Chapter #

CONTEXT-AWARE MOBILE ROLE PLAYING GAME FOR LEARNING

Chris Lu[1], Maiga Chang[1], Kinshuk[1], Echo Huang[2], and Ching-Wen Chen[2]
[1]*School of Computing and Information Systems, Athabasca University, Canada*
[2]*Department of Information Management, National Kaohsiung First University, Taiwan*

1. INTRODUCTION

With mobile platform features such as portability, multi-media capacity, wireless Internet access, sensor technologies and location-aware potential [p,q], mobile applications are widely used and bring opportunities to various application domains in our daily lives, including education, transportation, healthcare, tourism, and training.

While e-learning pedagogy is mainly compatible with the classroom paradigm, m-learning has made learning occur in the field [22]. With mobile devices' help, learning systems are capable of providing users immersive learning experiences in authentic learning environments. For instances, users can learn rainforest plants and ecology in the Amazon River zone of a botanic garden [7,9,21,47]. Mobile educational games further get users motivated while learning in museums and historical sites [8,45].

The research team of context-aware sub-project of a 5-year renewable national research program in Canada, namely the NSERC/iCORE/Xerox/Markin research chair program, proposed and designed a context-aware educational game-based mobile application in 2010, namely CAMEG [26-28]. The proposed mobile educational game can generate inquiry-based learning activities for users according to their needs (i.e., the course they take under formal learning situation and the knowledge they want to know more under informal learning situation) and the surrounding context. The usability of the game was confirmed [29].

To make the generated learning activities more attractive to users, a new version of the game, namely CAMRPG [30], then was further designed and developed in 2011. The research team implemented a story generation engine based on narrative theory [10,36,48]. The generated stories were used for decorating the learning activities so students might feel that they live in the game world and role play an actor, explore the game world, complete the quests, and learn something.

Two pilots had been conducted and questionnaires were designed and used to gather users' gaming and smartphone using experiences, computer game attitudes, acceptances toward the game, perceived usability toward the game. The data had been collected and analyzed with quantitative analysis approaches include independent t-test, regression, and path analysis for assessing various hypotheses. This chapter summarizes important findings and discussion. More detailed research methodology, results and findings can be found in individual papers [29,31-34].

2. LITERATURE REVIEW

Wu and colleagues argue that context-aware ubiquitous learning enables students to interact with learning objects in the real world with the supports from the digital world. They proposed an expert system which can provide students effective context-aware learning activities based on the domain knowledge [44,46]. Li et al. use students' ubiquitous learning logs to help them recall what they have learned via the automatically generated yes/no and multiple choice quizzes [25]. With the help of analyzing the ubiquitous learning logs (including the location information), the researchers are able to detect whether the students are near to where they have visited and whether the places have learning logs of other students. Furthermore, the learning habits can be caught and used for making recommendation for the students to encourage them to learn. With the use of the expert system, students' cognitive abilities like analyzing and evaluating have been significantly improved. It is important for a mobile learning system being context-aware; hence, the research team chooses to create an interesting context-aware mobile game for students learning domain knowledge.

There are many different game genres [1], and two of them seem to be rather suitable for educational purposes: adventure games and role-playing game [13,35]. During the adventure journey of the gameplay in these games, players may encounter missions, tasks, and puzzles. The implicit knowledge or solutions for these quests require players' judgments and reactions. The challenges that a game gives to the players and the pleasure experiences that players gain from achievements in the game also motivate them to play the

game continuously and foster their comprehensive understanding of domain knowledge.

A game without the story could not keep players even it has shiny graphics. Parker & Lepper examine the effect of using fantasy context in teaching materials and find students having significant greater learning outcome than normal group [39]. Dickey presents an overview of game genres and analyzes how important narrative in educational game design [11]. Rowe, McQuiggan, & Lester also find story is capable of pulling students into the plots and increasing their motivation for learning [41]. Some researchers also propose that the use of narrative design in the game gives players empathy toward the characters (i.e., have pity toward the victim character or feel responsibility like a hero). The generated fun and empathy of games attract players to be involved constantly [2].

Agent is a computer program which is capable of acting autonomously and learning continuously to meet its design objectives [4,37]. In multi-agent system, many agents can work together to reach the system goal by satisfying users' needs [24,43]. Balaji and Srinivasan summarize the benefits of multi-agent systems as [3]: (1) increased speed and efficiency because agents are working in parallel and asynchronously; (2) increased reliability and robustness since it is unlikely that all agents will fail at the same time; (3) increased scalability and flexibility since agents can be added at any time when needed; (4) reduced computational and communication costs due to the non-centralized architecture; and (5) high reusability because agents can be easily replaced or upgraded. Many other researchers have also applied the multi-agent concept to learning management and mobile educational system design, and have reported good results in system scalability [5,12,49].

