# Development of a contextual decision-making game for improving students' learning performance in a health education course

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## ARTICLE INFO

## ABSTRACT

Heath education is an important component of the curriculum for fostering children's correct health knowledge and good daily life habits. However, educators have indicated that most children might fail to realize the importance and meaning of health education content owing to the lack of authentic scenarios and daily life experience. With the advancement of computer technologies, researchers have tried to develop multimedia learning content in order to improve students' learning performance. Among various technology-enhanced learning alternatives, digital game-based learning has been recognized as a highly potential approach to motivating students. However, several previous studies have indicated that, without properly incorporating learning content into game scenarios, the effectiveness of digital game-based learning might not be as good as expected in comparison with conventional technology-enhanced learning. In this study, a contextual digital game was developed for improving students' learning performance in an elementary school health education course. A quasi experiment was conducted to evaluate the effectiveness of the proposed approach by situating the experimental group in the game-based learning scenario and the control group to learn with conventional e-books. The experimental results showed that the proposed approach not only improved the students' learning motivation, but also their learning achievement and problem-solving competences. Moreover, the significant two-way interaction suggested that the contextual game-based learning approach benefited the higher motivation students more than the lower motivation ones in terms of the advanced knowledge, showing the importance and potential of applying contextual games to health education activities.

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## 1. Introduction

Health education has been identified by educators as an important component of the curriculum for fostering children's correct health knowledge and good daily life habits (Noguera, Jiménez, & Osuna-Pérez, 2013; Sisask et al., 2014; Thomas, 2013). On the other hand, educators have indicated the challenges of teaching health education courses owing to the lack of learning activities that help students experience the importance of having sufficient health knowledge in their daily life (Asuero et al., 2014; Chuang & Tsao, 2013; Consorti, Mancuso, Nocioni, & Piccolo, 2012).

Due to the development of computer and multimedia technologies, many scholars have attempted to employ digital learning content to improve students' learning motivation. Many studies have examined the effectiveness of technology-enhanced learning and have reported its benefits (Abdulla, 2012; Chow, Herold, Choo, & Chan, 2012; Pivec, 2007). For example, Chuang and Tsao (2013) found it effective to use the mobile phone short message service to enhance nursing students' knowledge of medication; Kazemi, Cochran, Kelly, Cornelius, and Belk (2014) employed mobile applications to reduce high risk drinking among underage students. On the other hand, researchers have also indicated that, without proper learning design, technologies might not be helpful, or could even cause negative effects in educational settings (Chu, 2014).

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Among the various technology-enhanced learning approaches, digital game-based learning has been well recognized by researchers as being a highly potential approach to motivating learners of all ages (Prensky, 2001, 2003). For example, Wolters (1999) and Prensky (2003) reported that learning via games could promote learners' motivation and hence enhance their learning efficacy. Czikszentmihalyi (1990) further proposed the "Flow Theory" to explain the situation in which players devote themselves completely to the game scenario and ignore the changes in the environment surrounding them as well as the passage of time.

In the meantime, researchers have emphasized the importance of providing authentic contexts to help students connect the knowledge learned from the textbooks to their daily life. If learning is removed from authentic contexts, students might lack the ability of applying the knowledge to their daily life; moreover, their learning motivation might be affected (Anderson, 1993; Mayer, 2002). That is, it is important to integrate daily life contexts as well as the learning content in the gaming scenarios and engage students in making decisions to complete the gaming missions (Huang, Huang, & Tschopp, 2010; Kim, Park, & Baek, 2009; Prensky, 2001).

Therefore, in this study, a contextual digital game was developed by integrating authentic contexts of health problems and learning content of the health education course into gaming scenarios. In addition, an experiment has been conducted to evaluate the effectiveness of the proposed approach by investigating the following research questions:

(1) Do the students who learn with the contextual digital game show higher learning motivation than those who learn with the conventional technology-enhanced learning approach?
(2) Do the students who learn with the contextual digital game show better learning achievement than those who learn with the conventional technology-enhanced learning approach?
(3) What is the relationship between the contextual digital game approach and the students' motivation levels?

