Weaving Discussions with Questioning

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Mathematics teacher educators' (MTEs') questions support prospective teachers' (PTs') development of pedagogical routines (Kazemi, 2016) and deepen professional thought (Olsher & Kantor, 2012). Although teacher educators assume initiating discussions with questions supports PTs' "curiosity and inquiry" (Dillon, 1980, p. 17), questions can provoke frustration (Olsher & Kantor, 2012) and dampen discussions (Dillon, 1984). Ambiguity in outcomes of MTE questions suggests a need for inquiry into MTEs' experiences using questions to initiate pedagogical conversations. We examined MTEs' experiences posing questions to engage PTs in discussions focused on mathematics teaching to address the question: How do MTEs use questions with relational intent to build discussions?

Like Guilfoyle et al., (1997), we are critical friends who share perspectives and interest in teaching about teaching (Loughran, 2006). In our mathematics methods courses, we use questions to motivate discussions but remain unsatisfied by the results. We share a commitment to improving our relational teacher education practice (Kitchen, 2005) and derive our practice from the principles of constructivist teaching (Steffe & D'Ambrosio, 1995). Central to our view of constructivist teaching is the construction of models from evidence of PTs' conceptions of mathematics teaching and learning. Models are then used to inform our instructional activities. We assume MTEs use questioning and discussions in instructional activities to support PTs' development of conceptions of mathematics teaching and learning. Discussions are central learning tools in constructivist teaching that involve gaining perspective on one's ideas through the corroboration of others (von Glasersfeld, 1995). Openness and sense making in discussions allow community members to be corroborators and motivate the construction of new concepts.

Our different institutional contexts provide diversity in our critical friendship (Guilfoyle et al., 1997). Signe and Susan work with elementary PTs but at a research-focused university and a teaching-focused university respectively. Alyson works with secondary mathematics PTs at a university transitioning from teaching-focused to research-focused. Signe is committed to mentoring faculty and graduate students to support belongingness in the mathematics education community. In this work, relational teacher education and constructivist teaching are used to develop her identities (Newberry, 2014) as a professor and mathematics teacher educator. She works to find ways to legitimize self-based methodologies in mathematics education, particularly self-study of MTE practice. Susan is committed to professional development work in India. She works with a quality improvement team to create self-assessment culture in schools. Susan's reflective practice across cultural contexts of India and the US informs conscious decision- making in her teaching and collegial collaborations. Alyson has extensive teaching experience in urban public schools. She is committed to supporting mathematics teachers' development of effective practices, but recognizes that her constructivist teaching goals are often constrained by her attention to policy structures in K-12 educational settings.

We recognize that PTs' mathematics learning includes the experience of being questioned. Nolan

(2007) described the physical effect of such experience even after earning degrees in mathematics and science: “the hairs on the back of my neck stand on end and I break out in a cold sweat when I think someone is about to ask me a question that tests my ‘knowledge’ in math or science” (p. 21). Mathematics teachers report similar physical and emotional responses in mathematics autobiographies (Towers et al., 2017) and describe the source as experiences in mathematics classrooms. PTs’ experiences with mathematics as product oriented, where procedures are used and algorithms are taught, has been linked to feelings of shame in teachers (Bibby, 2002). Bibby identified the source of such feelings as distance in relationships among learners and between learners and their teacher.

Prospective teachers’ experiences in mathematics classrooms suggest that creating discussions from questions in mathematics methods may be challenging. Brandenburg’s (2008) exploration of her “taken-for-granted assumptions about teaching and learning” (p. 3) in mathematics teacher education, included providing PTs with opportunities to participate in reflective discussions. Yet Brandenburg found that providing opportunities sometimes prompted silences rather than discussion. Initiating and sustaining discussions using questioning involves drawing on interpersonal relationships (Schwab, 1954) and gaining insight into PTs’ lived experience. Understanding PTs’ histories can allow MTEs to build meanings for comments as well as silences in discussions.

Aim/Objectives

Our earlier self-study into learning to teach about mathematics teaching through questioning (Kastberg et al., 2019) resulted in awareness of imbalance among course goals and desire to construct relational practice. In that study, we characterized assumptions (Dillon, 1990), purposes, and roles implicit in our questions. Findings motivated us to restructure our questions. We then focused on questioning as a relational practice (Kitchen, 2005). We found that our questions were seldom informed by PTs’ experiences. Although improving our practice meant gaining insight into and asking questions informed by PTs’ experiences, we struggled to sustain PTs’ relevant talk. Findings from our study of MTEs’ questions and PTs’ responses inspired inquiry into the interplay between questions and discussions. We define discussions as a “form of group interaction where members join together in addressing a question of common concern, exchanging their knowledge or understanding, their appreciation or judgment, their decision, solution or action over the matter at issue” (Dillon, 1994, p. 8). Discussions are not recitations where students respond to questions and responses are collected. Yet PTs in our classes seemed to treat questions we intended to elicit discussions as opportunities for recitation. Given our earlier work we expected imbalance. We refocused our inquiry on the relational intent of our questions within discussions, asking in this present study: How do we build discussions from the relational intent of our questions?

