

The Integration of Augmented Reality Mobile Learning and Self-Regulated Learning by using Concept Mapping - A Case Study of the Plants in Campus

Po-Han WU^{a*}, Gwo-Haur HWANG^b, Yu-Syuan WANG^a & Yen-Ru SHI^c

^a *Department of Mathematics and Information Education, National Taipei University of Education, Taiwan*

^b *Department of Information Networking and System Administration, Ling Tung University, Taiwan*

^c *Department of Information and Learning Technology, National University of Tainan, Taiwan*

*cincowu@gmail.com

Abstract: With the rapid development of mobile devices, ubiquitous learning becomes the new trend of digital learning. In recent years, many scholars found that learning through augmented reality methods can improve students' interest and motivation. Therefore, in this study, an integration system of augmented reality mobile learning and self-regulated learning by using concept mapping is proposed for conducting learning activities. Students can observe the plants in campus and draw the concept maps by augmented reality technology and self-regulated learning strategy. According to the drawn concept maps and the learning contents from real situations, the system can provide students the guidance and feedback to help their thinking. Students can set their learning goals and adjust their learning progress according to the nature of the learning tasks via self-regulated strategies. The experimental results were expected that the proposed approach is able to improve the students' the cognition of the plants for students in campus and raise students' learning motivation and effectiveness.

Keywords: Augmented reality, mobile navigation, self-regulated learning, concept mapping, campus plant

1. Introduction

In traditional teaching environment, it is difficult to express the abstract concept of knowledge. Thus, with the improvement of information technologies, many scholars tried to import some multimedia technologies into courses in the past. And some scholars found out that the multimedia learning systems can improve students' learning motivation and effectiveness (Govaere Jan, de Kruif, & Valcke, 2012; Uluyol & Agca, 2012). But students think that multimedia learning systems are not in real environments. Because of the difference between virtual environments and real environments, students cannot associate learning contents with everyday life. (Barfield, Sheridan, Zeltzer, & Slater, 1995; Eysenck & Keane, 2005). However, augmented reality (AR) is a technology combined with virtual and reality images (Azuma, 1997). Thus, students can directly scan learning objects in real environments and get the relational teaching contents immediately. In the past, many scholars applied AR technologies in classes. For example, Martín-Gutiérrez et al. (2010) used AR technologies in learning the spatial integration ability in geography, history, arts and humanities. The results of their study showed that AR technologies can raise the attraction of students and have the easy manipulation characteristics, and it can improve their space ability. Wernhuar and Ou (2012) developed a smartphone butterfly ecological system in virtual environments by AR technologies. The results of their study showed that AR technologies for learning can improve students' learning effectiveness. Hwang et al. (2013) developed a multi-language learning system by AR technologies. This system can appeared correspondence learning contents when students scan the objects in real environments. In addition, it can also provide multi-language spelling and voice teaching by the objects. The purpose of this system is to let students study languages. At the same time, it can also let students practice pronunciation.

In traditional teaching environments, teachers faced too many students and cannot consider the individual learning situation for students. Thus, the learning effectiveness is not very good (Hwang, Tsai, & Yang, 2008; Wu, Hwang, Milrad, Ke, & Huang, 2012). In the past, some scholars indicated that students can use mobile electronic devices in real situations. For students, those methods cannot only solve the problems in one-to-many teaching environment (Wu, Hwang, Su, & Huang, 2012), but also can let students study according to their own learning pace. For teachers, they can act the leader roles and understand the students' learning situations from the systems.

Bandura (1986) indicated that self-regulated learning is defined as “personalization means perception, motivated willingness, and active behaviors in the learning process”. And self-regulated learning is built learning goal by students. The process of setting goal contains self-monitoring, standard setting, evaluative judgment, self-appraisal, and affective self-reaction (Schunk, 2001). In real environments, learning activities are very complex and difficult. If teachers use unsuitable teaching tools, they need to take attention to individual students and provide guidance and assistance, and it is a difficult thing. In the past, many researches showed that concept mapping was thought an effective learning strategy, and it is a visual method. Concept mapping expresses the cognitive structure between “Concept” and “Relationship”. The purpose is to let students understand learning contents (Hwang, Panjaburee, Triampo, & Shih, 2013; Panjaburee, Triampo, Hwang, Chuedoung, & Triampo, 2013).

