Chapter 3.5
Changing Middle School Science through STEAM

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ABSTRACT

Virtual environments are a topic of discussion for many in the business and commerce fields. However, K-12 school systems have been slow to embrace technology within the typical classroom environment, much less a virtual environment. This chapter examines the development of Web-based Flash® content, an Interactive Science Lab in Second Life®, and newly created software called the STEAMiE engine being used by rural Appalachian middle school science classrooms in Ohio, USA. Presented are discussions of the design process through the use of teachers as content experts, the designing of games and simulations for middle school children, the changes in teaching strategies of middle school science teachers, and Fellows and the expectations of school administrators, teachers, and students during design and implementation.

INTRODUCTION

Schools continue to champion the integration of technology into the K-12 classroom although in many cases effective integration to improve student learning has proven to be a difficult problem. Due to budget constraints, teachers' lack of professional development in the use of technology for teaching and learning, and often a teacher attitude which does not support technology's value in the classroom, schools continue to struggle in bringing high performance technology into the framework

of classroom instruction (Franklin, 1999). While classroom teachers struggle with the integration of technology, the students presently sitting in these classrooms are integrating technology into their daily lives at a rapid pace. These students engage in blogs, mashups, YouTube, virtual games, Club Penguin, Facebook, MySpace and video conferencing at a pace unrecognized by schools (Prensky, 2005).

By not employing technology in the learning process, schools are creating a larger gap between informal learning which occurs at home through the use of multimedia technologies and formal classroom learning which relies primarily on text. This formal text based curriculum found in schools creates a divide between a student's home life and school life and limits experiential learning that should connect home and school (Downes, 1999).

This chapter examines the design, implementation, and preliminary research concerning the use of digital science games supported by content based on the National Science Education Standards (NSE, http://www.nap.edu/readingroom/books/nses/overview.html) and the Ohio Science Academic Content Standards (OSAC, http://www.ode.state.oh.us) in rural middle schools in Appalachian Ohio, USA. The digital science content has been used over the course of two years of a three year National Science Foundation GK-12 grant, *Science and Technology Enrichment for Appalachian Middle-schoolers* (STEAM) project. The games are being built with three software environments: 1) *Flash*-based and delivered through the internet, 2) virtual world software [*STEAMiE*] created by the team of researchers, and 3) the commercial version of the virtual world, *Second Life*. During the chapter, the term 'games' will be used to identify the digital science content modules having a simulation and/or game focus created in the three different software environments by the STEAM project.

The concerns and issues surrounding the use of digital content in the format of games, the development of the STEAM modules (digital science content) in multiple software environments, issues of implementation in schools, changes to teaching and learning strategies by both teachers and Fellows, and future concerns of game play in K-12 schools are within the conversation of this chapter. Upon completion of this chapter, readers will be able to:

1. Appreciate the 'culture of school' in examining middle school science teachers and Fellows' roles as games are introduced into the classroom learning environment.
2. Discuss how college faculty (engineering and education) working in interdisciplinary environments may come to have a better appreciation of the strengths of each discipline after working in the STEAM Project.
3. Identify a list of issues which must be addressed with each constituency group (administrators, teachers, and parents) when working with schools to implement virtual games in rural middle school classrooms?
4. Describe and evaluate strategies for gaining support from school administration, teachers, and parents for the use of games in the learning of content (math, science, social studies, and language arts) in rural classrooms?
5. Understand the design processes critical for implementation of virtual games and simulations in rural middle school classrooms?
6. Discuss how school environments influence choices made by software developers.
7. Compare the concerns that games must be 'standards based' to the present day issues of 'high stakes testing' occurring in schools.
8. Effectiveness of learning is a critical component of bringing a different form of instruction such as games into the classroom, what questions might be examined as part of research to support the implementation of games in the classroom?

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