The Implementation of GIS (Google Earth) in Natural Sciences Class: Teaching and Learning

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Abstract: This study designs a Geographic Information System (GIS) based learning system incorporates real weather *information into natural sciences education.* By employing Google Earth, near-time rainfall distribution data and Satellite Images, teachers can use it on weather related curriculum and students can learn the cloud-rain relation in real case by themselves. Evaluation results for the technology acceptance model (TAM) indicated that teachers' and students' satisfaction with and willingness to adopt the system have a significant positive influence on the system. The results also demonstrate that the better information technology ability to apply GIS codes, the higher their satisfaction and willingness to adopt the system. Results also shown that not only the resolving of misconception of weather, but also the learning achievement are getting better on students.

Keywords: Geographic information system, technology acceptance model, Google Earth

Introduction

Information technology (IT) applied in education has been developed for a long period, teachers usually can integrated IT into the teaching policy and processes [1-3]. Computer Integrated Instruction and Technology Integration are the key issue in highlighting the importance of IT in class and curriculum [4]. The number of new technologies which can be utilised for educational purposes increases rapidly today. However, incorporating these technologies into school curriculums and utilising them effectively in classroom settings is not easy [5]. Geographic Information Systems (GIS) which was specifically designed for professional spatial analysis and is a set of integrated software programs designed to store, retrieve, manipulate, analyse and display geographical data-information concerning people, places and the environment [6]. Many classes including Geography, Weather, Science, Environmental and Social Sciences, Biology and Mathematics can adapt the GIS information [7-11].

Michelle K. Hall-Wallace and Carla M. McAuliffe [12] mentioned using classroom observations, student interviews and surveys, pre and posttests of knowledge, and measures of spatial skills to quantify student learning that occurred with a GIS-based module on plate tectonics and geologic hazards. They found positive correlations between

students' spatial ability and performance on both the posttest and a regular course exam that covered the material in the GIS activity.

Todd C. Patterson [13] mentioned that the implementation of Geographic Information Science (GIScience) applications and discussion of GIScience-related themes are useful for teaching fundamental geographic and technological concepts. As one of the newest geographic information tools available on the World Wide Web, Google Earth has considerable potential to enhance methods for teaching geography and helping students develop other capabilities. He also emphasized that Google Earth's utility as a teaching tool in precollegiate environments is illustrated through development of a South Carolinabased lesson plan focused for seventh grade students that increases students' geographic awareness while also building critical thinking, analysis, and inquiry skills in support of various educational standards.

This study designed an information system based on web and Google Earth, it use special information technologies like "Add Image overlay", "The KML program language", "Download KMZ files" to construct the weather course for teaching and learning (Fig. 1). It makes student easier to learn more, and for the teacher, it can increase the origin teaching material to reach the goal that information combine with the course. Misconception of weather concept will be the key point to study before and after the use the Google Earth. We can not only discussing the resolve of the misconception of weather, but also can analysis the usage willing of teacher and student. The results can propose the concrete suggestion to consult for teachers cultivates the organization, the teacher instructs of the natural curriculum, and nationals elementary school.

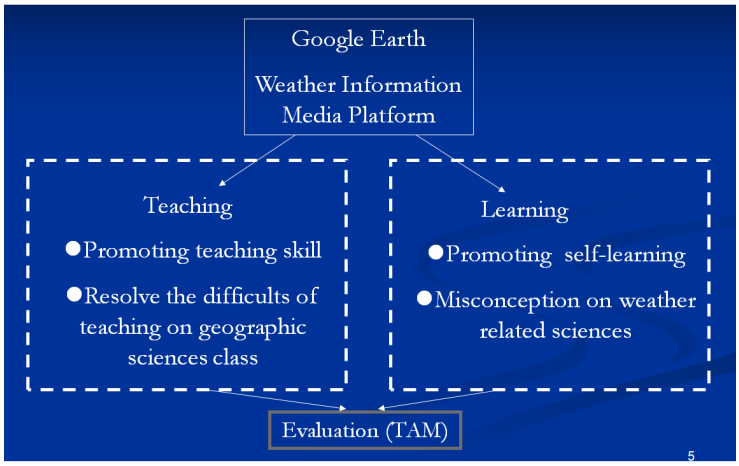

Figure 1: Design of Google Earth weather Information Media System

Google Earth Weather Information Media Platform

This study developed an innovative tool for diverse geographic learning environments that can enable teachers and students to use and apply ubiquitous GIS tools. We developed an education information system that combines near-time precipitation recodes and satellite image then integrated to web-based GIS – Google Earth. Teacher can download and choose the suitable weather episodes KML files from the platform, then integrated the rainfall distribution and cloud distribution both in temporal and spatial domain. The surface rainfall can overlap by upper satellite to recognize the position of weather conditions. The framework of our learning tool is shown in Fig. 2. It can identify where there is raining, and where is cloud covering. Students can learn the concept of water cycle in the nature environment, learn how to make clear the geographic relationship rainfall with cloud.