Therefore, in this study, we developed an integration of augmented reality mobile learning and self-regulated learning by using concept mapping. This system is different from traditional paper textbooks and traditional media materials, which appeared text or images only. Thus, this system use augmented reality methods to improve students' learning willing. At the same time, it uses self-regulated methods to complete students' goals. And it uses the concept mapping method, so that students may conduct reflection to finish their learning goals.

2. Development of System

2.1 System Architecture

The system architecture (includes three learning modules) which is composed of self-regulated learning, AR learning navigation, and concept mapping (see Figure 1). The self-regulated learning module function includes setting the observed goals and getting the learning feedback. When students use the AR learning navigation, they can collect data such as photos, videos and audio, so that more supplementary materials can display on the screen. The concept mapping module provides a way to improve the learning effectiveness of students. It allows students to create their own concept maps and gives them a rank with appropriate materials. The system is built by HTML5 and converted into the mobile platform through Phone Gap. All of the learning data is stored in the machine in JSON format, and upload to the server when the internet is connected.

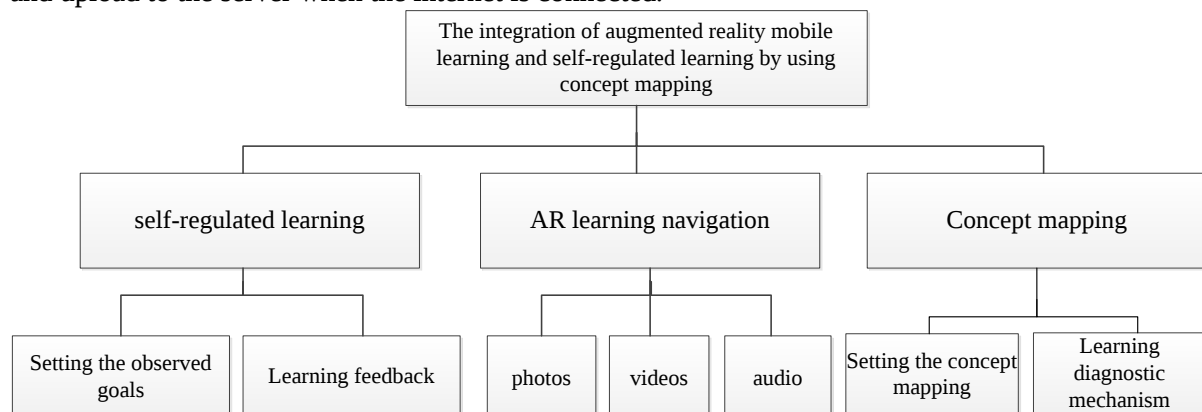


Figure 1. The system architecture.

2.2 Interfaces for Users

At first, students may login the homepage of the system by usernames and passwords. In self-regulated mode, this system provided learning goal contents for students. Students can use the dropdown menu to select their learning objects, and the system will provide the learning contents according to their learning goals. Then students can select their learning goals for the learning object. Students also can choose the confirm button to learning, as shown in Figure 2. After setting goal, the system will appear the main screen. The main screen contains four bottoms: data collection, concept mapping, operating instructions and log out, as shown in Figure 3. The four buttons are described in detail as follows.

