ABSTRACT

The purpose of this research is to explore a new computer-based interactive learning approach to assess the impact on student learning and attitudes toward science in a large university ecology classroom. A comparison was done with an established program to measure the relative impact of the new approach. The first inquiry project, BearCam, gives learners the freedom to navigate bear images and videos online to complete a scientific report. The new program, Virtual Ecological Inquiry (VEI), is based in the Second-Life platform and allows students to create an avatar and explore the Wolong Nature Reserve, collecting plant and environmental data in virtual form. Both inquiry projects show potential to engage learners and promote the acquisition of investigative practices and processes within inquiry. Inquiry assessment methods and changes to the VEI program are shared.

Keywords: Computer-Based Learning, Educational Technology, Environmental Education, Scientific Inquiry, Virtual Ecological Inquiry (VEI), Virtual Environments, Virtual Inquiry

INTRODUCTION

While scientific thinking is highly respected in the United States, there is evidence that there are not enough domestic students entering into STEM – science, technology, engineering, and mathematics – careers. Since the U.S. science and engineering labor market continues to grow, both in absolute numbers and as a percentage of the total labor market, this presents a challenge for the future of the United States’ economy and national defense (National Science Board, 2012).

The majority of American students fail to perform at or above proficiency on The National Assessment of Educational Progress (NAEP) assessments (National Science Board, 2012). The lack of proficiency continues into the first year of college and affects students’ perceptions of their abilities. According to the 2011 National
Freshman Attitudes Report, nearly half of first year college students lack confidence in their math and science skills (Noel-Levitz, 2011).

Fortunately, there is a great deal of research focused on increasing student performance and interest in science. One of the most promising ways to do this is through the use of inquiry learning. Inquiry learning refers to “the activities of students in which they develop knowledge and understandings of scientific ideas, as well as an understanding of how scientists study the natural world” (NRC, 1996, p. 23). More recently, researchers have concentrated on the importance of the acquisition of investigative practices or processes within inquiry defined as “ways of empirically and systematically studying the natural world” (Singer, 2012, p.141). For students to develop scientific thinking and investigative practices, they must have authentic experience with scientific inquiry (Lave & Wenger, 1991).

This inquiry approach to teaching and learning has had great success, particularly in undergraduate biology (Singer, 2012). Hendesman, Ebert-May, Beichner, Bruns, et al. (2004) and Singer (2012) suggest that supplementing or even replacing lectures with active learning strategies can improve learning and knowledge retention. Today, “[m]ost educators agree that scientific literacy is best achieved by learning science through inquiry” (Finn, et al., 2002), and a growing body of evidence suggests that inquiry-based approaches are much more effective than traditional techniques (Blanchard, et. al., 2010). Both content learning and motivation have been shown to increase for students involved in computer-based inquiry, demonstrating the ability for virtual inquiry to engage students and affect their attitudes about science and their own science learning (Papastergiou, 2009; Liu, et.al., 2011; Reynolds & Caperton, 2011).

Despite these acknowledged benefits, large introductory university courses experience difficulty with inquiry learning due to their size. Effective inquiry involves personalized instruction, cooperative learning, and student-centered, in-class experiences, simulations and discussions (Ebert-May, et al., 1997; Singer, 2012). Without this, students usually become passive learners who absorb concepts and facts only long enough to get through the test.

Ecology classes have added difficulty due to a false perception that ecologists do not use experimentation because of logistical and ethical difficulties of performing ecological experiments (i.e. experiments on rainforest habitats in an arctic climate or modifying animal populations and their environments)(Finn, et al. 2002). Unlike some other biological fields, ecological experiments require field trips to gather data. In most settings, this requires resources – time, location, transportation, and money – that are not readily available (Dillon, et al., 2006). In addition, teachers also have to consider the fear and concern about student health and safety and their own lack of confidence in teaching outdoors (Dillon, et al., 2006).

Using a virtual environment for experimentation can remove these limitations. Technology allows for more personalized instruction, an ability to cooperate with members of the class online without supervision and time restraints, and increases the range of experiences and simulations available for instruction (Blumenfeld et al., 1991; Winn, et al., 2002; Kirriemuir & McFarlane, 2004; Martin-Dunlap & Fraser, 2007). Specifically, technology contributes to enhancing interest and motivation, providing access to information, allowing active, manipulable representations, structuring the process with tactical and strategic support, diagnosing and correcting errors, managing complexity, and aiding production (Blumenfeld et al., 1991). Some researchers have predicted that virtual worlds will bring major changes to the current instructional paradigm (Aldrich, 2009; Clarke & Dede, 2005).

In addition, using technology to navigate big data is a factor in science education that is gaining global interest (NRC, 2008). Large open-access data sets offer unprecedented opportunities for scientific discovery — classic examples are the global collapse of bee and frog populations (Lindenmayer & Likens, 2013). However, few research studies have compared
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