

Chapter 53

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

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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.

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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 ongoing 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

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