In the AR learning navigation module, students click data collection button that they enter data collection interface according to system tasks guidance. In the AR learning navigation module, students can click data collection button, so that they can enter the data collection interface and record the data by photo, video, or audio format. According to their collection, they also can record the names, the found locations and the number of the found plants, as shown in Figure 4. In the concept mapping module, students can draw relationships by using image methods according to the learned content. In the concept mapping module, there exists a learning diagnostic mechanism. In the learning diagnostic mechanism, when students click the edit-finished button, the system will evaluate the concept maps draw by students and produce summary reports, as shown in Figure 5. The completion rates of learning goal and self-learning goal will appear in the summary report. The concept maps drawn by students will appear at the bottom of the summary report, as shown in Figure 6. When an error happened in the concept map drawn by a student, an error-list button will appear at the bottom of the summary report. In the error list, the system will provide some information for the concept map drawn by a student and correct his/her misconception. According to the unfinished learning tasks, students can adjust the goal to learning, as shown in Figure 7. In addition, when a student clicks the operating-instructions button, the system can appear operating instructions interface, as shown in Figure 8. The system can provide guide and learning-goal materials for students, and they can learn the materials via the AR technologies, as shown in Figure 9.



Figure 2. Setting goal.



Figure 3. Main screen.



Figure 4. Data collection.

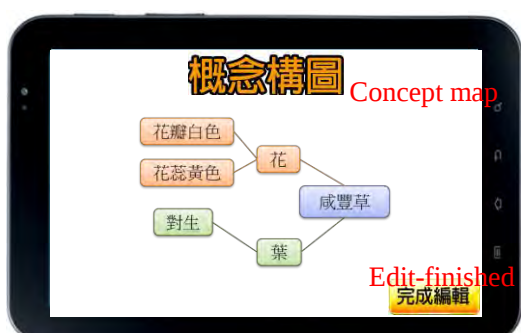


Figure 5. Concept mapping.



Figure 6. Summary reports.



Figure 7. Error messages.



Figure 8. Operating instructions.



Figure 9. AR learning materials.

3. Conclusion and Future Works

3.1 Conclusion

In this study, an integration system of augmented reality mobile learning and self-regulated learning by using concept mapping is developed. Students can use AR technologies to learn in a real environment. At the same time, students can also learn according to their own learning pace. And students can understand the learning contents and the cognitive structure between the concept and the relationship through concept mapping strategies. In the other hand, the system provides the guide and the learning diagnostic mechanisms, which can correct the misconceptions of students and provide the feedback to students. The experimental results were expected that the proposed approach is able to improve students' learning motivation and effectiveness

3.2 Future Works

In future works, we will continue the experiment of this study. We will conduct teaching experiment at a certain school in the Northern region of Taiwan. The participants are about 60 students in two classes. One class is the experimental group, which is using our system. The other class is the control group, which is using AR mobile navigation learning strategy only. All students will conduct pretest, posttest and questionnaire, which contain learning effectiveness, learning motivation, learning attitude, learning satisfaction and cognitive load. After the experiment, we will analyze whether the learning motivation and the effectiveness between the experimental group and the control group exist significant difference. In addition, we will analyze the log data of students to find what behavior may influence students' learning effectiveness, as shown in Figure 10.

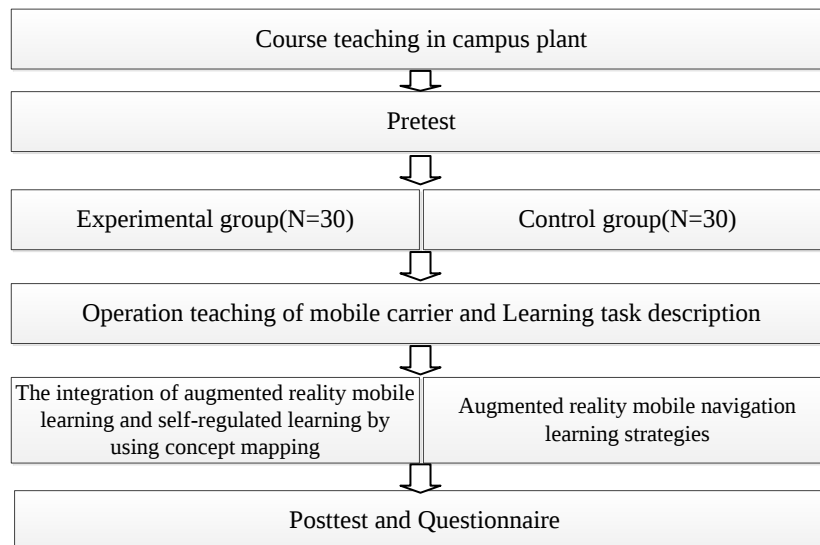


Figure 10. The flowchart of the experiment.

