Chapter 31
Serious Educational Games (SEGs) and Student Learning and Engagement With Scientific Concepts

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ABSTRACT

Situated in the video game design literature to foster problem-based learning, this chapter illustrates the application of educational theories to create Serious Educational Games (SEGs). SEGs present a learning condition where students can be engaged in standard-based STEM concepts and incorporate these concepts into a fun, interactive challenge where the goal is to solve a problem. This chapter explores a theoretical research investigation of such a learning environment. Students researched standard-based STEM concepts then used design techniques (i.e., story creation, flow chart, decision trees, and storyboarding techniques) and proprietary software to develop their own SEGs. This work sheds light on the process and encourages others to partake in creating similar learning environments, while providing insight into how to design for sustainability.

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INTRODUCTION

Serious Educational Games (SEGs) are on the rise and several psychological and educational theories have been utilized by researchers to justify why educators should invest time and energy to incorporate SEGs into teaching environments (Dede, 1995; Dede, 2005; Gee, 2003; Gee, 2005; Shaffer, Squire, Halverson, & Gee, 2005). SEGs "allow teachers and students to connect real-world scenarios with common school content, thus answering the age-old question, 'Why do I need to know this?' (Annetta, 2010). Teachers face this question often. In an effort to incorporate a more well-rounded and holistic curriculum we highlight in this chapter a three-year project to bring STEM boldly into one teacher's classroom. The project entailed teachers attending professional development for video-game construction then bringing their students to summer workshops to have students create their own video games. Science and mathematics teachers were invited to summer institutes where they used game development software to create content standard-based video games their students would play during the school year. Student perceptions were gathered after they played their teacher's game. This feedback was used to inform further development of the software funded through the National Science Foundation (for further details see Annetta, Holmes, Cheng, & Folta, 2010). The software was scaled-up and used the following year by the same students to create their science content standard-based video game. The intention was to have the video games from the project in a repository to be used as part of educational activities.

In this chapter we will first present the research foundation of SEGs and problem-based learning then we turn to our theoretical research, a study where teachers and students created science content video games. Third, we discuss focus group interviews conducted to gather information about student perceptions toward their learning of and engagement with scientific concepts through research and SEG development. We also interviewed a teacher who explored the value of integrating SEGs into the curriculum. We complete the chapter with classroom models for the incorporation of SEGs into science classrooms.

SERIOUS EDUCATIONAL GAMES

According to Shaffer (2006), games provide a more authentic context for student inquiries. This supports the National Science Education Standards position that "inquiry into authentic questions generated from student experiences is the central strategy for teaching science" (NSES, 1996).

Annetta, Cook, and Schultz (2007) explored how video game design could foster problem-based learning that was congruent with inquiry-based instruction. In the article, they discuss a game that was created by a high school science teacher based on science competency goals that allowed for students to engage in an interactive environment while learning the science content. According to the researchers, "one way to harness the power of video games for science instruction is to design games as problem based learning scenarios" (Annetta, Cook, & Schultz, 2007). As students played the game, their prior knowledge of the science content the teacher had taught was connected to real-life experiences that students could experience through the virtual world as they engaged in solving a problem within the gaming environment.

According to Dickey (2007), educational game design is based on constructivist teaching models. As students play the game, they are able to explore and construct knowledge. Challenges embedded for players throughout the game allow students to use their critical thinking skills to solve problems. In this way, educational games become more than just a way to entertain students and captivate students' at-