In summary, multi-agent-based architecture not only allows different agents to have different responsibilities, but also provides an expandable way to develop further functions. For instance, new agents can be put into the game for special purpose and old agents can be replaced with new and more functional ones. Multi-agent system design principles were adopted into the game design; hence, the game could run on different smartphones easily with the help of multiple agents [28].

3. GAME DESIGN

3.1 Learning Activity Generation

Wu and colleagues propose a ubiquitous knowledge structure for museum learning and elementary-level botanic learning [44]. It has been

proven to be a good way to store the knowledge that learning objects (in the real world) and materials (in the textbook) in one single knowledge structure. Its hierarchical structure is easy to understand and manage for general administrators (e.g., school teachers and system managers) and there is no specific rule for building a knowledge structure. In addition, a single structure can store knowledge associated with multiple domains/disciplines. Fig. 1 shows the altered context-awareness knowledge structure.

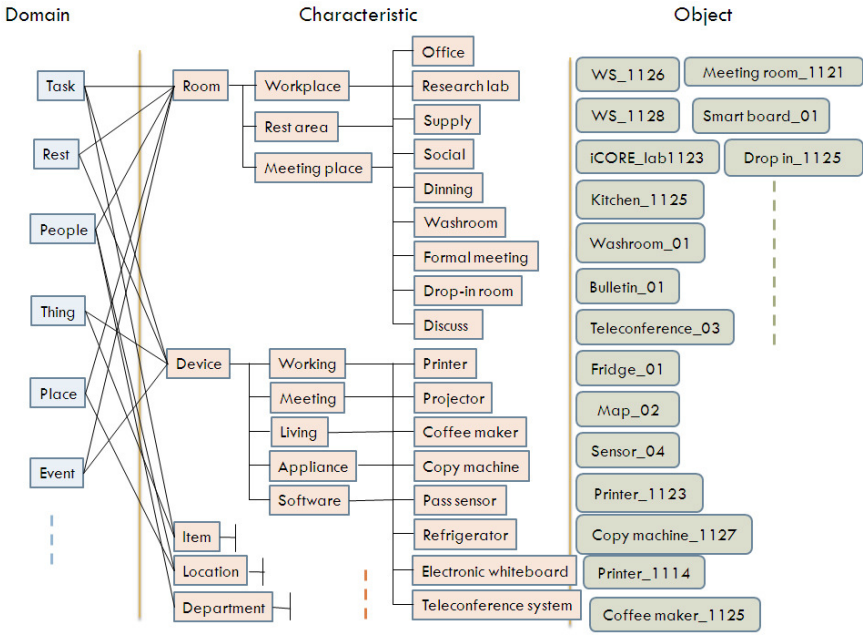

Figure #-1. Partial ubiquitous knowledge structure of an authentic learning environment.

Three layers of the ubiquitous knowledge structure were adopted to build the context-awareness knowledge structure of the authentic learning environment in which the mobile game takes place. The domain layer represents learning topics and domains that users are learning as well as the game themes that users can choose to play. The characteristic layer is a hierarchical structure in which the root nodes are associated with one or more nodes in the domain layer. The object layer stores all learning objects in the real world (e.g., rooms, equipment, pine trees, etc.) and in the virtual world (e.g., payroll system, business policy, electronic forms, etc.).

Since the knowledge structure stores all learning objects and their attributes and embedded concepts, as well as the relationships among objects, an approach of retrieving relevant learning objects according to the user context, e.g., the chosen theme, location, learning experiences, was

developed. The learning objects retrieved via the approach can make users feel that the objects are what they want to see/know. Fig. 2 shows the learning activity generation flow. More details of the learning activity generation mechanism can be found in [29].