## 2. Literature review

### 2.1. Digital game-based learning

An educational computer game can provide students with a learning environment in which gaming elements such as humor, suspense and drama are included in the storyline during the learning process of taking on challenges, and hence arouse students' learning motivation (Nelson, Erlandson, & Denham, 2011). There are usually some rules and prizes in a game to guide and encourage learners to think and analyze so as to make correct and meaningful decisions (Coller & Scott, 2009); for example, in some gaming scenarios, questions are used to provide hints or guides to learners for solving problems, initiating thinking, or completing learning tasks (Sung & Hwang, 2013).

Roussou (2004) has pointed out that computer games can increase students' enjoyment of learning and promote their learning motivation. Moreover, in comparison with conventional technology-enhanced learning approaches, educational computer games tend to provide more imaginary and challenging scenarios, and hence learners usually have more interactions with the learning systems (Hwang, Sung, Hung, Yang, & Huang, 2013). Lancy (1987) summarized three factors for an effective educational computer game: (1) Feedback and Fulfillment: During the gaming process, learners need to follow the gaming rules to move on. When moving from lower to higher levels, they receive immediate feedback and increasing fulfillment; (2) Curiosity and Adventure: After spending more time on an educational computer game, learners gain better gaming skills via receiving the guidance of the game and making reflections based on the mistakes they made in the previous trials, which then enables them to find and deal with new missions and more difficult gaming levels; and (3) A Sense of Achievement: For those games that are designed with the features enabling players to feel intrigued, gain new knowledge, and achieve better performance, learners are able to gain a sense of achievement (Coller & Scott, 2009). Prensky (2001) further pointed out several important factors to be taken into account when developing educational computer games, including the learning objectives, topics, achievement, feedback, conflicts, challenges, interactions, reinterpretation, and storyline.

In the past decade, various educational computer games have been developed for different educational purposes. For example, Ebner and Holzinger (2007) applied the digital game-based learning approach to teaching the theories related to concrete structures in a civil engineering course. Ketelhut and Schifter (2011) also used game-based learning to help students understand how diseases spread and to investigate the causes and effects of a disease in different situations. Hwang, Sung, Hung, Huang, and Tsai (2012) developed educational computer games to investigate the effects of learning styles on students' learning performances. Recently, Hwang, Yang and Wang (2013) developed an educational computer game for helping elementary school students identify plants on school campuses. Kebritchi and Hirumi (2008) further reviewed several studies and reported the potential of digital game-based learning for motivating students to learn.

### 2.2. Contextual learning

Contextual learning refers to the process whereby learners gain knowledge by taking part in a simulation environment and having interactions with people, events, or objects within that environment (Johnson, 2002). Hull (1993, P. 41) addressed the importance of contextual learning as follows: "the mind naturally seeks meaning in context—that is, in the environment where the person is located—and that it does so through searching for relationships that make sense and appear useful."

The concept of contextual learning was formed via observing people's cognitive activities in daily life. Previous research has found that thinking mainly happens in the contextual and practical activities related to people's daily life experience (Mayer, 1992). That is, people gain knowledge when they are situated in the environment or scenario where relative events or activities take place (Brown, Collins, & Duguid, 1989). Learners must learn within the environment using existing cognition to construct knowledge, and hence experience meaningful learning. Collins (1991) further indicated that contextual learning can help learners apply knowledge to various scenarios; moreover, learners' creativity could be enhanced when facing different situations in the context. On the contrary, if context is removed from the learning process, learners might not be able to depict or recall the relevant knowledge, which might lead to poor learning results.

Therefore, an effective learning approach is to link knowledge to corresponding contexts that reflect authentic scenarios (Sadler & Zeidler, 2005; Wu & Tsai, 2007). That is, in a learning environment, the context must be sufficient to reflect practical scenarios. As Lave