Chapter 21
Online Homework and Correlated Success in University Mathematics Courses: A Longitudinal Study

Stephen W. Kuhn
University of Tennessee–Chattanooga, USA

Sandy W. Watson
University of Tennessee–Chattanooga, USA

Terry J. Walters
University of Tennessee–Chattanooga, USA

ABSTRACT

The primary goals of this project at the University of Tennessee at Chattanooga (UTC) were to use a free, open-source online tool developed at the University of Kentucky (UK) called WHS (Web Homework System) for Web-based homework and quizzes in first year mathematics courses and to demonstrate that the use of this system by students would improve and correlate well with their success in these courses. Quantitative data were collected and analyzed across four years involving 832 students using this system and 753 not using the system in seven courses. The findings indicate that faculty and students found the Web-based homework assignments helpful for a variety of reasons, though some of each found it occasionally frustrating. Students with high (low) scores on the Web homework had a very high probability of having high (low) grades in the courses, but there were no statistically significant improvements in final course grades over traditional methods.

INTRODUCTION

At the University of Tennessee at Chattanooga, we had been very frustrated using a variety of traditional homework formats in our university mathematics classes, we wanted to take advantage of the benefits of the online systems described above, and we believed that with the right choice of systems we could overcome many of the disadvantages described later in this article. Therefore, we chose to use the Web-based Homework System (WHS) online homework system, maintained at the University of Kentucky (UK), to

DOI: 10.4018/978-1-4666-4912-5.ch021

provide our first-year mathematics students with a homework experience that included the complete attempt-feedback-reattempt sequence outside of the classroom setting and allowed us to employ a variety of question types, ranging from complex multiple-choice questions to questions with algebraic expressions, decimal numbers, and fractional numbers as answers. Moreover, the answer choices in the multiple-choice questions are so numerous that guessing as a successful strategy is precluded. WHS is a no-cost system (obviating the concern in Hu (2007) and Vascellaro (2006) about the high cost of online homework), non-commercial, internet-based homework system that includes built-in communication tools between students and faculty, with immediate email linkages to specific problems. We wanted to demonstrate that the time and effort our students spent on their online homework, especially with email feedback from course instructors, would likely improve both their grades and their understanding of the course material. We wanted to improve overall success in several first-year courses by taking advantage of the tools developed in WHS for homework and quizzes, and we believed that with this system we could avoid some of the pitfalls associated with other online systems. Utilizing this system, we collected and analyzed data across a four-year period at the University of Tennessee at Chattanooga. The longitudinal nature of this study makes it unique among other similar studies found in the literature.

BACKGROUND

Benefits of Traditional Homework

Many researchers, even some as far back as 85 years ago, have shown that the use of traditional homework is an instructional strategy that has positively influenced student achievement for generations (Austin, 1979; Foyle, 1984; Hagan, 1927; Keith & Cool, 1992; VanLehn et al., 2005; Walberg, Paschal, & Weinstein, 1985). Homework has been viewed as a necessary tool for student understanding and advancement as it allows students "opportunities to practice skills and concepts demonstrated by their instructors" (Brewer & Becker, 2010, p. 355). Since the 1930's, homework has been an integral element of schooling in America as a form of assessment of and contribution to school learning (Keith & Benson, 1992; Kodippili & Senaratne, 2008; Warton, 2001), and many books and articles devoted to the positive characteristics of homework have been produced (e.g., Kodippili & Senaratne, 2008; Walberg, Paschal, & Weinstein 1984; Vatterott, 2010). Learning theorists, including constructivists (Davis, Maher & Noddings, 1990) and social cognitive theorists (Schunk, Pintrich, & Meece, 2008), have long posited that homework is necessary for students' retention of information and that feedback on homework must be prompt to be effective. Moreover, large scale reviews of educational research show that in all subjects and at all grade levels, homework has a positive effect on student learning outcomes (Cooper, 1989). According to Hattie, (2009):

The most powerful single moderator that enhances achievement is feedback. The most simple prescription for improving education must be 'dollops of feedback'… homework with feedback is much more effective than homework without feedback, and recent reviews point to the power of feedback as a discriminator between more and less effective uses of computers in classrooms. (p. 171). Moreover, (Hattie, 2009) refined this idea to clarify the feedback that was most crucial:

It was only when I discovered that feedback was most powerful when it is from the student to the teacher that I started to understand it better. When teachers seek, or at least are open to, feedback from students as to what students know, what they understand, where they make errors, when they have misconceptions, when they are not engaged—then teaching and learning can be synchronized and powerful. Feedback to teachers helps make learning visible. (p. 173)