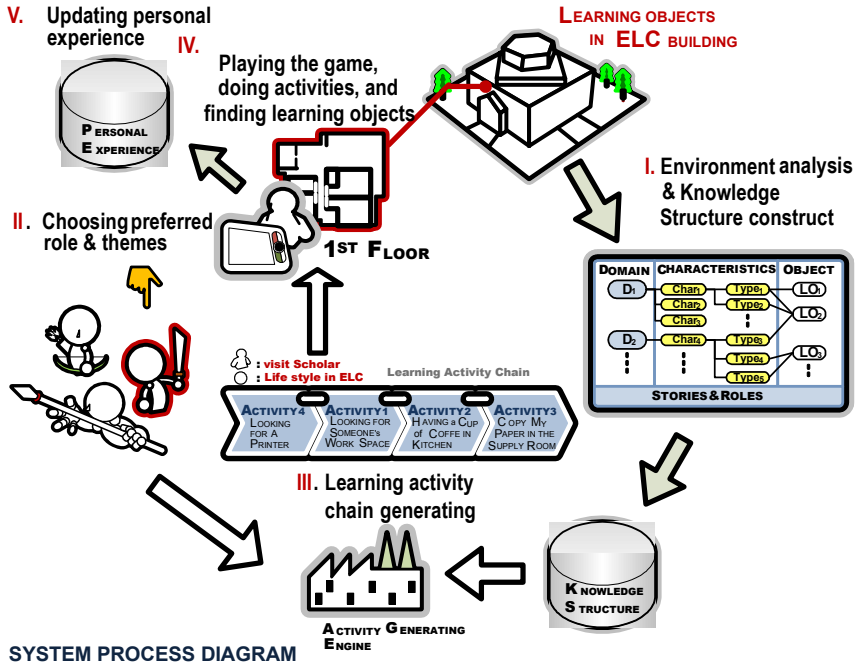

Figure #-2. Learning activity generation flow.

3.2 Multi-Agent System

Mobile phones have limited computing power and resources compared to desktop and laptop computers, the mobile applications hence are usually small and simplified. Tan and Kinshuk propose five design principles for developing applications on mobile devices [42]: multiplatform adaptation, little resource usage, little human/device interaction, small data communication bandwidth use, and no additional hardware. The multi-agent based system design approach is geared towards helping in complying with the abovementioned five design principles.

The multi-agent architecture was designed while implementing the mobile educational game in order to comply with the five design principles as well as to develop a lightweight, flexible, and scalable mobile education

game. This architecture not only enables different agents to work on different tasks, but also provides a way for easy improvements and maintenance of the game. For instance, we can put new agents into the game for special purpose and replace old agents with new and more functional ones. Fig. 3 shows the multi-agent architecture of the proposed mobile educational game.

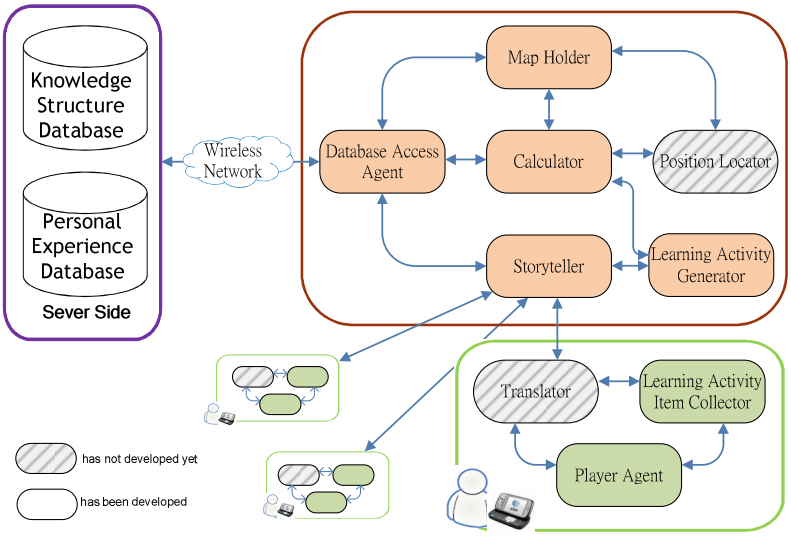

Figure #-3. Multi-Agent architecture of the proposed mobile educational game

Two groups of agents reside on the user's mobile phone: three agents form a group to serve and interact with the user, namely Player Agent, Translator, and Learning Activity Item Collector; and six agents form a group to work out context-awareness and the location-based learning activity chain, namely Learning Activity Generator, Calculator, Map Holder, Database (DB) Access Agent, Storyteller, and Position Locator. The conceptual model illustrates the relationships among agents from the system's point of view. Each agent has its goal, task, demands, and communicated targets. More details for the responsibilities of each agent and the collaborations among agents can be found in [28].

3.3 Story Generation

Even the game can generate a series of learning activities for users, users may still be bored if they are just asked to do activities one by one. Story is important for designing an interesting and engaging game. Most of popular games have its background story no matter the story is a simple linear story

(i.e., saving the princess) or a complex drama (i.e., the war happened between Alliance and Horde in World of Warcraft). Good story in the game design makes the game realistic and immersive as well as users involve constantly.

A story usually begins with putting one or more characters, in a kind of situations, in one of the settings in the game [40]. The research team designs a narrative knowledge structure with core narrative elements identified from literature review as Fig. 4 shows. The structure can be used to store all necessary narrative elements for creating a story.