Method(s)

We draw from self-study as self-initiated, improvement-aimed, interactive, and involving validation via trustworthiness (LaBoskey, 2007) to inform our approach to self-study as open, collaborative, and involving reframing (Samaras & Freese, 2009). Our questioning and discussion practices were opened to each other for critique. Collaboration allowed us to gain perspective by comparing our questions with relational intent and resulting discussions across our contexts (The Arizona Group, 1996). We are “insiders” in mathematics education, engaged in a “reciprocal” critical friendship (Stolle et al., 2019, p. 23) since 2013. We explored our questioning and discussion practice through weekly analytical dialogues (Placier et al., 2005) conducted through video calls.

Primary data sources were collections of transcripts of classroom teaching episodes from each author. Questions, defined as “interrogative utterances” which are “followed by answers” (Dillon, 1981, p. 51), were identified in each transcript. We used analytical dialogues with two cycles of inquiry to build knowledge about our questions and their use in initiating discussion. First, we analyzed our initial questions through the lens of relational teacher education, identifying how the questions: (1) conveyed respect and empathy, (2) helped PTs face problems of practice, and (3) showed receptivity to growing in relationship (Kitchen, 2005). We identified the question’s relational intent and explored the resulting discussions. This analysis revealed many of our questions elicited recitations, so we turned back to our transcripts and recordings. Second, we looked at our data for evidence of phenomenological characteristics of discussions: “freedom of address” and commitment to “search for meaning” (Dillon, 1994, p. 12). We each identified one discussion that began with a question and contained some evidence of the two phenomenological characteristics. Analytical dialogues for our second round of inquiry focused on one transcript for each MTE and a summary of the transcript that identified the initial question and characteristics of the discussion. We explored why these questions elicited discussions. The dialogues stimulated “a remembering of much more about the situation” around the discussions than the recording or transcript contained (Ham & Kane, 2004, p. 114). Our researcher inquiry into the interplay between our MTE questions and the resulting discussion unearthed factors that mediated the relational intent of our teacher questions.

Outcomes

Across all three contexts, the relational intent of our questions was typically insufficient to initiate discussions. Questions with relational intent sometimes elicited discussion, but as often as not elicited recitation. We share this outcome in the next section. We then share evidence from our class discussions that set the stage for descriptions of factors that support elicitation of discussions rather than recitations.

Recitation and Discussion

The primary relational intent of our questions was to convey “respect and empathy” (Kitchen, 2005, p. 15). One way we intended to convey respect and empathy was to gather PTs’ experiences or reasoning. For example, Alyson intended to draw from PTs’ experiences with mathematics content by asking “What do you remember about angle sums in polygons?” This question was designed to serve as a foundation for a pedagogical discussion. However, Alyson’s question resulted in a stilted sharing of facts in which PTs hesitantly offered short phrases, uncertain if their answers were correct and looking to Alyson for verification. As Alyson urged sharing of experiences, PTs offered disconnected memories of angle sums in polygons that amounted to a recitation.

In contrast, Susan posed a question intending to draw from PTs’ experience with or observations of strategies used for addition and subtraction. Susan hoped to discuss key mathematical relationships and compare strategies. Susan’s question resulted in PTs sharing memories of learning algorithms and children’s strategies observed in field experiences with little facilitation by Susan. Contributions opened possibilities for discussion of an addition or subtraction strategy, what made the strategy successful, common errors, and how to support children’s mathematics. PTs’ built from each other’s responses. Contrasts between Alyson and Susan’s experiences using questions with relational intent to elicit discussion re-framed our inquiry on phenomenological characteristics of discussions that support PTs engagement in discussions.

Susan's Class Discussion

PTs come into my elementary mathematics methods course as a cohort taking the same classes during their last four semesters. Mathematics methods is mid-way through the program. Friendships and support groups within the cohort have been established. The cohort of 19 PTs from fall 2019 demonstrated unusual desire to understand how and why mathematics procedures work in the context of learning to teach mathematics. The discussion introduced in the last section occurred two-thirds of the way through the course and was initiated with the question: "What do you remember about learning [addition and subtraction] for yourself or from your experiences with children learning addition and subtraction?" I anticipated this would generate examples of correct strategies as well as common errors. The ensuing 11-minute discussion included nine PTs who shared specific examples of addition and subtraction strategies, with other voices in the class of 19 murmuring or chiming in. PTs shared personal experience such as, "back in the day when I was a kid, I only remember the strategy of counting on my fingers and then when we got to bigger numbers only learning the algorithm." Others shared observations of children, "a little girl, she's in first grade … when she started doing double-digits like 14 plus 5, she would start doing 41 plus 5." Each beginning generated examples from PTs' experience. I prompted for elaborations when needed, "can you give an example?" and "do you want to demonstrate it for us?". One PT built on a previously shared example she described as "messed up subtraction," saying "can I do some more of that messed up subtraction?" Later, a PT presented a first-grade student's strategy that she described as "really confusing to them [the students]." Four PTs excitedly in voices-overlapping clarified the strategy. They explained sense-making involved in finding 15 minus 7 by splitting the 7 into 5 and 2, subtracting 5 from 15 to get 10 and then subtracting 2 more.

