Computers & Education 87 (2015) 243–253

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

The effectiveness of the meaningful learning-based evaluation for different achieving students in a ubiquitous learning context

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ARTICLE INFO

Article history:
Received 9 March 2015
Received in revised form 28 June 2015
Accepted 30 June 2015
Available online 8 July 2015

Keywords:
Evaluation methodologies
Evaluation of CAL systems
Human–computer interface

ABSTRACT

In recent years, fueled by the rise of mobile technology, ubiquitous learning has shown great potential in various disciplines, especially in context-aware environments. However, improper applications of this learning approach may also lead to inefficient learning and even reduced learning effectiveness. It is thus necessary to assess whether a ubiquitous learning project is able to achieve the aim of meaningful learning, so as to empower learners in scaffolding their knowledge students with different levels of achievement, especially low-achieving ones. This study aims to investigate the impact of a meaningful learning-based evaluation method on ubiquitous learning, in order to enhance the target system. A quasi-experiment is designed for this purpose, in which the post-evaluation and refined ubiquitous learning activities are adopted for the experimental group, in contrast to the control group, which works without the proposed evaluation method. The findings show that the evaluating ubiquitous learning using the meaningful learning paradigm can significantly enhance learning effectiveness, especially for low-achieving students, although the gains were not so significant for the high-achieving students, as seen in the posttest. Moreover, no significant differences in learning effectiveness were found between the experimental and control groups. The results of the posttest showed that the low-achieving students in the experimental group significantly outperformed those in the control group. This study suggests that the functions of a learning system may be need to be further enhanced to better suit the needs of low-achieving students, and that the use of a meaningful learning-based evaluation method is an effective way to find out what needs to be improved.

1. Introduction

With advances in wireless Internet technology and ubiquitous computing, many ubiquitous-learning (u-learning) systems have been developed and are now being used by teachers and students (Hwang, Tsai, & Chen, 2012). The application of u-learning in education not only provides instructors with a more diverse range of teaching strategies, but also offers students more learning opportunities (Hwang, Chu, Lin, & Tsai, 2011; Massey, Ramesh, & Khatri, 2006; Tsai, Tsai, & Hwang, 2011). U-learning has now been applied to many different subjects such as natural science, the learning of foreign languages and

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http://dx.doi.org/10.1016/j.compedu.2015.06.009
0360-1315/

environmental education (Chen, Chang, Lin, & Yu, 2009; Wurst, Smarkola, & Gaffney, 2008). However, inadequate applications of this novel technology may cause meaningless learning of operational techniques, rather than practical, meaningful involvement in learning (Hall & Bannon, 2006; Liu, Lin, Tsai, & Paas, 2012; Shih, Wang, Chang, Kao, & Hamilton, 2007). In addition, most emerging information technologies for education ignore the fact that students with different levels of achievement with different levels of achievement require different designs of learning systems and learning strategies. Tsai and Shen (2009) noted that electronic learning (e-learning) not only applies information and communication technology (ICT), but also requires developers to focus on the issue of overall learning effectiveness, especially for low-achieving students. Lee, Shen, and Tsai (2010) indicated that such students face a number of problems in traditional education, such as a passive attitude, low levels of interaction, and a lack of confidence. Fortunately, ICT technology has the potential to use u-learning to provide adaptive and personalized learning activities for different students with different levels of achievement. In this context, u-learning requires constant evaluation and refinement to sustain its feasibility and applicability, and an effective evaluation scheme is the foundation of this.

Huang, Chiu, Liu, and Chen (2011) proposed an effective evaluation methodology for u-learning, based on the concept of meaningful learning. This is because only meaningful learning can ensure that all the learning activities learners participate in are actually effective, in such a way that what they have learned can be transformed into individual knowledge, rather than simply facts that have been memorized. However, this evaluation model still needs to be examined with regard to its effects on learning.

This study thus applied a natural science course to a u-learning context, and examined how this could be improved using a meaningful learning evaluation, with a focus on the effects on students with different levels of achievement. Based on the results of this, the focal learning activity was further refined to achieve the requirements of meaningful learning. A quasi-experimental design was employed to conduct the experiment. The ubiquitous learning activities assessed by the meaningful learning evaluation were used with the experimental group, with this condition called *post-assessment ubiquitous learning*, while the ubiquitous learning activities not assessed by the evaluation method were used with the control group, and this condition is named *pre-assessment ubiquitous learning*. The design of this experiment is thus intended to investigate the influence of post-assessment ubiquitous learning on the students' of learning effectiveness, and to further analyze the differences between high- and low-achieving groups, in order to better understand the differences between the experimental and control groups with regard to learning effectiveness. The research questions examined in this work are as follows:

- Is the ubiquitous learning assessed by the meaningful learning evaluation beneficial to the promotion of learning effectiveness?
- Is the ubiquitous learning assessed by the meaningful learning evaluation beneficial to the promotion of the learning effectiveness of high-achieving students?
- Is the ubiquitous learning assessed by the meaningful learning evaluation beneficial to the promotion of the learning effectiveness of low-achieving students?

2. Literature review

This section reviews two major streams of literature, those studies on promoting the learning effectiveness of students with different levels of achievement, and those on the use of meaningful learning-based evaluations for ubiquitous learning.

2.1. Promoting learning effectiveness of different achieving students

Many studies of computer-assisted instruction (CAI) or electronic learning (e-learning) have examined how to promote learning effectiveness. Woo and Reeves (2007) considered that CAI represents a teaching tool that involves the use of programs to facilitate the education of students. Its major goal is to provide effective learning through educational technology. Tsai and Shen (2009) stated that e-learning should focus on improving learning effectiveness, especially for low-achieving students.

The use of new technology in education, as seen in mobile learning and u-learning, has been examined for its effects on learning outcomes. Tsai (2009) noted that it is necessary to evaluate these novel learning technologies to see if they are really helpful for students with different levels of achievement, especially for low-achieving ones. Moreover, low-achieving students often behave passively in learning activities, seldom cooperating with peers and lacking the confidence to make their own arrangements to carry out learning (Lee et al., 2010). Fortunately, a u-learning environment can provide a rich, interactive learning community for learning activities, which may give low-achieving students an opportunity to improve. Moreover, further improvements can be made by applying the appropriate pedagogical philosophy to the learning environment.

2.2. Meaningful learning-based evaluation for u-learning

Rapid advances in information technology and telecommunications have enabled instant access to information and knowledge (Tsai, 2009; Tsai, Jessie Ho, Liang, & Lin, 2011), while the use of mobile technology and ubiquitous computing have