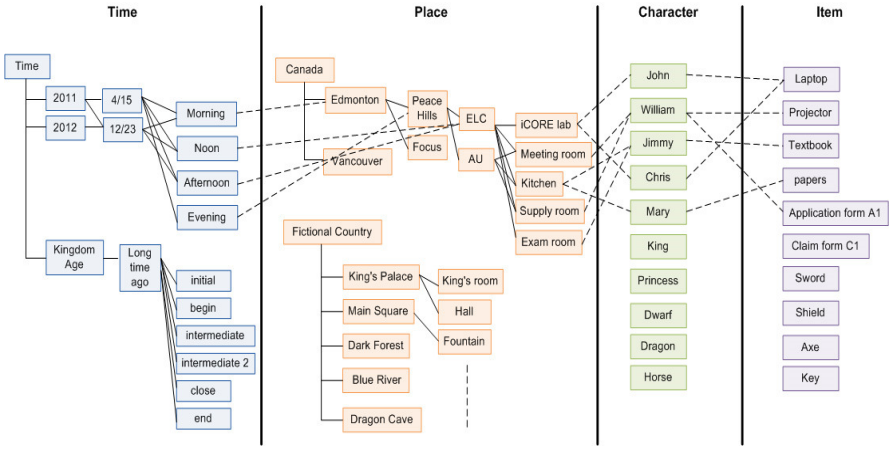

Figure #-4. Narrative knowledge structure.

Each layer in the narrative knowledge structure is hierarchical form and has more than one level. The elements can be mixed of truth and fiction. Different schema is designed to store the properties of narrative elements and can be used for generating story. A simple method is designed to pick up narrative data from the structure. The method is simple but still maintains the consistency of two story fragments in the same storyline. More details of the story generation engine can be found in [30].

4. PILOTS

4.1 Participants

Two pilots were conducted for gathering users' acceptance and perceived usability toward the game. Both pilots were conducted in the department of

Information Management (IM), National Kaohsiung First University of Science and Technology (NKFUST), Taiwan.

The participants of the first pilot were 37 graduate students including 25 male and 12 female students who were just accepted by the master program. They were not familiar with the new environment (i.e., new school, new policy, new campus, and new faces) and qualified to the objective of the mobile educational game – "users can get familiar with the new working environment and learn new procedure and work flow by playing mobile educational game."

The participants of the second pilot were 55 undergraduate students including 31 males and 24 females recruited from students who enrolled management information system – an undergraduate course. In the pilot, teaching building E of the university was redesigned as a virtual science park where many famous IT business and company reside in for participants learning management information system concepts while playing the game.

All participants play the game with the smartphones prepared by researchers, as not all participants have smartphones and to avoid the influences that different devices may have in terms of affecting users' experiences in playing the game and perceptions toward the game.

4.2 Questionnaire

To gather users' gaming and smartphone using experiences as well as their perceptions toward the game in terms of acceptance and perceived usability of the game, questionnaire consists of demographic section, technology acceptance section (only second pilot's questionnaire has this section), and usability section were designed and revised from questionnaires used and proposed by other researchers.

The demographic section collects participant's gender information, experiences of playing games, time spent in playing games, and experiences with smartphones.

The revised technology acceptance section has thirty one five-point Likert-scale items (ranging from 5 for "strongly agree" to 1 for "strongly disagree") to address four main constructs of Technology Acceptance Model [6,17] (i.e., perceived ease of use, perceived usefulness, attitude toward using, and behavioral intention of using), and two game features (i.e., context-awareness and story generation).

The revised usability section contains same eleven five-point Likert-scale items for both pilots (5 for "strongly agree" to 1 for "strongly disagree") which may affect a system's usability in the three constructs described in ISO 9241-11 [18,29], i.e., effectiveness, efficiency, and satisfaction.

4.3 Reliability and Validity of Questionnaire

Although the questionnaire was adopted from previous research results and its validity and reliability had been proven, the research team assessed the reliability and validity of questionnaire with the collected data once again before applying quantitative analysis approaches to verify given hypotheses.

The Cronbach's alpha values of the revised usability section are 0.840 for first pilot and 0.873 for second pilot indicating that the items can be seen as reliable due to its internal consistency is good enough (i.e., exceeds 0.75) [16]. Furthermore, the Cronbach's alpha value of the revised technology acceptance section for the second pilot is 0.826, also indicating the items are reliable

On the other hand, with the help of principal component analysis, some items with lower factor loading were identified and removed. The removal of those items improved the Cronbach's alpha values; therefore, the remained items were still capable of representing the correspondent constructs respectively.

