A Comprehension Tool for Mathematics?: The Math Forum@Drexel’s Online Mentoring Project

Abstract: Two studies of the Math Forum’s Online Mentoring Guide are reported. In Study 1, the culture of the mathematics classroom for preservice teachers (PTs) and its impact on their developing comprehension of mathematics and mentoring is investigated. In Study 2, the impact of targeted mentoring that is mathematical on PTs’ mathematics and mentoring is studied. Findings are discussed in terms of implications for building online comprehension tools that support mathematics learning.

Introduction

It has been suggested that computer supported collaborative learning environments do not support mathematics learning because they do not include rich problems and tools for supporting the development of comprehension (Nason & Woodruff, 2004). Given the identified potential 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 comprehension tools for mathematics seems likely. The open question is of what such tools need to consist. In order to explore this question, preservice teachers’ (Pts’) work with the Math Forum’s Online Mentoring Project (OMG, mathforum.org), a research and development project, were designed. The studies focus on the relation between use of the OMG and elementary and middle school PTs’ mathematical content knowledge and their ability to mentor 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 (1) math achievement, (2) level of interest for mathematics, or (3) 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? Addressing these questions also requires considering: (a) How might the mathematics culture of the PT classroom be described and studied? (b) How might the mathematical thinking of PTs be assessed? (c) What are characteristics of effective mentoring online?

Background on the OMG

The OMG is an interactive tool for supporting preservice teachers (PTs) to learn how to provide online feedback to elementary pupils working online nonroutine challenge problems on the site. 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 mentor. 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) work with: online problems the OMG, their professor’s mentoring of their responses, class assignments, and the mathematics culture of their classroom are described. 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 mentored by their professor as they were in Study 1, and one half of the PTs (14: 2M, 12 F) were mentored by trained mentors using a scaffolding rubric in which mathematical content provided the basis of the mentoring exchange (see Figure 1).
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) and the culture within which they are learning allows them to avoid the challenging parts of a powerful learning environment such as the OMG (Lehtinen et al., 1995). 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, suggests that more consistent support for mentoring in the online environment may help PTs and their professor to develop their understanding of and readiness to mentor the students’ mathematics in work with the FunPoW.

In Study 2, combined methods in a study of another group of PT students’ work with the OMG were employed to consider the impact of mentoring that is specifically and consistently mathematical. Findings from this intervention indicate that target PTs experienced gains in mentoring and the control PTs did not. Analysis of the mentoring of the target group reveals that they learned to ask questions and provide feedback 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. They did not change in their abilities to work with students who had only a basic understanding of the problem. This finding may reflect their own limited understanding of mathematics and ability to do the types of error analysis required, even if provided with a solution template. The target PTs’ work with FunPoWs from the beginning of the course to the end of the course did suggest increases in mathematical thinking, but they did not reach significance.

Importantly, the PTs and professors in both studies reported liking work with the OMG and recommended its use in subsequent classes. These data suggest that as a tool for comprehension-monitoring, the OMG has good potential. However, changes to three aspects of the OMG appear warranted: (a) the professor could make work with the OMG congruent with classroom practice, (b) the students could be assigned additional mentored work with the FunPoW, or nonroutine challenge problems, prior to working with the OMG; (c) the OMG mentors could undertake mentoring of PTs with a focus on the development of each individual’s strengths and needs as a mathematical thinker, rather than mentoring thread by thread.

References
Figure 1: Samples of Coding of Mentoring to Support Mathematical Thinking

Example of a level 4 (thread 263):
>It took him 8 hours to go the 50 miles.
>First I figured out that if you added the two >answers(3 1/2 and 9)it got half the 25 miles.

Hello Thomas,

Good job on getting the answer to the POW correct. You have a very good start to your explanation in your first sentence. I am wondering if there are more steps that you could include to make your explanation very clear to other students reading your submission? You might include each step taken to get you from 3 1/2 and 9 to the 8 hours. It looks like you knew how to figure this out but just didn’t type it all out for us.

I would love to see the rest of your thoughts.
Melissa

This was given a score of 4 for connections, strategy, autonomy, and emotional support, because Melissa* seems to have recognized what strategy Thomas* used and gave him specific tasks and encouragement to improve his work. While we might have liked to see more explicit reference to the math strategy he used, her ability to work with a less well-developed explanation of an alternative strategy earned her a score of 4.

Example of a level 3 thread
Thread 185
>1. He spends 9.84 hours making the 50 mile trip
>EXTRA. he spends 24.3 miles on horse and 25.7 on foot
>he takes a 50 mile horse ride....half the time he walk and the other half he rides. He rides and walk 25 miles
>he rides 9 mph an hour
>25/9=2.7 hours on hourse
>he goes 3 1/2 mph on foot
>25/3.5=7.14 hours on foot
>2.7+7.14=9.84
>He spends 9.84 hours making his trip
>EXTRA---2.7 * 9= 24.3 miles on horse
> 7.14 * 3.5= 25.7 miles on foot

Thank you for submitting to the POW problem. Are they asking for how long it takes to walk 25 miles and ride 25 miles or are they asking for how long it would take to travel 50 miles spending equal time walking and riding?
You should also check your work for completeness ex. 25 (what) / 3.5 (what) = 7.14 hours on foot. You do a good job writing your work in easy to follow steps. I am looking forward for to your resubmission.

This thread received a score of 3 for connections, strategy, autonomy, and emotional support. The PT recognized the students’ error, but did not provide any other outside mathematical feedback. Their description of the students’ work was minimal, as was the encouragement, but it did reflect on something specific in the student’s work, it just wasn’t in proportion to the actual quality of the submission.