

Red X's and Green Checks: A Preliminary Study of Student Learning from Online Homework

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Homework is thought to play an important role in students' learning of mathematics, but few studies have addressed what, if anything, students learn from doing online homework. This study is a preliminary attempt to answer the question do students learn what instructors intended they learn from an online homework assignment about sequences?

Keywords: homework, sequences, instructional triangle

Homework is thought to play an important role in students' learning of mathematics. University calculus students spend more time doing homework than they do in class (Ellis, Hanson, Nuñez, & Rasmussen, 2015; Krause & Putnam, 2016), meaning that homework accounts for the majority of students' interaction with content. Due to increasingly sophisticated technology, online homework has become more prevalent in mathematics courses. However, few studies have investigated student learning from online homework. Researchers have found that online homework format does not have a statistically significant effect on course or exam grades, or that it has a slight positive effect (Dedic, Rosenfield, & Ivanov, 2006; Halcrow & Dunnigan, 2012; Hauk, Powers, Safer, & Segalla, 2002; Hirsch & Wiebel, 2003; LaRose, 2010). A few studies have investigated qualitative factors related to homework, such as students' preferred format (Hauk & Segalla, 2002; Krause & Putnam, 2016) and the resources they use while doing homework (Krause & Putnam, 2016). However, we do not know much about what, if anything, students learn from doing online homework. This study is a preliminary attempt to answer the question *do students learn what instructors intended they learn from an online homework assignment about sequences?*

The study design reflected a theoretical perspective employed by Ellis et al. (2015), who positioned homework as a *task* in Herbst and Chazan's (2012) instructional triangle. In the triangle, edges represent the interactions between teacher, students who complete tasks, and the knowledge at stake. This study used a series of clinical interviews with professors to determine what they saw as the knowledge at stake within a particular online homework assignment, and observations and interviews with students to investigate whether their interaction with the homework supported their learning that knowledge. Specifically, the researcher conducted clinical interviews (Hunting, 1997) with two calculus II instructors about what they hoped students would learn from each of 14 problems on an online homework assignment about sequences. The researcher then video-recorded three students as they worked individually on the homework. In the third phase, the researcher and student watched the video together while the researcher asked questions about what the students did and why, if the student felt (s)he had learned anything from the problem, and if the student felt (s)he had learned or noticed what the professor intended for that problem.

Preliminary findings indicate that students learned some of what professors intended (e.g., how to generate terms in a recursive sequence, what notations like a_n and $b_n = a_{n+1}$ mean) but not all (e.g., that a sequence is defined on a set of sequential integers, not on the set of real numbers). Analysis is ongoing, and should yield implications for designing homework tasks that engender desired understandings of ways of thinking.

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