5. FINDINGS AND DISCUSSION

5.1 Perceptions of Female Users are More Positive

Although both of male and female participants perceived the usability of the game positively, female participants' responses to all factors were relatively higher than male participants in both studies. Many researchers also found that male participants tend to feel the educational games are boring while their counterpart (i.e., female participants) has more positive perceptions toward the educational games [15,23]. One possible reason of having this finding is female participants are more likely than male participants in terms of using mobile phones [50]. More detailed data collected, data analysis approaches, and results and findings can be found in [29,33].

5.2 Story Helps Male Users Perceive Effectiveness and Satisfy the Game

The game in the second pilot has built-in story generation engine. The participants of the second pilot, hence, see a generated story fragment for the learning activity they take. The result shows that the participants of the

second pilot perceive higher effectiveness and are more satisfying with the game than their counterpart – the participants of the first pilot. Without story's help, the game is more like a game that participants are familiar with in the real world. Therefore, they are more satisfying with it then the version without story.

Moreover, the result of independent t-test for examining the difference between male and female participants of the first pilot shows that the male and female participants are significant different in terms of satisfying with the game they played. However, there is no significant difference on the perceived satisfaction towards the game among male and female participants of the second pilot. This finding implies that the stories may make male participants feel the game more like a real game and make them have higher satisfaction towards the game.

More detailed data collected, data analysis approaches, and results and findings can be found in [32-34].

5.3 Having no Experience of Using Smartphone doesn't Affect Perceived Usability toward the Game

The result shows no significant difference between participants who have experience of using smartphone and those who don't. Therefore, experience of using smartphone not affects participants' perceived usability of the game. The reason of having such finding may be caused by the easy of use user interface and intuitive way of collecting quest items in the real world – users only need to use the built-in camera to scan the QR code tag attached to the real world objects and the system will proceed to the next stage without user intervention. This finding suggests that there is no need to worry about whether or not a user has used a smartphone while designing and deploying such context-aware mobile role-playing game for learning. More detailed data collected, data analysis approaches, and results and findings can be found in [33].

5.4 Only Attitude towards Computer Games and Comfortable to Computer Games Affect Users' Voluntariness of Using the Game

The independent t-test result shows that male participants like computer games much more than female participants as well as have higher confidence in playing computer games. However, having confidence in playing computer games and liking computer games in fact have no influence on

participants' voluntariness of using the proposed game. The result shows that only attitude towards computer games and comfortable to computer games make participants have significant different voluntariness of using the game and similar games for learning in the future.

As the proposed game is not quite like commercial computer games and has simple and intuitive user interface compared to commercial ones that participants always see, they may be more comfortable in trying the proposed game. Moreover, as the content of the game is learning oriented instead of defeating monsters or solving difficult mystery like a commercial game usually asks them to do in the game-play, they may have higher confidence in playing the proposed game. Under such circumstance, having confidence in playing computer games and liking computer games become not an issue to affect participants' voluntariness of using the game. Therefore, only participants' attitude towards computer games and whether or not feel comfortable to computer games influence their voluntariness of using such kind of games in learning.

The finding implies that users are willing to use mobile educational games for learning as long as they feel comfortable to computer games and they are positive to computer games. On the other words, mobile educational games are also welcome by female users. This finding proves that games can be equally effective and motivating for both male and female students [19,38] and makes us be aware of how positive perception towards the use of game-based learning solutions that female participants have. It is not like what most of us thought and were afraid of before – "male participants love educational games much more than female and female students may not want to give the educational games a shot."

More detailed data collected, data analysis approaches, and results and findings can be found in [31].

5.5 Hard-core Players Treats the Game as a Real Game

According to the demographic information of the participants, hard-core game players spend average almost ten times of the hours on playing computer games than casual game players. Since hard-core game players play more games and more often, it may lead us to have an assumption that they have a higher standard while evaluating games they play than casual game players. The result shows that hard-core game players hive higher acceptance towards the game than casual game players. One possible reason is – "hard-core players like game and would like to give any game a shot." However, as the data was collected after the game play; therefore, this finding implies the hard-core players treat the game as a real game instead of

a "learning application". More detailed data collected, data analysis approaches, and results and findings can be found in [34].

6. CONCLUSION

This chapter first reveals the design of personalized context-aware mobile learning activity generation and transition story generation. Two pilots have been done for assessing the proposed game and the collected data has been analyzed with quantitative approaches. The proposed game is well-designed and is considered as a real game by hard-core players. No matter users have experience in using smartphone, they appreciate the usability of the game. On the other hand, the game is easy to learn and easy to use for users who don't have experience in using smartphone.

