

Using Educational Computer Games for Science Teaching: Experiences and Perspectives of Elementary Science Teachers in Taiwan

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ABSTRACT

This study explored 21 elementary science teachers' experiences of and attitudes toward playing computer games, and their positions regarding using computer games in science teaching. Also, these teachers' perspectives, willingness, and relevant professional abilities of integrating educational computer games (ECGs) into their instruction were investigated. There were three stages of data collection in this study: tape-recorded pre-interviews, experiencing an ECG for science learning, and tape-recorded follow-up interviews. This study revealed that less than forty percent of the teachers had ever used computer games in their teaching. After experiencing the ECG in this study, most teachers recognized the educational essence of ECGs, and all of them were willing to integrate ECGs in their science classes. However, most of the teachers expressed poor understanding of ECGs and digital game-based learning, and recognized the significant role of specific pedagogical content knowledge and the need for computer skills.

Keywords: Digital Game-Based Learning, Educational Computer Game (ECG), Elementary Science Teacher, Experiences, Science Education

INTRODUCTION

Rapid development in information technologies has dramatically influenced the ways of teaching and learning (Knezek & Christensen, 2002). This has also enhanced the role of computer games, which are no longer considered merely a form of entertainment, but also a form of edutainment. Recently, a growing number of researchers and educators have recognized the powerful potential of using computer games for educational purposes (e.g., Connolly et al.,

2012; Gee, 2003a, 2003b; Kebritchi, 2010; Paraskeva, Mysirlaki, & Papagianni, 2010). In particular, the use of educational computer games can provide more active involvement, promoting personal motivation and satisfaction, accommodating multiple learning styles, and providing interactive and decision-making contexts (Kebritchi & Hirumi, 2008; Kebritchi, 2010). Prensky (2001) proposed the term "digital game-based learning" (DGBL), noting how the motivation of games could be combined with curricular goals and content.

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In recent years, digital game-based learning has been implemented in many learning domains, and the use of computer games in education has long been a focus of interest for researchers in different subjects (Paraskeva, Mysirlaki, & Papagianni, 2010; Peterson, 2010). In one of these subjects, science education, educational computer games have also been increasingly discussed (e.g., Annetta et al., 2009a; 2009b; Barab et al., 2005; Mason, Bub, & Lalonde, 2011). For science learners, scientific concepts can be relatively more abstract and complicated compared to other disciplines, and scientific inquiry and problem-solving skills often require long-term cultivation and repeated practice. As a result, science learners generally exhibit a sense of anxiety and face difficulties in science learning. To help them overcome their learning anxiety and difficulties, and to improve their learning motivation and outcomes, the use of computer games in science learning has received increasing attention from science educators and researchers in recent years (Hwang & Wu, 2012).

Despite the potential benefits of game-based learning, educational computer games have not been widely adopted by teachers (Kebritchi, 2010). It should be noted that while learners' learning styles are changing rapidly with the development of technology and the Internet, teachers' instructional strategies and the pedagogical methods they use are not synced with this change. More specifically, traditional didactic instructional teaching methods are still prevalent in many schools, resulting in the low motivation of learners (Lim, 2008). However, today's learners are often recognized as "digital natives" (Annetta, 2008; Prensky, 2001, 2006). Most are positive about and familiar with using new information and communication technologies, including computer games (Paraskeva et al., 2010; Blakely et al., 2010). Besides, in their daily lives, they are also used to interacting and collaborating through various social networking tools or computer games (Ketehut & Schifter, 2011). This means that, to motivate these digital native students, teachers have to adapt to their

learning styles. In other words, teachers may play a central role in implementing game-based learning in schools.

In the last decade, an increasing number of studies have explored issues related to using educational computer games in science education. Nevertheless, most of the relevant research has mainly focused on the student, demonstrating that the use of educational computer games in science learning is capable of improving scientific knowledge construction (e.g., Miller et al., 2011), inquiry ability (e.g., Barab et al., 2005), engagement (e.g., Annetta et al., 2009b), and motivation for learning (e.g., Li, 2010; Papastergiou, 2009). Only very little research on DGBL in science education has addressed the teachers in any fashion. In one of the few examples, Kennedy-Clark (2011) explored pre-service secondary science teachers' knowledge of and attitudes toward the use of scenario-based multi-user virtual environments in science education, revealing that these teachers have a reasonable understanding of both the potential advantages and disadvantages of using multi-user virtual computer games within a classroom setting. Annetta et al. (2013) reported a design-based study on middle and high school science teachers' professional development using video games. Further DGBL research addressing science teachers would be of great importance.

To fill this research gap, the exploration of teachers' experience and understanding regarding educational computer games and digital game-based learning will be one of the important research directions. Researchers have also argued that games are powerful educational tools if used appropriately (Alessi & Trollip, 2001). Becker (2007) stated that "teachers cannot be expected to embrace digital games as a tool for learning unless they have a sound understanding of the potential as well as the limitations, and the confidence in their ability to use games effectively to enhance learning" (p.478), suggesting that science teachers' prior experience and understanding of educational computer games and digital game-based learning are crucial for successful implementation

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