Acknowledgements

This study is supported in part by the Science Council of the Taiwan under Contract No. NSC 103-2511-S-152-001-MY2 and MOST 103-2511-S-275-002-MY2.

References

- Azuma, R. (1997). A survey of augmented reality. *Presence: Teleoperators and Virtual Environments*, 6, 355-385.
- Bandura, A. (1986). *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Barfield, W., Sheridan, T., Zeltzer, D., & Slater, M. (1995) *Presence and performance within virtual environments*. Virtual Environments and Advanced Interface Design. W. Barfield and T. Furness (eds). New York, NY: Oxford University Press.
- Eysenck, M. W., & Keane, M. (2005). *Cognitive psychology a student's handbook*. East sussex, UK: Psycholoty Press.
- Govaere Jan, L. J., de Kruif, A., & Valcke, M. (2012). Differential impact of unguided versus guided use of a multimedia introduction to equine obstetrics in veterinary education. *Computers & Education*, 58(4), 1076-1084.
- Hwang, G. H., Lee, C. Y., Hwang, H. L., Huang, G. L., LIN, J. Y. & Cai, J. J. (2013). *Using augmented reality to assist an interactive multi-language learning system in an elementary school*. Workshop Proceedings of the 21st International Conference on Computers in Education. Indonesia: Asia-Pacific Society for Computers in Education.
- Hwang, G. J., Panjaburee, P., Triampo, W., & Shih, B. Y. (2013). A group decision approach to developing concept effect models for diagnosing student learning problems in mathematics. *British Journal of Educational Technology*, 44(3), 453-468.
- Hwang, G. J., Tsai, C. C., & Yang, S. J. H. (2008). Criteria, strategies and research issues of context-aware ubiquitous learning. *Educational Technology & Society*, 11(2), 81-91.
- Martín-Gutiérrez, J., Luís Saorín, J., Contero, M., Alcañiz, M., Pérez-López, D. C., & Ortega, M. (2010). Design and validation of an augmented book for spatial abilities development in engineering students. *Computers & Graphics*, 34(1), 77-91.
- Panjaburee, P., Triampo, W., Hwang, G. J., Chuedoung, M., & Triampo, D. (2013). Development of a diagnostic and remedial learning system based on an enhanced concept effect model. *Innovations in Education and Teching International*, 50(1), 72-84.
- Schunk, D. H. (2001). *Social cognitive theory and self-regulated learning*. In B. J. Zimmerman, & D. H. Schunk (2nd eds), *Self-regulated Learning and Academic Achievement: Theoretical Perspectives* (pp. 125-151). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

- Uluyol, C., & Agca, R. K (2012). Integrating mobile multimedia into textbooks: 2D barcodes. *Computers & Education*, 59(4), 1192-1198.
- Wernhuar, T., & Ou, K. L. (2012, March). *A study of campus butterfly ecology learning system based on augmented reality and mobile learning*. Paper presented at the 7th IEEE International Conference on Wireless, Mobile, and Ubiquitous Technologies on Education (WMUTE 2012), Kagawa, Japan.
- Wu, P. H., Hwang, G. J., Milrad, M., Ke, H. R., & Huang, Y. M. (2012). An innovative concept map approach for improving students' learning performance with an instant feedback mechanism. *British Journal of Educational Technology*, 43(2), 217-232.
- Wu, P. H., Hwang, G. J., Su, L. H. & Huang, Y. M. (2012). A context-aware mobile learning system for supporting cognitive apprenticeships in nursing skills training. *Educational Technology & Society*, 15(1), 223-236.