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A contextual game-based learning approach to improving students' inquiry-based learning performance in social studies courses

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ABSTRACT

Inquiry-based learning, an effective instructional strategy, can be in the form of a problem or task for triggering student engagement. However, how to situate students in meaningful inquiry activities remains to be settled, especially for social studies courses. In this study, a contextual educational computer game is developed to improve students' learning performance based on an inquiry-based learning strategy. An experiment has been conducted on an elementary school social studies course to evaluate the effects of the proposed approach on the inquiry-based learning performances of students with different learning styles. The experimental results indicate that the proposed approach effectively enhanced the students' learning effects in terms of their learning achievement, learning motivation, satisfaction degree and flow state. Furthermore, it is also found that the proposed approach benefited the "active" learning style students more than the "reflective" style students in terms of learning achievement. This suggests the need to provide additional supports to students with particular learning styles in the future.

1. Introduction

Owing to the rapid advancement of information technology, technological instruction has attracted much attention. Researchers have developed diverse computer-assisted learning approaches or systems to promote the learning effectiveness of students (Li & Lim, 2008; Pedaste & Sarapuu, 2006). In general, effective instruction is required to foster students' key competences (Šimonová, Poulová, Sokolová, & Bílek, 2013), including complex problem-solving, critical thinking, and so forth (Voogt & Roblin, 2012); furthermore, computer-assisted learning which provides students with opportunities for problem solving has been shown to display a major difference in comparison with traditional direct instruction. Many researchers have recognized inquiry-based learning (IBL) as an excellent teaching approach to engage students in self-directed learning and to make learning more meaningful (Benson & Bruce, 2001; Pedaste & Sarapuu, 2006). Furberg (2009) indicated that inquiry learning environments provide potential affordances for students to interact with specific knowledge domains. Ikpeze and Boyd (2007) asserted that inquiry-based learning facilitates students' participation in meaningful activities and reinforces their critical thinking skills with the aid of technology. Moreover, Lin, Liang, and Tsai (2012) revealed that Internet-assisted inquiry activities provide students with prompts for exploration, investigation and identifying alternative ideas, and stimulate them to learn autonomously. As a consequence, IBL can be an instructional approach for stimulating students' higher-order thinking processes and promoting self-directed learning skills (Lim, 2004; Looi, 1998).

Oliver (2008) further illustrated that inquiry-based learning can be in the form of a problem or task for triggering student engagement and participation. In addition, scholars consider that problem solving is one of the most meaningful and significant ways of learning and thinking (Chu, Hwang, Tsai, & Tseng, 2010; Jonassen, 1997), implying the importance of facilitating students' problem-solving ability (Hwang, Wu, & Chen, 2012). Even so, researchers have indicated that IBL is confronted with several problems in large classrooms, involving

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the dilemmas of being time consuming to develop the learning activities, to facilitate students' learning motivation, to organize the data and to emulate the learning context (Kuhn, Black, Keselman, & Kaplan, 2000; Lee & Butler, 2003; Ucar & Trundle, 2011).

The utilization of computer and network technologies has assisted in solving some of these problems. Conventional technology-integrated IBL environments can not only provide opportunities for students to collect and analyze data and to provide explanations, but can also motivate them with the right questions and engage them in various learning activities (Lee & Butler, 2003; Ucar & Trundle, 2011); that is to say, the acquisition and application of the data for inquiry-based learning activities has been resolved. However, it remains a challenge to situate students in the real-world, especially for social studies courses; thus, it is crucial to afford students the learning situations to conduct meaningful inquiry activities (Lim, 2004). Accordingly, the development of an effective instructional approach for supporting inquiry-based learning activities has become an important and challenging topic (Raes, Schellens, de Wever, & Vanderhoven, 2012).

Educational games are regarded as an effective instructional approach for promoting the learning motivation and problem-solving skills of students (Moreno-Ger, Burgos, Martínez-Ortiz, Sierra, & Fernández-Manjón, 2008; Prensky, 2003). It can offer situated meaningful learning environments in which students acquire problem-solving abilities and enhance their knowledge while taking part in the gaming activities (Hwang, Sung, Hung, Huang, & Tsai, 2012; Kim, Park, & Baek, 2009). For example, Inal and Cagiltay (2007) emphasized that interacting during gameplay events can stimulate students' motivation; on the other hand, Kiili (2007) revealed that authenticity and learning by doing, the most important characteristics of effective educational games, can enhance students' problem-solving abilities. In this study, to facilitate students' learning effectiveness in the problem-solving learning activities, an inquiry-based educational computer game has been developed for engaging students in meaningful learning activities.

