Tupelo Enacted: How Teachers Shape Learning Opportunities in Middle Grades Mathematics

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Abstract: Building from the triangle of interactions outlined by Cohen and Ball, this study considers the implications of enactment for student learning opportunities in three classrooms. Data included classroom videotapes and teacher interviews that allowed the researchers to understand the implications of three different enactments of the same open-middle mathematics problem. . The findings highlight implications of different implementations for the mathematical concepts that students had opportunities to learn in each classroom.

Background

Research in education and psychology has demonstrated that adults and children often understand shared experiences in very different ways, but much less is known about how teachers and their students understand shared lessons or how classroom learning occurs as teachers' and students' understandings interact over sequences of lessons. In this poster we adopt Cohen and Ball's (1999) framework of interactions that describes classroom instruction as a function of interactions among teachers, students, and content as mediated in curricular materials. To explore this framework, we consider how a single open-middle problem from the *Connected Mathematics Program* (CMP; Lappan, Fey, Fitzgerald, Friel, & Phillips, 2002) called the Tupelo Township problem was enacted in three teachers' classrooms. As with Simon and Tzur (1999), we account for teachers' practices by explaining them from the perspectives of the researchers. Our initial research interest was to understand how students' learning opportunities were shaped by the teachers' enactment of the problem.

Methodology

Data for this report were collected across one to four days of instruction in each of three sixth-grade classrooms. These data included all days of instruction for the task, which provided a map of a town that was unequally divided among various landowners and asked students to consider what fraction of the land each landowner held. Students had to partition the parcels of land further in order to answer this question. From our perspective, these problems involve adding and multiplying fractions but do not require formal computation procedures.

We used two cameras to videotape each lesson: one camera followed the teacher and one focused on student and teacher writing. Later the same day, we combined the video and audio using an audiovisual mixer to create a *restored* view (Hall, 2000) that captured much of what each teacher and her students said and were looking at during the lesson. We then videotaped interviews with students from each class and asked them to explain their reasoning as they solved the problem and to comment on video segments of the lesson that we played back for them. Finally, we videotaped teacher interviews in which we used video segments of their lessons and their students' interviews to engage the teachers' reflections on their teaching strategies, goals, and student thinking. We analyzed the videos using fine-grained analysis of talk, hand gestures, and drawings. These data were drawn from a larger body of data that included these kinds of data for an entire unit of instruction lasting 6-10 weeks in each classroom.

We analyzed data in three stages. First, during data collection we identified segments of classroom and student interview video to include in our interview efforts. Second, we conducted a retrospective analysis using a version of the constant comparative method described by Cobb and Whitenack (1996) for conducting longitudinal analyses of classroom video recordings. We analyzed interview transcripts for links among teacher's instructional actions, students' classroom activity, students' responses and subsequent activity during the interviews, and the teacher's reactions and reflections on all of the above. Third, we focused the analysis in three key areas based on the initial findings from the first passes through the data. These three areas were: teacher response to student difficulties (what happens when kids make suggestions that are different from what the teacher had in mind?); the intermediate goals set by the teacher as part of this experience; and the skills and processes stressed in each classroom. In an effort to understand how students were making sense of these data, we also looked for evidence of connections among mathematical ideas.

Findings

The Tupelo Township investigation allows for multiple approaches for reaching the solution, is exploratory in nature, and is cognitively complex. Each of the teachers in this study made adaptations—with the intent of simplifying their students' work, narrowing the mathematical scope of the problem, or managing the class. Ms. Reese interpreted the investigation as a stepping-stone in a path to more important concepts—operations with fractions—and accordingly set the pace for her students, providing intermediate goals and structure for accomplishing the goal of the lesson. She anticipated student difficulties and organized the lesson to prevent confusion and to limit time spent on what she thought were non-constructive solution strategies. Ms. Moseley remained open to the possibility that her students could, in individual groups, reason their way through the investigation. As a result, she provided little upfront structure but offered immediate and specific feedback to groups. Her main task was to keep students focused on a single section of the map and on finding fractional portions of land—she was not concerned with acreage. Unlike Ms. Reese and Ms. Moseley, the third teacher, Ms. Archer, did not fully anticipate the challenges embedded in the investigation, and she therefore initially let the problem remain open to students' interpretations only to guide all of the students to do it her way as they progressed through the activity. Ms. Archer's students pursued many dead-ends that were met with guidance to "extend the lines" and led to Ms. Archer announcing hints to prevent the rest of the class pursuing the same erroneous paths.

In our analysis, we found important differences between classrooms (e.g., how one teacher set a series of intermediate goals that limited the open-ended possibilities of the problem, while another left the problem completely open to student interpretation) and explored the mathematical implications of those differences (e.g., one teacher told struggling students to focus on what they already knew and another told similar students to begin by extending the lines). In so doing, we tie our results back to the interaction triangle (Cohen & Ball, 1999) noting the nuances embedded in the triangle that have not been previously explicated and articulated. By looking at these three cases closely, we begin to understand how teachers make sense of open-ended problems, student understanding, and their roles as teachers. We also make strides toward a better articulation of the factors impacting teachers' instructional decisions when teaching with open-ended problems.

References

Cobb, P., & Whitenack, J. W. (1996). A method for conducting longitudinal analyses of classroom videorecordings and transcripts. *Educational Studies in Mathematics*, *30*(3), 213–228.

Cohen, D. K., & Ball, D. L. (1999). *Instruction, capacity, and improvement* (No. CPRE–RR–43). Philadelphia, PA: Consortium for Policy Research in Education.

Hall, R. (2000). Videorecording as theory. In A. E. Kelly & R. A. Lesh (Eds.), *Handbook of research design in mathematics and science education* (pp. 647–664). Mahwah, NJ: Erlbaum.

Lappan, G., Fey, J. T., Fitzgerald, W., Friel, S. N., & Phillips, E. D. (2002). *Connected mathematics series*. Glenview, IL: Prentice Hall.

Simon, M, & Tzur, R. (1999). Explicating the teacher's perspective from the researchers' perspectives: Generating accounts of mathematics teachers' practice. *Journal for Research in Mathematics Education, 30*(3), 252-264.

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