

ONE TEACHER'S ANALYSIS OF HER QUESTIONING IN SUPPORT OF COLLECTIVE ARGUMENTATION

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The use of questioning is an effective strategy for orchestrating collective argumentation. However, teachers with minimal experience facilitating argumentation may conceive of effective support as providing little to no verbal input in the argumentation. In this study, we analyzed one teacher's analysis and critique of her support for collective argumentation during her first three years of teaching. We argue that learning to analyze her support for collective argumentation enriched the teacher's understanding of questioning. More specifically, by explicitly identifying how her questions elicited components of arguments from students, the teacher re-evaluated her questions, focusing on purpose rather than form. Implications from this study draw connections between learning to facilitate argumentation and the dilemma of telling that teachers encounter when trying to teach mathematics in ways that honor students' thinking and sense-making.

Keywords: Classroom discourse, High school education, Instructional activities and practices

Teachers have a pivotal role in orchestrating argumentation. Teacher moves such as revoicing and establishing social and sociomathematical norms are supportive of mathematical argumentation (Forman et al., 1998; Yackel, 2002). Further, researchers (e.g., Hunter, 2007; Martino & Maher, 1999) have recognized that teacher questioning is a key factor in supporting mathematical argumentation. For instance, Martino and Maher suggested that a sequence of questions that offer an opportunity for generalization help students to build mathematical arguments. However, teachers have difficulties incorporating questioning strategies in their classroom teaching, even when supported by curricular materials (e.g., Sahin & Kulm, 2008). Furthermore, some researchers argued that teachers may not have a clear understanding of what effective questioning strategies are or how to implement them in order to support argumentative discourse (e.g., Kosko et al., 2014; Zhuang & Conner, 2018). In particular, Kosko et al. (2014) found that some teachers envision mathematical argumentation being left to the responsibility of students with relatively limited input from the teacher. The purpose of this paper is to demonstrate how a teacher learned to analyze her support for argumentation while also co-developing an understanding of her role in supporting argumentation with a special focus on questioning as a strategy for supporting argumentation.

Theoretical Perspective and Conceptual Framework

Drawing from a situative perspective, we conceptualize learning as socially constructed; it takes place through interaction with other human beings, within a specific context, and through active engagement and participation in meaningful practices (Lave & Wenger, 1991). In this study, the situative perspective led us to attend to a teacher's participation and use of analytic tools when discussing selected video representations of her teaching. As the teacher examined, commented on, and critiqued her support of argumentation with another more experienced other (i.e., the mathematics teacher educator-researcher, MTE-R), they built and negotiated the meaning of the practice of supporting argumentation in school mathematics.

Following Toulmin's (1958/2003) model of argumentation, an argument consists of at minimum a *claim* (statement whose validity is being established), *data* (support provided for the claim), and *warrant* (statement that connect data with claims). In this paper, we focus on collective argumentation (i.e., individuals working together to determine the validity of a claim). According to the Teacher Support for Collective Argumentation (TSCA) framework (Conner et al., 2014), teachers can support collective argumentation in three ways: directly contributing to the argument (e.g., providing a claim), asking a question (e.g., requesting an action or information from students), or using other supportive actions (e.g., repeating a student's claim to the class). For the purpose of this paper, we focus on the teacher's questions and her critique of those questions.

Methods

Participant and Data

Jill (a pseudonym) was a participant in a 6-year longitudinal study focused on understanding how beginning teachers learn to facilitate collective argumentation. Jill agreed to participate in the final phase of the study, which was to follow her into her first three years of high school teaching. For this paper, we analyzed data from the first and third years of Jill's teaching because we noticed a significant shift in Jill's participation in analyzing her support for collective argumentation between those two time points and that this contrast provided insights into her understanding of questioning to support argumentation. Data includes 6 classroom observations in her first year and 9 classroom observations during her third year. The research team video-recorded each lesson observation, collected lesson artifacts (e.g., worksheets), and made field notes. After each lesson observation, the team identified episodes of argumentation in the video-recordings and referred to lesson artifacts and field notes as needed to make sense of what happened in the video-recordings. In post-lesson interviews (Interview 6 through Interview 19), the third author interviewed Jill to discuss her supportive actions with respect to collective argumentation by having her analyze selected argumentation episodes from the lesson's video-recordings. The focus of these interviews was to assist Jill in analyzing her support for argumentation, understand Jill's goals for the lesson, and gain insights into Jill's perspective of the school context in which she worked. All post-lesson interviews and video clips were transcribed as data sources.

Data Analysis

At the first stage of analysis, the research team diagrammed episodes of argumentation identified in Jill's lessons using a revised Toulmin's (1958/2003) model (as described in Conner, 2008). The team classified all of Jill's supportive actions for argumentation using the TSCA framework, including Jill's direct contributions to arguments, questions, and other supportive actions. In the second stage, the team developed a codebook to identify moments when Jill analyzed her support for argumentation. The subset of the codes included *identifies argument* (i.e., teacher identifies an argument or episode of argumentation), *identifies component* (i.e., teacher identifies data, claim, or warrant of an argument), *identifies support* (i.e., teacher identifies a question or other supportive action), *teacher critique of support* (i.e., teacher's evaluation of her own support or observation about the presence of support or lack thereof), and *teacher analysis of support* (i.e., teacher categories or otherwise gives ideas about what kinds of support she provided). After coding all the post-lesson interviews from Jill's first and third year, the team generated reports of all the instances of these codes in the data. The team used these reports to compare Jill's analysis of her questioning over time. This analysis is ongoing; initial results are presented in this paper.

