Are Good Games Also Good Problems? 
Content Analysis of Problem Types and Learning Principles in Environmental Education Games

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ABSTRACT

Based on theories from problem-based learning, this study content analyzed how educational messages are communicated to players in 108 web-based educational games. An argument of digital game based learning was also examined. Specifically the argument that good games will engage players with problems to solve, include more learning features to support problem-solving, and are more popular because of these learning features. This study found that the majority of games communicated environmental messages not as problems to solve and reflect upon, but as explicit values and facts to accept and memorize. The games that used ill-defined problems (i.e. multiple solutions) incorporated more learning principles than games that used well-defined problems (i.e. fixed solutions) and explicit facts. However, number of learning features did not predict game popularity.

Keywords: Content Analysis, Digital Game Based Learning, Environmental Education, Problem Based Learning, Serious Game

INTRODUCTION

An increasing number of digital games are used as educational tools in schools, professional trainings, and for health interventions (e.g., Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Peng, 2009; Squire & Barab, 2004). These games used for purposes other than pure entertainment are known as serious games (Michael & Chen, 2006). It is estimated that more than 125 million US dollars are invested into developing educational serious games every year (Blunt, 2007).

With an increasing number of educational serious games used for formal and informal learning, little is known about their content and quality. Hays (2005) conducted a literature review of 106 articles on educational games and found that the effects of educational games were inconsistent. While some games are effective...
in certain fields, other games did not show any effects in comparison to traditional pedagogical methods. Kebritchi and Hirumi (2008) reviewed 55 educational games and found that 24 of the games stated that pedagogical theories were incorporated into their design. Kebritchi and Hirumi’s (2008) approach provided a general categorization of the pedagogical theories incorporated into game design. However the method excluded games that did not report their theoretical foundation or did not respond to the researchers. Thus, it does not provide a comprehensive understanding about how well educational game links to theory. Without comprehensive knowledge about how well existing serious games are designed according to theory, teachers, parents, and policy maker cannot determine whether serious games should be used in curriculums, or which games are better suited for their goals.

This study seeks to fill this gap by conducting content analysis on 108 online serious games. This study not only provide an overview of the learning potential of existing serious game design, this study also examined an argument of digital game based learning (DGBL) that good games communicate their messages as problems for players to solve, incorporate more features that facilitates learning, and are more popular because they are better problem-solving experiences for players (e.g., Gee, 2003, 2007; Prensky, 2001). This study can contribute to the literature of DGBL and has practical implications for serious game design and education practitioners.

Digital Game-Based Learning

A general definition of digital game-based learning (DGBL) is the involvement of digital games in any kinds of formal or informal learning (Prensky, 2001). There are currently two major approaches in the study of DGBL. The first approach asks “what can education learn from the success of digital games?” These studies focus on identifying features that makes games appealing to learners. The second approach asks “how can digital games be used to enhance education?” These studies focus on designing and adapting games to teach curricular contents and skills.

Earlier studies taking the first approach sought to identify intrinsic motivational features of digital games (e.g., Cordova & Lepper, 1996; Driskell & Dwyer, 1984; Malone & Lepper, 1987). These authors witnessed learners’ lack of intrinsic motivation towards classroom learning with the contrasting success of digital games (Prensky, 2003). In fact, many learners were shaping their expectations towards formal education from their experience with digital games (Oblinger, 2004). These studies argued that if formal education could adapt the features that make games intrinsically motivating, learners would actively engage in learning. Many features were identified, for example challenge, curiosity, control, fantasy (Malone & Lepper, 1987), rules, sensory stimuli (Garris, Ahlers, & Driskell, 2002), and story (Baranowski et al., 2003; Dickey, 2007). However, raising motivation is not the only advantages of DGBL.

In addition to motivational factors, some studies identified design features in games that make them ideal learning tools. For example, the simulation affordances of digital games allow situated learning (Gee, 2003). Unlike textbooks which merely describe relationships within a system, digital games can simulate the environment or scenario in which the relationships interact. These simulated game environments allow learners to visualize and interact with relationships within working systems, encouraging learners to observe the systems’ behavior from different perspectives and across time. Many games allow learners to take on different identities (Garris et al., 2002; Gee, 2007), which facilitates perspective-taking (Peng, Lee, & Heeter, 2010) that generate deeper understanding of different perspectives around an issue. Some games allow learners to manipulate variables that are unalterable in real life, pose hypothetical questions and compare the simulated results to their previous understanding of the systems (Squire, 2003). Sometimes games can also facilitate peer-learning among
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