Some interesting and important findings have been found. For instance, as long as users feel comfortable to computer games or they are positive to computer games, they will be voluntary in using such kind of mobile games for learning and their gender doesn't matter. In such case, educational game developers could be encouraged by putting more efforts on designing high quality games with simple and intuitive user interface and gaming features such as the adoption of two dimension code scanner with built-in camera. Also, this research finds that story plays a very important role in terms of making male users perceive the effectiveness of the game and be more satisfied with the game. Therefore, the educational game developers should pay more attention on the story creation and the connection between learning activities and decoration stories. So the effectiveness of their games can be well perceived.

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REFERENCE

1. ACMI. (2013). Game Genres. Australian Centre for the Moving Image. Accessed: http://www.acmi.net.au/explore_game_genres.htm
2. Aylett, R., Louchart, S., Dias, J., Paiva, A., Vala, M., Woods, S., & Hall, L. E. (2006). Unscripted Narrative for Affectively Driven Characters. *IEEE Computer Graphics and Applications*, *26*(3), 42-52.
3. Balaji, P. G., & Srinivasan, D. (2010). Multi-Agent System in Urban Traffic Signal Control. *Computational Intelligence Magazine*, 5(4), 43-51.
4. Baylor, A. L. (1999). Intelligent agents as cognitive tools for education. *Educational Technology*, *39*(2), 36-40.

5. Blair, J. & Lin, F. (2011). An Approach for Integrating 3D Virtual Worlds with Multiagent Systems. In *the Proceedings of IEEE Workshops of International Conference on Advanced Information Networking and Applications*, (WAINA 2011), March 22-25, 2011, Singapore, 580-585.
6. Bourgonjon, J., Valcke, M., Soetaert, R., & Schellens, T. (2010). Students' perceptions about the use of video games in the classroom. Computers & Education, *54*(2010), 1145-1156.
7. Chang, A., & Chang, M. (2006). A Treasure Hunting Learning Model for Students Studying History and Culture in the Field with Cellphone. In *the Proceedings of the 6th IEEE International Conference on Advanced Learning Technologies*, (ICALT 2006), July 5-7, 2006, Kerkrade, The Netherlands, 106-108.
8. Chang, C., Wu, S., Chang, M., & Heh., J.-S. (2008). Activity Generator for Informal Learning in Museum. In *the Proceedings of the 7th WSEAS International Conference on E-ACTIVITIES*, (E-ACTIVITIES 2008), December 29-31, Cairo, Egypt, 189-194.
9. Chen, Y.-S., Kao, T.-C., Yu, G.-J., & Sheu, J.-P. (2004). A Mobile Butterfly-Watching Learning System for Supporting Independent Learning. In *the Proceedings of the IEEE International Workshop on Wireless and Mobile Technologies in Education*, (WMTE 2004), March 23-25, 2004, Chung-Li, Taiwan, 11-18.
10. Conle, C. (2003). An Anatomy of Narrative Curricula. Educational Researcher, *32*(3), 3-15.
11. Dickey, M. D. (2006). Game design narrative for learning: appropriating adventure game design narrative devices and techniques for the design of interactive learning environments. *Educational Technology Research and Development*, *54*(3), 245-263.
12. Dutchuk, M., Muhammadi, K. A., & Lin, F. (2009). QuizMASter - A multi-agent game-style learning activity. In *the Proceedings of the 4th International Conference on E-Learning and Games* (Edutainment 2009), August 9-11, 2009, Banff, Canada, 263-272
13. Frazer, A., Argles, D., & Wills, G. (2008). The Same, But Different: The Educational Affordances of Different Gaming Genres. In *Proceedings of the 8th IEEE International Conference on Advanced Learning Technologies*, (ICALT 2008), July 1-5, 2008, Santander, Cantabria, Spain, 891-893.
14. Gil-Rodríguez, E.P. & Rebaque-Rivas, P. (2010). Mobile Learning & Commuting: Contextual Inquiry and Design of Mobile Scenarios. In *Proceeding of IEEE 10th International Conference on Advanced Learning Technologies*, (ICALT 2010), July 5-7, 2010, Sousse, Tunisia, 738-739.
15. Gwee, S., Chee, Y.-S., & Tan, E.-M. (2010). Spatializing Social Practices in Mobile Game-Based Learning, In *the proceeding of 10th IEEE International Conference on Advanced Learning Technologies*, (ICALT 2010), July 5-7, 2010, Sousse, Tunisia, 555-557.
16. Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate Data Analysis* (5th ed.). Upper Saddle River, NJ: Prentice Hall.
17. Ibrahim, R.. (2011). Towards Educational Games Acceptance Model (EGAM): A Revised Unified Theory of Acceptance and Use of Technology (UTAUT). *International Journal of Research and Reviews in Computer Science*, *2*(3), 839-846.
18. ISO/IEC. (1998). *Ergonomic Requirements for Office Work with Visual Display Terminals (VDT)s - Part 11 Guidance on Usability*. Geneva.
19. Ke, F. (2008). A case study of computer gaming for math: Engaged learning from gameplay? *Computers & Education*, 51(4), 1609-1620.
20. Kim, H.-J., & Schliesser, J. (2007). Adaptation of Storytelling to Mobile Entertainment Service for Site-Specific Cultural and Historical Tour. In *Proceedings of 14th International Conference on Information and Communication Technologies in Tourism*, (ENTER 2007), January 24 - 26, 2007, Ljubljana, Slovenia, vol. 3, 97-108.

