ABSTRACT

In incorporating technology in science education, some have expressed concern that the value added by technology is primarily due to the novelty or excitement about using the devices, resulting in no lasting effect on student motivation or learning in science. This research addresses this concern through evaluation of student motivation during a two-week, multi-user virtual environment (MUVE)-based curriculum for middle school ecosystems science. Analysis of multiple surveys at the beginning, middle, and end of the curriculum found that students continued to find the activity engaging from beginning to end, while student value of its utility in helping them learn science increased significantly. Furthermore, while initial student engagement resided primarily at the technology interface level, with time and experience students became increasingly engaged in the student-led, collaborative inquiry experiences afforded by the embedded scientific investigation.

Keywords: EcoMUVE Pond Module, EcoMUVE, Inquiry-Based Teaching, Multi-User Virtual Environments (MUVEs), Virtual Avatar

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INTRODUCTION AND THEORETICAL FRAMEWORK

Multi-user virtual environments (MUVEs) are an internet-based technology that has become increasingly popular. A MUVE can be described as a 3-D graphical world or worlds used to create a simulated immersive experience. The user is represented by a virtual avatar, and interacts with the environment by controlling the moves and actions of this avatar through the 3-D environment. Participants in a MUVE may have a variety of tools with which to interact with virtual objects, and also opportunities to communicate and interact with other users and with computer-based agents in simulated environments.

MUVE’s have also become recognized as promising educational platform. MUVEs can simulate environments otherwise impossible in school settings, providing opportunities for classroom students to explore simulated worlds, travel in space and time, and explore events at different scales (e.g., Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Kafai, 2010; Omale, Hung, Luetkehans, & Cooke-Plagwitz, 2009). In particular, there has been significant recent work on the use of MUVEs in science education, and MUVEs have been found to be effective in engaging middle and high school students in learning science, through shared participation in rich immersive experiences (Clarke, Dede, Ketelhut, & Nelson, 2006; Trindade, Fiolhais, & Almeida, 2002; Lim, Nonis, & Hedberg, 2006; Nelson & Ketelhut, 2007; Dede, 2009).

One issue involved in incorporating any new technology in science education, however, is the concern that the value added by technology is primarily due to the novelty effect - “the increased effort and attention research subjects tend to give to media that are novel to them” (Clark, 1983). More recent studies using multi-user virtual environments (MUVEs) for education have found that in the short term, students enjoy these virtual worlds primarily because the technology is new to them, in particular the ability to move around freely in a 3D space, to interact with virtual people and simulated experiences (Hew & Cheung, 2010). For example, research with one science MUVE found that most students said they enjoyed the MUVE because of the freedom to explore, which could serve as an extrinsic motivation to learn science concepts, but they also report that often, engagement in the MUVE did not necessarily lead to engagement in the learning task, and could in fact be a distraction (Lim et al., 2006). Research on the use of technology for learning therefore emphasizes the importance of designing the technology in ways that best serve the learning goals (e.g., Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011), and taking advantage of the learning affordances of MUVEs, so that “sound instructional design and pedagogy will prevail over the mere novelty of the technology” (Dalgarno & Lee, 2010).

This paper presents research on changes in student motivation during EcoMUVE, a two-week, MUVE-based curriculum (Metcalf, Kamarainen, Tutwiler, Grotzer, Dede, 2011). A motivation survey was administered three times to students, at the beginning, middle, and end of the curriculum, and the student responses were analyzed to determine whether student engagement can be attributed to novelty, which may attenuate with exposure to the technology, or whether engagement centers on the learning activities – the student-led, collaborative inquiry experiences afforded by the immersive virtual environment.

EcoMUVE is a 10-day middle school science curriculum that supports learning about causal patterns in ecosystems. It consists of two ecosystem modules, Pond and Forest, each centered on an immersive virtual environment that represents a complex causal scenario. The software is designed using an inquiry, role-based jigsaw pedagogy. Students work individually on computers, using a virtual avatar to explore the 3D ecosystem. They work together in teams of four in which each student has a distinct “role” (water chemist, microscopic specialist, naturalist, and private investigator). Students collect data specific to their roles, and then work with their team to analyze the combined data and understand the ecosystem interrelationships.
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