Characterizing Teachers' Analysis of Student Work

Jason Silverman, Valerie Klein, Wesley Shumar, and Cheryl Fricchione
Drexel University, 3141 Chestnut Street, Philadelphia PA
silverman@drexel.edu, valerie@mathforum.org, shumarw@drexel.edu, cls75@drexel.edu

Abstract: We report on our analysis of teachers' investigation of student work on open-ended mathematics tasks and present an emerging framework for explaining the variety of ways teachers engage with and attempt to analyze and organize conversations about student work. This emerging framework will provide potential starting points for professional development focusing on student-centered instruction

While the importance of instruction that builds on student thinking and understanding has been advocated by both research and policy documents, this type of instruction is often challenging for teachers to design and enact (Sherin, 2002). We argue that before we can effectively support teachers' sustained focus on student thinking and understanding as part of their instruction, we must better understand their current views and practices with regard to the role of student thinking in instruction. Building on the teacher "noticing" research (Sherin, Jacobs, & Philipp, 2011), we explore 24 mathematics teachers' participation in investigation of student work on open-ended mathematical tasks. We report on our examination and present an emerging framework for explaining the variety of ways teachers engage with and attempt to analyze and organize conversations about student work.

Theoretical Background

We follow Sherin et al. (2011), who note that analysis of student work is a key component of teaching expertise and can support teachers implementation of a variety of reform-oriented pedagogical practices. Instruction and feedback that is grounded in student thinking and understanding (i.e. using formative assessment) has been shown to significantly accelerate learning, when compared to students who receive traditional grades on assignments (William, 2011). Despite the importance of student thinking in instruction, mathematical noticing – "attending to particular events and making sense of events in an instructional setting" (Sherin et al., 2011, p. 5) – has only become a focus in mathematics education research in the past decade. While numerous recent have documented the importance of mathematical noticing and analyzing teachers' attempts to notice specific aspects of student thinking and classroom events and interactions, there is little known about the specifics of supporting teachers' ability to engage in productive mathematical noticing. Our current work is focused specifically on that issue and the proposed poster will explore a foundational question: *When tasked with engaging with student mathematical thinking, how do teachers interpret and enact that task?* We argue that any efforts to support teachers' productive mathematical noticing must be grounded in their current beliefs, understandings, and practices and the results of this study will increase our understanding in this area.

Setting and Method

Data for this poster comes from a three-day professional development institute focused on supporting teachers' ability to collaboratively develop and use formative assessment. We report on 24 teachers who were tasked with individually reviewing, analyzing and describing student solutions and explanations to open ended problems and then discussing that analysis as in small groups. The task was purposefully left open to allow the teachers to use existing experiences to individually construct and then as a group co-construct the task. Participants' written notes from the individual analysis and video recordings of the group discussion that followed were the primary sources of data for the current study. Members of the research team reviewed the data corpus and theoretically significant excerpts of audio/video were identified and transcribed. These excerpts were coded by at least two members of the research team using an open coding system and common themes and patterns within and across the groups were identified and noted. These conjectures about common themes and patterns were reviewed chronologically against the entire data corpus and contradictory and corroboratory evidence were identified. Empirically verified characterizations of the ways in which teachers' interpret and enact tasks that focus on analyzing student thinking were the result of the iterative process of conjecturing, testing, and revision of conjectures.

Analysis and Results

Three primary characterizations of the groups' activity with the student work emerged from our analysis: focus on instruction, focus on calculation, and focus on strategy. Below, we present an abbreviated analysis of two characterizations– focus on instruction and focus on calculation. In the proposed poster session, we will present detailed analysis of all three characterizations.

Focus on Instruction

One common way of interpreting the role of student thinking was to focus on instruction. For example, members of the Green group described the task that they were assigned as focused on "identify[ing] the big ideas of what is going on with the student work." While evidence and examples from the group's analysis of student work served to anchor the conversations, the exchange led to discussions about their own instructional practices and/or struggles rather than the student work and underlying student interpretations. For example, Sam commented on how well Fran's students explained their thinking and Fran described the instructions she gave her students:

Fran**:** "Make sure you write a story. I kept using the work story a lot. You know, you write a paper with a beginning, middle, end, and just support your ideas and your thinking because we can't just tell. I don't know if that's reflected in what they do or not."

Sam**:** Oh absolutely, if I had classes of kids that put out papers like this on a consistent level, I would be in heaven.

This group's conversation quickly became decontextualized from the student work, however, the task itself seemed to provide an opportunity to discuss the teachers' own practice. In particular, the importance of communication of mathematical ideas came up repeatedly (e.g. showing ones work, neat handwriting, identifying key variables, etc.). It is worth noting that this group neither solved nor discussed the mathematics of the problem nor did they look closely at the actual student work to unpack the mathematical thinking.

Focus on Calculation

Rather than collaboratively defining the task, "calculation" groups just dove into it. For example, the indigo group focused on a close analysis of one student's work and sought to understand what the student did by collectively piecing together their selections and discussing questions they had about the student's work. For example, consider the following extract:

Leila: What first intrigued me about this...was the box because the first time, I thought they were going to factor it and then I realized they were multiplying out that way…but didn't finish it. It's like they gave up when they had to multiply…-29 by -20.

Linda: Well, they didn't finish it up in the box, but they actually wrote it down at the bottom. So the x^3 minus…is still in the box.

Blake: I noticed that they were using variables and I was trying to infer what they were letting their variables represent, so I thought that they were saying x was equal to the number of students and then k was the dollar amount that each would pay, so like cost per student, I guess, or admission per student.

Leila: Which they set up a great equation.

The group worked collaboratively to make sense of what the student did – step by step – and where on the paper he did it. However, their analysis is very "surface level," focusing only on being able to describe and narrate the solution path this student chose to pursue, much like how a student would describe the steps he or she took presenting a solution to the class.

Discussion

In this poster, we will describe three characterizations of the way teachers interpret and co-construct the presented task (focusing on instruction, focusing on a calculations, and focusing on strategy). These characterizations provide potential starting points for professional development focusing on student-centered instruction; without recognizing the various understandings and interpretations various teachers bring to professional development, it is likely that teachers will not interpret instructions in the way they are intended. Further, it is likely that teachers with different interpretations may encounter communication challenges and have difficulty successfully completing the task, engaging in productive argumentation, or coming to consensus.

In addition to presenting the characterizations, we will also present a preliminary version of custom-designed software that will scaffold productive mathematical noticing and provide opportunities to surface teachers' current beliefs, understandings, and practices with regards to the role of student thinking in instruction and make them explicit topics of conversation.

References

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