Exploring Embedded Guidance and Self-efficacy in Educational Multi-user Virtual Environments

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Abstract: In this paper, we present the results of an exploratory study into the relationship between student self-efficacy and guidance use in a Multi-User Virtual Environment (MUVE) science curriculum project. We examine findings from a group of middle school science students on the combined effects on learning of student self-efficacy in science and use of individualized guidance messages. In addition, we report on findings that demonstrate the interplay between levels of self efficacy in science and use of an embedded guidance system in an educational MUVE.

Problem

In this paper, we describe a study probing the possible relationship between students' guidance use in an educational multi-user virtual environment (MUVE) and their self-efficacy in science, as well as the combined impact on learning of guidance use and self-efficacy level in an educational MUVE designed to teach scientific inquiry skills and experimental design to middle school students.

Our study centers on the River City graphical MUVE. In River City, small teams of students develop and test hypotheses about why residents of the town are ill. During a 12 session curriculum, students experience a year of virtual time in River City. Students first gather information over the course of four seasons in River City. This is followed by classroom-based experimental design group work. Students then re-enter River City to test their hypothesis in "control" and "experimental" worlds, which differ by one factor chosen by each team based on its experimental design. Students then write to the town mayor describing their hypothesis, experimental design, and results (Nelson, Ketelhut, Clarke, Bowman, & Dede, 2005).

Self-efficacy in scientific inquiry refers to a student's belief that they can conduct scientific inquiry; it is a measure of their confidence in conducting inquiry activities. Researchers have investigated both the origin of a person's self-efficacy and its effect on behavior. Of particular interest to this study is whether there is a relationship between self-efficacy and accessing guidance. Evidence for this relationship is equivocal with studies showing widely divergent results regarding whether high or low self-efficacy students are more likely to show help-seeking behaviors and whether this behavior is beneficial for learning or not (Pajares, 2004).

To explore the relationship between science self-efficacy and guidance use in River City, an embedded guidance system was added to the MUVE. The system monitors student activities to display text-based hints designed to assist them in understanding data found in the MUVE.

Use of the guidance system in River City relies on students' willingness to make use of it. Consequently, it is likely that use of the embedded guidance reflects the research on self-regulated learning and thus indicates that students with high self-efficacy would be more likely to access the guidance messages than students with low self-efficacy in science.

Research Questions

The research questions in this study are:

1. *Do students with low self-efficacy in science view fewer guidance messages within a MUVE-based science curriculum than students with high self-efficacy in science?*
2. *Do students with low self-efficacy in science who view guidance messages within a MUVE-based science curriculum perform as well on content tests as students who report high self-efficacy in science?*

Population

This study presents results of a 2004 implementation with 102 seventh-grade students who were provided access to embedded guidance in the River City MUVE.

Procedures

Students had access to a guidance system featuring continuously updated links to hints. Students could view three hints per pre-defined information object in River City. Whenever students clicked on a specially tagged object inside the MUVE, the guidance system flashed alternating colors to signal that new hints were available. To view messages, students clicked on the hint buttons, allowing us to track when students viewed guidance messages and which messages they saw.

Measures

Qualitative and quantitative data were collected. Pre- and post-intervention, students completed an affective measure adapted from three surveys; Self-Efficacy in Technology and Science (Ketelhut, 2005), Patterns for Adaptive Learning Survey (Midgley, 2000), and the Test of Science Related Attitudes (Fraser, 1981). To assess science inquiry skills and biology knowledge, we administered a 30 question content test, pre- and post-intervention with an internal consistency reliability of .80 in a middle school population.

Students' self-efficacy in scientific inquiry was measured using a subscale in the affective measure containing 12 items, each rated on a scale from 1 (low) to 5 (high) (Ketelhut, 2005). Overall scores are computed by averaging the student's responses across the twelve subscale items, with high scores representing high self-efficacy. The measure has an estimated internal consistency reliability of .86.

Findings

In answer to our first research question, we found that students with low initial self-efficacy in scientific inquiry viewed significantly fewer guidance messages ($p<.05$) than their higher self-efficacy peers. For example, a student with an initial self-efficacy score of 1 would view approximately 14 fewer messages on average than a student with a self-efficacy score of 3. In addition, it was found that boys viewed significantly fewer messages than girls ($p<.05$) overall, and across a range of initial science self efficacy scores ($p<.05$).

To assess the second research question, we first regressed student post-test scores on levels of guidance system use and pre-test scores. In this analysis, we found that viewing guidance had a significant positive impact on post-test scores ($p<.01$). In other words, holding pre-test scores constant, students who viewed more guidance messages out-performed students who viewed less. To investigate whether low self-efficacy students who viewed guidance performed as well as students with higher self-efficacy, we added initial level of self-efficacy in science to our model. We discovered that self-efficacy also predicted for post-test content scores in a model with guidance views ($p<.05$).

Conclusion

This exploratory study indicated that (a) students with low self-efficacy in science view fewer guidance messages embedded in an educational MUVE than students with higher self-efficacy, and (b) students who view more guidance messages outperform those who view fewer, with high self-efficacy students outperforming lower self-efficacy students across a spectrum of guidance use. With well-designed educational MUVE-based curricula incorporating embedded guidance and engaging inquiry, we hope that all learners can better understand and apply principles of real-world science inquiry.

References

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