2. Literature review

2.1. Inquiry-based learning

Researchers have indicated the importance of utilizing inquiry-based learning, which refers to the effect of making learning more meaningful and self-directed by means of determining the problem-solving procedures (Hwang, Tsai, & Chen, 2012; Lim, 2004). Oliver (2008) asserted that students with inquiry-based learning would be encouraged to use high-order thinking and take on more responsibility for their learning. Inquiry-based learning aims to situate students in a meaningful environment to formulate and justify explanations based on evidence, and to solve problems that could be analogous to real life (Lin et al., 2012; Shih, Chuang, & Hwang, 2010).

Inquiry-based learning empowers students to conceptualize a problem and then search for possible explanations related to that problem (Olson & Loucks-Horsley, 2000) so as to enhance their high-order thinking abilities and problem-solving skills. Ikpeze and Boyd (2007) indicated that inquiry-based learning encourages students to participate in explanations, reflections, and reinforcement of critical thinking abilities by way of meaningful activities. Pedaste and Sarapuu (2006) illustrated that the inquiry-based process requires various problem-solving and science process skills, including basic and integrated skills. Moreover, Cunningham and Duffy (1996) considered problems as a stimulus of authentic activity to develop the skills related to solving the problems, including collecting information and honing one's metacognitive skills.

To elaborate the benefits of inquiry-based learning activities, it is crucial to carefully design learning tasks or problems that can enhance students' learning effectiveness. Lee and Butler (2003) asserted that authentic activities are significant in promoting inquiry for the high degrees of complexity provided by natural problem-solving contexts. Thus, appropriate learning situations are needed for students to perform tasks effectively (Endsley, 2000). Researchers have demonstrated the requirements and significance of situating students in authentic environments where they can meaningfully learn via linking their prior knowledge with the real-world scenarios when participating in the learning activities (Brown, Collins, & Duguid, 1989; Dabbagh & Dass, 2013). Situated cognition learning has described that learning happens in real activities while searching for equitable explanations of knowledge and inquiry activities that are the general practices of the culture (Brown et al., 1989; Hwang, Chu, Lin, & Tsai, 2011). In this study, situations need to be afforded to guide students while conducting inquiry learning activities.

The progress of computer and network technologies has provided the potential benefits of inquiry-based instruction (Ucar & Trundle, 2011). Many previous studies have demonstrated positive impacts of the technology-integrated IBL environment on learning effectiveness (Hwang, Tsai, et al., 2012; Kuhn et al., 2000). Utilizing technology as a cognitive support during the inquiry-learning process can not only provide students with opportunities for developing high-order abilities, but can also motivate them with the problem-solving learning activities (Oliver, 2008; Ucar & Trundle, 2011). However, when conducting inquiry-based learning activities in conventional classrooms, it remains a dilemma to afford students the situations required to conduct meaningful inquiry activities (Lim, 2004), especially for social studies courses.

Using the traditional approach, classroom environments might not be suitable to facilitate students' collection of the information necessary to carry on inquiry activities (Lee & Butler, 2003). Moreover, even in a technology-integrated IBL environment, educators still face many challenges in designing inquiry activities in a complex and ill-structured learning environment (Lim, 2004). Accordingly, in this study, an educational computer game with an inquiry-based approach is proposed to cope with these problems.

2.2. Digital game-based learning

Digital game-based learning (DGBL) is a student-centered educational approach which adopts the form of simulations situating students in a learning environment (Hung, Hwang, Lee, & Su, 2012; Hwang, Yang, & Wang, 2013; Prensky, 2003). Thus, DGBL is a kind of learning context in which players compete while acquiring educational goals according to specific rules and principles, contributing to the development of their cognitive skills and their construction of knowledge, while at the same time promoting their motivation (Erhel & Jamet, 2013; Huang, Huang, & Tschopp, 2010; Moreno, 2012; Moreno-Ger et al., 2008). Moreover, Hwang, Sung, et al. (2012), Hwang, Tsai, et al. (2012), Hwang, Wu, et al. (2012) indicated that educational computer games can be considered as a situated learning environment in