Figure 2. Results of display on Google Earth, left panel shows rainfall distribution, right panel shows satellite image, the middle panel shows overlapping combination

The system design for teaching is further explained below.

(1) A workshop advised by supervisor to learn the usage of Google Earth and the platform;
(2) According to the design of curriculum, teacher can download the KMZ files into the client PC;
(3) Teaching in class, then go evaluation of learning.

The following is the self learning scenario: One student is learning the nature science which goes into weather part, water cycle in natural environment is the key issue, such as rain, cloud, fog… Teacher at first introduce the use of Google Earth, after the student familiar with the control panels of Google Earth, the KMZ file prepared by teacher will extract to Google Earth and let the student operate by himself. Observation key points are the position and timing of rainfall and cloud, are them show in the same location? Also in the same time? Finally, a test is used to evaluation the learning through Google Earth. Figure 3 shows the implementation processes both in teacher and student.

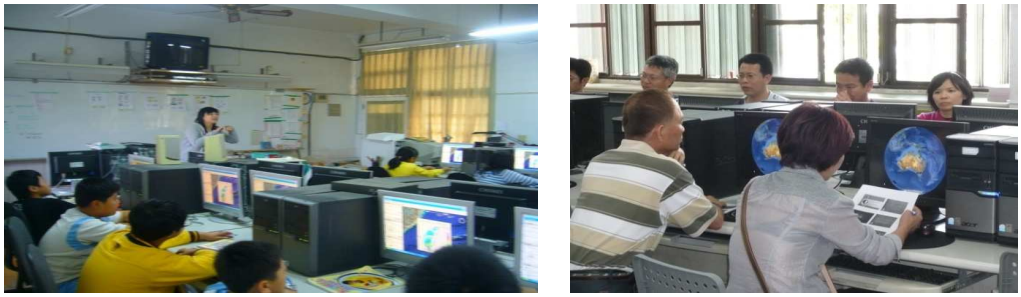

Figure 3. Implementation of Google Earth, left: student and right: teacher

Discussion

To evaluate the GIS information system, this study employed the technology acceptance model (TAM) to assess the feasibility and applicability of the system on teacher side. The evaluation tool used was a questionnaire we developed based on the TAM questionnaire designed by [14]. Questionnaires were distributed among 60 elementary teachers. These teachers first participated in a two-hour workshop on the Google Earth Learning System to learn the design concepts and functions of the Google Earth information system on weather related class. Then the teachers were instructed to complete the questionnaires. The main points for analysis (the variables) were the

aspects of “user capability,” “usefulness,” “ease of use,” and “attitudes and willingness to adopt.” We used multiple regressions to develop a path for teacher willingness to adopt the Google Earth information system; the analysis results are shown in Fig. 4.

The analysis results indicated that the various paths in the TAM model were significant. The correlation coefficient of the effect of the ease of using the Google Earth information system on the Google Earth information system usefulness was 0.638. This indicates that the higher the perceived ease of using the Google Earth system a teacher displays, the more positive their attitudes toward the perceived usefulness of the Google Earth system are. The correlation coefficient of the effect of the Google Earth information system usefulness on the teachers’ willingness to adopt the Google Earth information system was also high at 0.715. This indicates that the higher the perceived usefulness of the Google Earth system, the higher the teachers’ willingness to adopt the Google Earth information system. In the path analysis, the correlation coefficient of the effect of the ease of using the Google Earth information system on teachers’ willingness to adopt the Google Earth information system is 0.715. This indicates that the greater the perceived ease of using the Google Earth information system, the higher teachers’ willingness to adopt the Google Earth information system. This finding differs from that reported by [14] using the TAM model. The results of this study show that both the ease of use and the usefulness of the system have a significant positive correlation with teachers’ willingness to adopt the system in the future.