21. Kurti, A., Milrad, M., & Spikol, D. (2007). Designing Innovative Learning Activities Using Ubiquitous Computing. In *the Proceedings of the 7th IEEE International Conference on Advanced Learning Technologies*, (ICALT 2007), July 18-20, 2007, Niigata, Japan, 386-390.
22. Laouris, Y. & Eteokleous, N. (2005). We need an Educationally Relevant Definition of Mobile Learning. In *Proceedings of the 4th World Conference on mLearning*. October 25-28, Cape Town, South Africa. Accessed: http://www.mlearn.org.za/CD/papers/Laouris%20&%20Eteokleous.pdf
23. Law, E.L. (2010). Learning Efficacy of Digital Educational Games: The Role of Gender and Culture. In *the Proceedings of the AACE 20th World Conference on Educational Multimedia, Hypermedia and Telecommunications*, (ED-Media 2010), June 29-July 2, 2010, Toronto, Canada, 3124-3133.
24. Leung, S., Virwaney, S., Lin, F., Armstrong, A. J., & Dubbelboer, A. (2013). TSI-enhanced Pedagogical Agents to Engage Learners in Virtual Worlds. *International Journal of Distance Education Technologies*, *11*(1), 570-575.
25. Li, M., Ogata, H., Hou, B., Uosaki, N., & Mouri, K. (2013). Context-aware and Personalization Method in Ubiquitous Learning Log System. *Educational Technology and Society*, 16(3), 362-373.
26. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2010a). Context-awareness Learning Activity Generation and its Agents in a Mobile Educational Game. In *the Proceedings of Asia-Pacific Conference on Technology Enhanced Learning*, (APTEL 2010), Osaka, Japan, September 24-26, 2010, ID. 65.
27. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2010b). CAMEG-A Multi-Agent Based Context-Aware Mobile Educational Game for On-the-Job Training. In *the Proceedings of Workshop on New Paradigms in Learning: Robotics, Playful Learning, and Digital Arts, in the 18th International Conference on Computers in Education*, (ICCE 2010), Taipei, Taiwan, Putrajaya, Malaysia, November 29-December 3, 2010, 341-345.
28. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2011a). Architecture and Collaborations among Agents in Mobile Educational Game. In *the Proceedings of the 7th IEEE International Workshop on PervasivE Learning, Life, and Leisure*, in IEEE Pervasive Computing and Communication 2011, (PerCom 2011), Seattle, WA, USA, March 21-25, 2011, 171-175.
29. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2011b). Usability of Context-Aware Mobile Educational Game. Knowledge Management & E-Learning: An International Journal, *3*(3), 448-477.
30. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2011c). Story-based Learning Activity Generation in a Context-Aware Mobile Role Playing Game. In *the Proceedings of the 5th European Conference on Game-Based Learning*, (ECGBL 2011), Athens, Greece, October 20-21, 2011, 358-367.
31. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2012). Examining Computer Game Attitude Influence on Voluntariness of Using Educational Mobile Role-Playing Game. International Conference on Digital Game-based Learning (DGL 2012), Hangzhou, China, October 25-27, 2012, 161-165.
32. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2012). Usability of Story in Context-Aware Mobile Educational Game. In the Proceedings of the Global Chinese Conference on Computers in Education 2012 (GCCCE 2012), Kenting, Taiwan, May 28-June 1, 2012, 337-340.
33. Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2014). Context-Aware Mobile Role Playing Game for Learning – A Case of Canada and Taiwan. *Educational Technology & Society*. (in-press)

