Mobile Technology-Enhanced Learning

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Gwo-Jen Hwang
National Taiwan University of Science and Technology, Taiwan

INTRODUCTION

Mobile devices, such as smartphones and tablet computers, are becoming an important medium of providing anytime and anywhere learning (Looi et al, 2010; Terras & Ramsay, 2012). Using mobile devices as learning equipment enables students to learn across contexts, without being limited by space and time (Liu & Hwang, 2009).

In the past decades, researchers have given different definitions related to mobile technology-enhanced learning. For example, Sharples, Milrad, Arnedillo and Vavoula, (2009) defined "mobile learning" as the approach in which learners use mobile technologies to learn or the approach that enables learners to move during the learning process. Wong and Looi (2011, p. 1) defined the term "seamless learning" as "the seamless integration of the learning experiences across various dimensions including formal and informal learning contexts, individual and social learning, and physical world and cyberspace." It can be seen that those definitions are based on the assumption of one or more mobile device per learner, as indicated by Chan et al. (2006). Moreover, the latter also assume that wireless networks are available.

Another frequently used term for mobile technology-enhanced learning is "ubiquitous learning," which refers to learning can be proceeded in anywhere and at any time. Hwang, Tsai and Yang (2008) have indicated that "ubiquitous learning" could be a broad-sense definition referring to anywhere and anytime learning without relating to any specific technology, or it could be a very specific definition referring to the use of mobile, wireless, and/or even the ubiquitous computing technologies to support learning. They have further the term "context-aware ubiquitous learning" to represent the use of mobile devices with wireless communication facilities as a medium for conducting in-field learning activities with the assistance of sensing technologies, such as QR (Quick Response) codes, RFID (Radio Frequency Identification) and GPS (Global Positioning System) to detect the real-world status of learners (Hwang, Tsai, & Yang, 2008).

OVERVIEW

Sung and Hwang (2014, P1) indicated that "mobile technology-enhanced learning activities could be indoors or outdoors, within a single context, or across contexts, depending on the objectives of the learning activities, the features of the learning content, and the needs of associating the learning content to real-world contexts."

Dr. Mike Sharples (Sharples, 2000) at The Open University in the United Kingdom and Dr. Jeremy Roschelle (Roschelle, 2003) at the Center for Technology in Learning at SRI International in United States are among the earliest examining this topic.

In the past decade, mobile technologies have been applied to various learning activities, such as the activities for language courses (Abdous, Facer, & Yen, 2012; Chang, Lan, Chang, & Sung, 2010; Ogata & Yano, 2004), nursing courses (Wu, Hwang, Su, & Huang, 2012), chemistry courses (Hwang, Yang, Tsai, & Yang, 2009), and architecture design courses (Sung & Hwang, 2014); moreover, the technologies have also been applied to the field trips in museums (Hall & Bannonw,

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2006), temples (Chu, 2014; Hwang, & Chang, 2011) and ecology parks (Shih, Hwang, & Chu, 2010), as well as on school campuses (Chu, Hwang, & Tsai, 2010).

The advantages and potential of the approach have been reported by several previous studies. One benefit of mobile technology-enhanced learning is provision of personalized learning support in real-world learning scenarios, including personalized learning guidance or feedback in the field (Chu, Hwang, &Tsai, 2010; Hwang, Tsai, Chu, Kinshuk, & Chen, 2012),personalized learning schedules (Tatar, Roschelle, Vahey, & Penuel, 2003), personalized learning paths (Chiou, Tseng, Hwang, & Heller, 2010; Hwang, Kuo, Yin, & Chuang, 2010). Another benefit refers to the provision of peer communication facilities in the real-world learning environments (Huang, Kuo, Lin, & Cheng, 2008).

The lead-in of sensing technologies has further enabled the learning system to provide right information at the right place and in the right time (Hwang, Tsai, & Yang, 2008). For example, Ogata and Yano (2004) developed a mobile learning system for Japanese practice using GPS and mobile phones, so that the learning system could present quizzes related to the real-world location of the students. They found that the students' learning interest and confidence of learning Japanese were increased with such a context-aware supports. Another study conducted by Chu, Hwang and Tsai (2010) for helping students identify the plants on an elementary school campus with PDA (Personal Digital Assistant) and RFID also showed that providing guidance and hits based on the students' real-world contexts could significantly improve their learning outcomes. In addition, researchers have also indicated that, with the help of the sensing technologies, the students' physical locations and the time for arriving at the locations can be recorded for further analysis (Hwang, Wu, & Ke, 2011; Ogata, & Yano, 2004; Tan, Lin, Chu, & Liu, 2012).

Therefore, Liu and Hwang (2010) have inferred that the paradigm of e-learning has been shifted from "web-based learning" that uses desktop computers and wired networks to "mobile learning" that uses mobile computers with wireless networks, and will eventually be shifted to "context-aware ubiquitous learning" that uses mobile computers, wireless networks and sensing technologies to more actively provide personalized supports in the real-world environments.

CURRENT SCIENTIFIC KNOWLEDGE IN MOBILE TECHNOLOGY-ENHANCED LEARNING

Dr. Mike Sharples (Sharples, 2009; Sharples, Taylor, & Vavoula, 2007) at The Open University in United Kingdom, Dr. Gwo-Jen Hwang (Hwang & Chang, 2011; Hwang, Tsai, & Yang, 2008; Hwang, Wu, & Ke, 2011; Sung & Hwang, 2014) at National Taiwan University of Science and Technology in Taiwan, Dr. Marcelo Milrad (Milrad, Kohen-Vacs, Vogel, Ronen, & Kurti, 2011; Vogel, Spikol, Kurti, & Milrad, 2010) at Linnaeus University in Sweden, Dr. Chee-Kit Looi (Looi et al., 2010) and Dr. Lung-Hsiang Wong (Wong, Chin, Tan, & Liu, 2010; Wong & Looi, 2011) at Nanyang Technological University in Singapore, Dr. Hiroaki Ogata (Ogata et al., 2008; Ogata et al., 2010) at Kyushu University in Japan, and Dr. Hui-Chun Chu (Chu 2014; Chu, Hwang, & Tsai, 2010) in Soochow University in Taiwan are among the leading experts in mobile technology-enhanced learning.

Inquiry-Based Mobile Learning

The first research issue is inquiry-based mobile learning, which refers to the use of mobile technologies to support inquiry-based learning activities in field trips. For example, Vogel, Spikol, Kurti, and Milrad (2010) reported a "LETS GO" project, in which a learning system including for supporting in-field collaborative scientific inquiry activities was developed. The system enabled students to raise questions and formulate