A Comprehension Tool for Mathematics?: The Math Forum@Drexel's Online Mentoring Guide

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Abstract: Two studies of the Math Forum's Online Mentoring Guide (OMG) address whether and how online comprehension tools might support mathematics learning. In Study 1, the culture of the preservice teachers' (PTs') mathematics classroom and their work with the OMG and its impact on their developing comprehension of mathematics and mentoring is described. In Study 2, the impact of content-informed scaffolding of PTs' work with the OMG is investigated.

Introduction

Nason and Woodruff (2004) recently suggested that computer supported collaborative learning environments have been unsuccessful in their support of mathematics learning because they do not include rich problems and tools that support the development of comprehension. Given the identified ability of the online environment to both engage and provide a source of direct dissemination of reform practices to teachers (Renninger & Shumar, 2004), the potential to develop online comprehension tools for mathematics seems likely. The open question is of what such tools need to consist. In order to explore this question, two studies of preservice teachers' (PTs') work with the Math Forum's *Online Mentoring Guide* (OMG, mathforum.org), a research and development project, were undertaken. The studies focus on elementary and middle school PTs' use of the OMG and both their mathematical content knowledge and their ability to scaffold solutions to nonroutine challenge problems online. In particular, three questions are addressed: (a) Can PTs who have weak mathematics skills assess strengths and weaknesses of pupil submissions and use this information to mentor effectively? (b) Given some weakness in mathematics, are PTs' abilities to mentor mediated by their level of interest for mathematics or their stance toward problem solving? (c) And, what would an online mentoring guide need to provide in order to support PTs to develop their mathematics abilities and be an effective collaborative mathematics comprehension tool?

Background on the OMG

The OMG is an asynchronous collaborative tool for supporting PTs to learn how to provide online scaffolding to elementary pupils working with nonroutine challenge problems, as a way to help PTs to learn how to scaffold their future students. Lessons in the OMG each include a 4-phase process of doing, reflecting/discussing, interacting with an experienced mentor, and synthesizing the experience of the previous three phases. After completing the lessons in the OMG, PTs are assigned elementary student submissions (threads) to the Math Forum's Fundamental Problem of the Week (FunPoW) to scaffold. PTs draft a response to the solution, which is read over by an approver who either sends it back to the PT with feedback about the needed revisions or sends it on to the elementary student. All data from PT work is archived, allowing analysis of both the process of this work and its outcomes.

Design

Two studies of the OMG are reported. In the first, 27 PTs' (2M, 25 F) online work with the OMG and class assignments were studied to describe the culture of their classroom. In the second, an intervention conducted with students from the same university in the same course during the following year, one half of the PTs (14: 14 F) served as controls and were approved by their professor as they were in Study 1, and one half of the PTs (14: 2M, 12 F) were scaffolded by trained mentors using a content-informed scaffolding rubric in which mathematics provided the basis of the exchange (Renninger, Ray, Luft, & Newton, 2006).

Results and Discussion

In Study 1, combined methods were employed to address the culture of the preservice mathematics classroom and its impact on what PTs might need from an online extension of the classroom. The problem-solving stance, or mathematical beliefs, of this group of PTs suggests that their prior experience of mathematics has led them to focus on accuracy (Bereiter & Scardamalia, 2003). They are, as a group, in need of support to develop their

mathematical content knowledge (Hill, Rowen, & Ball, 2004). While working together on problem solving in the classroom provides the PTs with important and/or needed support for mathematics and problem solving, the professor comments that the OMG allows her to push the PTs further than she could if she were not using the OMG as part of the course. This feedback, coupled with findings indicating that (a) on exam problems the professor provides the PTs with the methods they should use to set up and solve the problems independently; and (b) the professor gives the PTs high grades when they follow through to do what she suggests, indicates that more consistent support for scaffolding in the online environment may help PTs to develop their understanding of and readiness to scaffold the elementary students' work with the FunPoW.

In Study 2, combined methods were employed to consider the impact of content-informed scaffolding on PTs' mathematical thinking and scaffolding of elementary students. Findings from this intervention indicate that target PTs experienced gains in mentoring and control PTs did not. Analysis of target PTs' scaffolding reveals that they learned to respond to two groups of students: those who had little idea of what a problem asked or those who had a full understanding of the problem. Their abilities to work with elementary students who had only a basic understanding of the FunPoW did not change. Given that in the OMG the PTs were provided with a number of possible solution strategies, this finding appears to reflect their own limited understanding of mathematics and ability to do the types of error analysis required. While the target PTs' work with FunPoWs from the beginning of the course to the end of the course suggests increases in mathematical thinking, they did not reach significance. Patterns of PT performance appear to be mediated by interest for mathematics and problem-solving stance (see Ray & Renninger, in preparation).

To summarize, answers to the questions guiding the two studies suggest that (a) PTs with weak mathematics skills are not very effective at assessing strengths and weaknesses of pupil submissions and using this information to scaffold. However, targeted mathematical scaffolding does support them to improve the quality of their scaffolding; (b) PTs' abilities to scaffold are constrained by their interest for mathematics and their stance toward problem solving; and (c) changes to three aspects of the OMP appear warranted: (1) the professor could make work with the OMG congruent with classroom practice, (2) the students could be assigned additional mentored work with the FunPoW prior to working with the OMG, and (3) online modules might be developed to accompany the OMG, which would provide support for PTs to develop their mathematics skills through work with specific problem content, error analysis, and live scaffolding. Importantly, the PTs and professors in both studies reported liking work with the OMG and recommended its use in subsequent classes. Thus, despite the challenges of its mathematical content, these data suggest that the OMG has good potential as a tool for comprehension monitoring. Considering that PTs who received mathematical scaffolding improved in their own scaffolding of mathematics, it seems possible that with appropriate modules in place, the OMP could become a powerful online comprehension tool for mathematics.

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