34.Lu, C., Chang, M., Kinshuk, Huang, E., & Chen, C.-W. (2014). The effect of story in mobile educational game. *Ubiquitous Learning Environments and Technologies*. Springer (in-press)
35.Lu, H.-M., Lou, S.-J., Papa, C., & Chung, C.-C. (2011). Study on Influence of Adventure Game on English Reading Confidence, Motive and Self-efficacy. In: Chang, C. at al. (eds.) In *Proceedings of the 6th International Conference on e-Learning and Games*, (Edutainment 2011), Taipei, Taiwan, September 7-9, 2011, Lecture Notes in Computer Science (LNCS), vol. 6872, 430-434. Berlin: Springer.
36.Mallon, B., & Webb, B. (2005). Stand up and take your place: identifying narrative elements in narrative adventure and role-play games. Computers in Entertainment, *3*(1), Article 6b.
37.McClure, G., Chang, M., & Lin, F. (2013). MAS Controlled NPCs in 3D Virtual Learning Environment. In *the Proceedings of the 9th International on Signal-Image Technology & Internet-Based Systems*, December 2-5, 2013, Kyoto, Japan, 1026-1033.
38.Papastergiou, M. (2009).Digital Game-Based Learning in High School Computer Science Education: Impact on Educational Effectiveness and Student Motivation. *Computers & Education*, *52*(1), 1-12.
39.Parker, L., & Lepper, M. (1992). Effects of fantasy contexts on children's learning and motivation: Making learning more fun. *Journal of Personality and Social Psychology*, *62*(4), 625-633.
40.Rabin, S. (2010) *Introduction to Game Development (Second Edition).* ISBN: 978-1-58450-679-9, pp 139–160. Boston, MA: CENGAGE Learning.
41.Rowe, J. P., McQuiggan, S. W., & Lester, J. C. (2007). Narrative presence in intelligent learning environments. In *the Proceedings of* 2007 AAAI Fall Symposium, November 2007, 126-133.
42.Tan, Q., & Kinshuk. (2009). Client Mobile Software Design Principles for Mobile Learning Systems. *International Journal of Interactive Mobile Technologies*, *3*(1), 32-37.
43.Weng, M., Lin, F., Shih, T. K., Chang, M., & Fakinlede, I. (2011). A Conceptual Design of Multi-Agent based Personalized Quiz Game. In *the Proceedings of IEEE International Conference on Advanced Learning Technologies*, (ICALT 2011), July 6-8, 2011, Athens, GA, USA, 19-21.
44.Wu, S., Chang, A., Chang, M., Liu, T.-C., & Heh, J.-S. (2008). Identifying personalized context-aware knowledge structure for individual user in ubiquitous learning environment. In *the Proceedings of the 5th IEEE International Conference on Wireless, Mobile, and Ubiquitous Technologies in Education*, (WMUTE 2008), March 23-26, 2008, Beijing, China, 95-99.
45.Wu, S., Chang, A., Chang, M., Yen, Y.-R., & Heh, J.-S. (2010). Learning Historical and Cultural Contents via Mobile Treasure Hunting in Five-harbor District of Tainan, Taiwan. In *the Proceedings of the 6th IEEE International Workshop on International Conference on Wireless, Mobile, and Ubiquitous Technologies in Education*, (WMUTE 2010), April 12-16, 2010, Kaohsiung, Taiwan, 213-215.
46.Wu, P.-H., Hwang, G.-J., & Tsai, W.-H. (2013). An Expert System-based Context-Aware Ubiquitous Learning Approach for Conducting Science Learning Activities. *Educational Technology and Society*, 16(4), 217-230.
47.Wu, T.-T., Yang, T.-C., Hwang, G.-J., & Chu, H.-C. (2008). Conducting Situated Learning in a Context-aware Ubiquitous Learning Environment. In *the Proceedings of the 5th IEEE International Conference on Wireless, Mobile and Ubiquitous Technologies in Education*, (WMUTE 2008), March 23-26, 2008, Beijing, China, 82-86.

48. Ying, K., Wu, S., Chang, M., & Heh, J.-S. (2009). Narrative Elements Analysis for Educational Mobile Game Development. In *the Proceedings of Technology Enhanced Learning Conference 2009*, (TELearn 2009), October 6-8, 2009, Taipei, Taiwan, No.26.
49. Zhang, L., & Lin, Q. (2007). MACVE: A mobile agent based framework for large-scale collaborative virtual environments. *Teleoperators & Virtual Environments*, *16*(3), 279-292.
50. Chiu, S.-I, Hong, F.-Y, & Chiu, S.-L. (2013). An Analysis on the Correlation and Gender Difference between College Students' Internet Addiction and Mobile Phone Addiction in Taiwan. ISRN Addiction, 2013, Article #360607. Accessed: http://www.hindawi.com/isrn/addiction/2013/360607/