applications. She can be contacted at email: rsasitho@wu.ac.th.