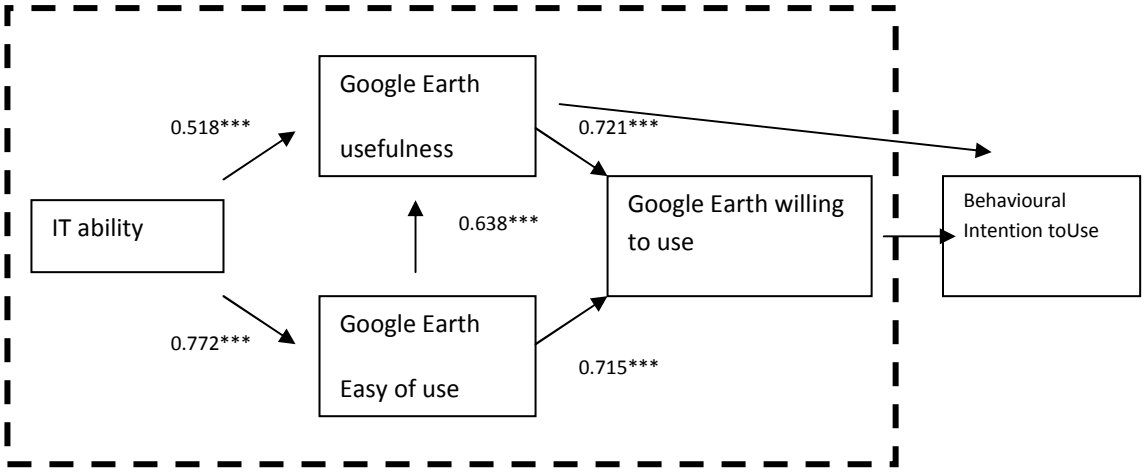

Figure 4 Technology Acceptance Model for Integrated Q-R Code Learning System

In the student side, we adopt the sensitivity test to understand the effect of Google Earth. There are 106 six-grade students separate two group to learn the water cycle in the atmosphere, half of them are learning in traditional processes, but the others are linking to the Google Earth information system. After the pre-test and post-test analysis, we learned that the t-test items of Google Earth group are all significant, this results imply it is very helpful to using Google Earth on the weather related class. In the knowledge test, post-test result shows the grads mean deviation raised 0.86 in the Google earth group compared with the traditional learning group.

Summary

From the analysis of this study, Google Earth has intuitive interface and powerful simple tools to help teachers and students to apply scientific logic to reach conclusions

promotes development of analytical skills. Students are made aware of spatial as well as temporal trends and implications while not explicitly knowing they are learning geography; this can be both a potential strength and weakness. Google Earth enables students to learn about spatial patterns and think spatially. Both in teaching and learning, the results of this study show that both the ease of use and the usefulness of the system have a significant positive correlation with teachers' and students' willingness to adopt the system in the future.

References

[1]. Levine, J. (1998). Planning strategically for technology integration. In S. McNeil, J. D. Price, S. Boger-MeHall, B. Robon, & J. Willis (Eds.), *Technology and Teacher Education Annual 1998* (pp.293-295). Charlottesville, VA: Association for the Advancement of Computing on Education.

[2]. Sprague, D., & Dede, C. (1999). Constructivism in the classroom: If I teach this way, am I doing my job? *Learning and Leading with Technology , 27*(1), 6-21.

[3]. Ertmer, P., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education, 32* (1), 54-72.

[4]. Dias, L. B. (1999). Integrating technology: some things you should know. *Learning & Leading with Technology, 27* (3), 10-13.

[5]. Demirci, A. (2009). How do teachers approach new technologies: Geography teachers' attitudes towards geographic information systems (GIS). *European Journal of Educational Studies, 1*(1), 43-53.

[6]. Fitzpatrick, C., & Maguire, D. J. (2000). *GIS in schools: Infrastructure, methodology and role. In: GIS: A sourcebook for schools* (ed D. R. Green), Taylor & Francis, Jersey, 61-62.

[7]. Broda, H. W., & Baxter, R. E. (2003). Using GIS and GPS technology as an instructional tool. *The Social Studies, 94*(4), 158-160.

[8]. Kerski, J. J. (2003). The implementation and effectiveness of geographic information systems technology and methods in secondary education. *Journal of Geography, 102* (3), 128-137.

[9]. Wigglesworth, J. (2003). What is the best route? Route-finding strategies of middle school students using GIS. *Journal of Geography, 102* (6), 282–291.

[10]. Bednarz, S. W. (2004). Geographic information systems: A tool to support geography and environmental education? *GeoJournal, 60*(2), 191–199.

[11]. Bednarz, S. W., & Van der Schee, J. (2006). Europe and the United States: The implementation of geographic information systems in secondary education in two contexts. *Technology, Pedagogy and Education, 15*(2), 191-205.

[12]. Hall-Wallace, M. K. & McAuliffe, C. M. (2002). Design, implementation, and evaluation of GIS-based learning materials in an introductory Geo-science course. *Journal of Geoscience Education, 50*(1), 5-14.

[13]. Patterson, T. C. (2007). Google earth as a (not just) geography education tool. *Journal of Geography, 106*(4), 145-152.

[14]. Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003.