Results

Year one: “Very leading on my part, I think”

During her first year of teaching, Jill did not perceive a teacher's questioning as essential support for students to make arguments. For example, Jill asked the MTE-R at the end of the first post-lesson interview, “How [do I] get them (students) to actually form arguments themselves without me having to do it for them? Like without me having to say ‘Well, why do you think that?’ You know, dictating every little step of it.” (Interview 6). Typically, when the MTE-R asked Jill to describe what she noticed after watching video clips of her first year of teaching, Jill described her questioning as leading. For example, “I said, ‘Well, what are the slopes of the two lines?’ and then she [the student] said, ‘Well, they're opposite reciprocals’...So it was very, very leading on my part, I think.” (Interview 8). We interpreted Jill's description of leading similarly to how she described her questioning in the first interview as “dictating every little step.” In other words, a question was leading to Jill if it resulted in the claim or warrant that she was expecting students to make in the argument.

In an attempt for Jill to see her questioning as supportive of argumentation, the MTE-R asked Jill in the last interview during her first year of teaching to provide examples of leading questions that she used during an episode of argumentation. As Jill went through the transcript, she began to re-evaluate some of her questioning. For example, Jill stated, “I think, where I say, ‘Wait, what else do we know?’ that was not a leading question. That was very open” (Interview 8). This question had the potential to elicit an unexpected claim from students, and she evaluated it as not leading, which supports our interpretation of her meaning for “leading.” The MTE-R next assisted Jill in identifying how her questioning supported students in contributing claims or warrants (Interview 8):

MTE-R: You say, “How do we know these are right angles?” So, you're emphasizing, okay, the claim here that we're looking at. It is these are right angles, right?

Jill: These are right angles (nodding).

MTE-R: And so, then a student says, “Because of the slope.” So, you are then saying, ‘Okay, let's go with that. Because of the slope, what do we need to know about the slope essentially?’ Right?

Jill often described her questioning in her first year of teaching as leading, but she seldom considered how her questions supported students to make contributions to the argument, such as providing a claim or warrant. We argue that having Jill examine her questioning in relation to supporting students to contribute claims or reasoning for the claims assisted her to reconsider the purpose of her questioning and how it was a useful strategy to support collective argumentation. The MTE-R provided these opportunities to Jill over the course of her second and third years of teaching. Jill identified argument components (e.g., claims or warrants) and her supportive actions, such as questioning, in relation to students' contribution of those components.

Year three: “But that's different than leading”

At the end of her third year of teaching, Jill was provided with an episode of argumentation from her class and asked to identify what she did to support students to contribute components of the argument. Jill pointed out several questions she used to support students' contribution of claims or warrants. For example, Jill stated, “Okay so... ‘Why does 6 not work?’ would be [what] got her to say that [warrant] but it goes to [give reason for] that [claim]. So that [question] was my support for that part of this little [warrant]” (Interview 17). Jill even identified claims or warrants that were unprompted by her: “And then...so her friend said that [claim]. I don't think I said anything really” (Interview 17). After identifying all of her supportive actions (questioning and other supportive actions), Jill reflected on her questioning without any prompting.

Jill: So, really, I think I didn't, I didn't say too many leading things here.

MTE-R: Huh-uh (affirmative).

Jill: Which is probably what made this argument good. Because I didn't say anything.

MTE-R: No, you said things.

Jill: Well I just, I gave her...

MTE-R: You said appropriate things.

Jill: Slight direction. Nothing leading.

MTE-R: True, true.

Jill: But slight direction I think sometimes is necessary because they're still new with things.

MTE-R: Oh yeah. Mm-hmm (affirmative).

Jill: But that's different than leading them. (Interview 17)

This was a shift in Jill's analysis of her questioning in relation to her observations from her first-year interview. Recall, Jill initially asked the MTE-R how to get students to make arguments without her having to "dictate every little step." By her third year of analyzing her questioning, Jill described her questioning as supportive of getting students to contribute to the argument and reflected that asking those questions "sometimes is necessary."

Discussion

Kosko et al. (2014) hypothesized two reasons for why teachers envisioned providing minimal scaffolds, such as questions, during argumentation: lack of teaching experience with argumentative discourse or falling victim to the conception of "not telling" (Lobato et al., 2005). This study provides support for the latter hypothesis. Early in Jill's analysis of her support, she critiqued her questions as "too leading" based on their *form* (i.e., a question that does not allow for multiple contributions from students) rather than their *function* (i.e., getting students to make claims or provide explicit warrants). Reformulation of telling in terms of function rather than form was an important consideration to make explicit for Jill when first learning to analyze her support of mathematical arguments. Jill's analysis of her questioning with assistance from the MTE-R and the TSCA framework (Conner et al., 2014) supported her to reformulate the purpose of her questioning. Lobato et al. (2005) also argued for the reformulation of telling in terms of conceptual rather than procedural content of the new information and the relationship of the "telling" action to other teacher actions. While Jill initially focused on the form, rather than the function, of her questions to support argumentation, it is reasonable that these other reformulations may need to be explicitly addressed with teachers as they learn to facilitate argumentation. Nonetheless, this study provides evidence for the interaction between a teacher's learning to facilitate argumentation and the dilemma of telling regarding the form and function of her questions when trying to honor students' mathematical thinking.

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