An Examination of High School Students’ Online Engagement in Mathematics Problems

Woong Lim, Department of Teacher Education, Educational Leadership & Policy, University of New Mexico, Albuquerque, USA

Ji-Won Son, Department of Learning and Instruction, University at Buffalo, The State University of New York, Buffalo, USA

Susan Gregson, Department of Curriculum and Instruction, University of Cincinnati, USA

Jihe Kim, Department of Secondary and Middle Grades Education, Kennesaw State University, Kennesaw, USA

ABSTRACT

This article examines high school students’ engagement in a set of trigonometry problems. Students completed this task independently in an online environment with access to Internet search engines, online textbooks, and YouTube videos. The findings imply that students have the resourcefulness to solve procedure-based mathematics problems in an online environment without formal instruction. This article suggests that self-directed online learning could be more effective for solving procedure-based problems than multi-step problems. Moreover, to be successful in online learning environments, students may need training to improve keyword searching skill and their ability to utilize various online learning tools.

KEYWORDS

Online Learning, Procedure-Based Problems, Self-Directed Learning, Students

INTRODUCTION

Studies report that students who take mathematics courses online can be as successful as those taking similar courses in face-to-face classrooms (Cavanaugh, Gillan, Bosnick, & Hess, 2008; Heppen, et al., 2012). For instance, Heppen et al. (2012) found that students with access to online Algebra I in the eighth grade learned more algebra that year than their peers in regular classrooms and were twice as likely to take advanced mathematics courses in high school.

As online learning programs proliferate, researchers have examined the effectiveness of online learning by content area (e.g., Carr, 2000), type of student (e.g., Clark, 1983), and nature of online learning practice (e.g., hybrid, instructor-directed, self-directed) (e.g., Clark, 1983; Means, Toyama, Murphy, Bakia, & Jones, 2009). As high schools expand opportunities for students through online learning programs, research about the suitability of online programs for the students involved will be required. Specifically, it will be useful to know more about how students with different needs respond to the constraints and affordances of self-directed online environments. Thus, more studies analyzing students’ autodidactic efforts to solve mathematics problems in online environments are warranted.

In this study, we seek to extend the current literature by identifying barriers and supports for online mathematics learning, and providing details about when and how self-directed learning of...
procedure-based mathematics problems can be most effective. Specifically, this study examines high school students’ performance in an autonomous online environment with respect to four key factors that impact learning – persistence, use of online tools, Internet skills, and motivation. In this study, 53 U.S. high school students participating in an afterschool program, engaged in an untimed online mathematics task involving 10 elementary trigonometry problems that had not been taught in advance. The students had access to the Internet and online textbooks, but worked independently. We examined the differences in persistence, use of online tools, Internet skills, and motivation demonstrated by students in this environment. Our study was guided by the following research questions:

1. How did pre-calculus students perform on trigonometry problems in a self-directed online environment?
2. Did students’ persistence, use of online tools, Internet skills (keyword searching and speed), and motivation align with their performance (below vs. above average) on a procedure-based mathematics assessment?

LITERATURE REVIEW

Student Interaction in Online Learning

Because of their potential to provide more flexible access to content and instruction at any time, from any place, online learning programs continue to proliferate. Given the rapid and expanding use of online learning in K-12 education, educators, researchers, and instructional designers are faced with the on-going task of understanding the pedagogical implications of online learning for students. Highlighting both the unique aspects of computer mediated learning environments, and their paradigmatic potential for shifting the way we think about teaching and learning, requires attention to multiple student interactions. Rourke and Anderson (2002), who studied computer-based education, identified three kinds of interactivity affecting online learning: interaction with content, interaction with instructors, and interaction among peers (see Figure 1). Interaction with content refers to the learners’ interactions with both course materials and course concepts and ideas. Interaction with instructors refers to the ways in which instructors teach, guide, correct, and support students. Interaction among peers refers to the interactions between learners, which can take many forms—debate, collaboration, discussion, peer review—and be informal or incidental learning experiences. Each mode of interaction supports learning and can be uniquely enacted in online learning environments. This study focuses on interaction with content.

Student Interaction With Content in Online Learning

Interaction with content refers to the learners’ interaction with and attitudes toward knowledge, skills, and concepts (Rourke & Anderson, 2002). Prior studies have examined online learning in terms of content performance and student perceptions. With respect to K–12 students, students performed modestly better (on average) in online settings than those receiving traditional face-to-face instruction of the same material (e.g., Means et al., 2009; Zanberg & Lewis, 2008). In fact, learning outcomes for students engaged in online learning exceeded those of students in face-to-face instruction with an average effect size of +0.20, favoring online conditions. Other researchers (e.g., Harasim, 1990; Levin, Kim, & Riel, 1990) noted that students perceived online learning to be more equitable and democratic than traditional classroom learning because it allows for the presentation and inclusion of multiple viewpoints. Spiro and Jeng (1990) suggested that online environments may be especially supportive of the development of divergent thinking, complex conceptual knowledge, and/or problem solving. They found that students who explored complex topics from multiple perspectives through hypermedia programs (e.g., the World Wide Web) scored higher on measures of complex understanding than students presented with similar material in traditional (linear) formats. Thus, hypermedia can
Contextualized Learning: Supporting Learning in Context
[www.igi-global.com/chapter/contextualized-learning-supporting-learning-context/4968?camid=4v1a](www.igi-global.com/chapter/contextualized-learning-supporting-learning-context/4968?camid=4v1a)

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