Alyson's Class Discussion

PTs enter my program as early as their freshman year. We work to develop community among them through frequent events such as caramel apple socials and "Wear your Program shirt" days. On the day of this discussion, the ten PTs entered carrying chili bowls from the Annual Chili Cook-Off, wearing matching shirts and chatting about the cold weather. Throughout this methods course, I encouraged reflection on activities and continued questioning of teaching actions through "wondering" about teaching practice decisions. This class session, near the end of the semester, centered on reflecting across a semester-long letter writing exchange in which each PT corresponded with at least two high school mathematics students about a problem involving two swimmers in a lap pool. I began the class by providing reflection questions, followed by five minutes of individual reflection and 10 minutes of small group talk. I then shared research related to written feedback and encouraged the small groups to continue their conversations incorporating the research. To begin the whole class discussion I asked, "What are you wondering about effective feedback for students?" The 16-minute whole-class discussion that followed included contributions from 7 of the 10 students in the class ranging across four themes: differentiating feedback, encouraging without answering questions directly, gauging the correct level for feedback, and tone. The transition between speakers, which occurred with little input from me, began with phrases such as "I did the same thing" or "I was the opposite from them" as PTs built on previous statements. In addition, PTs asked questions of each other, such as "How do you give effective feedback and not give them the answer?" and responded to each other's questions with suggestions and support for frustrations. Most PTs expressed disappointment and fear that their feedback "might have confused" their pen pals. As a group, the PTs reminded each other that mathematical goals should drive their feedback and questioned, "What concepts are we wanting them to learn and what is the goal?" Throughout the discussion, I observed and listened, but needed to moderate infrequently as the PTs controlled the flow of conversation. At

the conclusion of this discussion, I provided opportunity to continue reflecting on the letter-writing exchange through a written assignment.

Signe's Class Discussion

PTs take mathematics methods the semester before student teaching and are familiar with each other since the program has less than 80 students per semester taking required courses together. PTs in mathematics methods engage in out of class activities together: traveling abroad, sharing apartments, and belonging to the same sorority. I have no sense of the social structure of PTs, but see them respond to each other. For example, during a whole class conversation in Fall of 2018, when one student responded to a question I posed, I turned to see two other students knowingly looking at each other and then quickly looking away. I let the moment pass, not really knowing what to make of it. This moment came back to me during dialogue with Alyson and Susan, reminding me of what I did not know about PTs' relationships with each other.

My discussion excerpt came from small group exchanges focused on addressing PTs' identified challenges with initiating and sustaining productive math talk. Throughout the semester I had been trying to initiate and sustain discussions using questioning. PTs selected their own seats and collaborated with colleagues in groups of 3 or 4 who acted as a support system and confidants. Whole class "discussions" typically begin with a request to "talk at your tables" and then a sharing out of ideas while I scribe.

The lesson in this excerpt capitalized on PTs' willingness to talk to each other in the small groups. One of several related activities in the lesson involved PTs working in groups of 4 or 5 to create poster paper lists of pedagogical choices to address challenges of initiating and sustaining productive math talk. PTs then engaged in a gallery walk, reviewing suggested choices, and identifying limitations and affordances of each choice.

One group created pedagogical choices to address the challenge of managing student participation in discussions (such as not talking, talking out of turn, and off-topic talking). One choice listed was "pulling sticks," meaning randomly pulling sticks with students' names on them from a cup to decide who would participate next. The group shared that "pulling sticks" would ensure that all students had the opportunity to participate. Asked to identify limitations and affordances of the suggested choices, PTs focused on limitations of "pulling sticks."

> Micha: Pulling sticks (reading the choice written on the poster aloud to the group).
>
> Anita: That is stressful. Kids get stressed about that. Like maybe I'm the one who is going to get pulled next.
>
> Signe: (Nodding her head in agreement.) Whenever we would do multiplication facts around the room, I would be like counting. Mine's going to be four times eight.
>
> Anita: Yeah
>
> Jessie: You can't really build wins like that. You like every time they get pulled.… (indistinct talk)
>
> Micha writes "stressful, embarrassing, can't win/random" focusing on limitation of the

choice.

During the gallery walk, a different group of PTs discussed the choices as well the limitations of "pulling sticks" listed on the poster.

> Nicole: That's how you grow up.
>
> Maddie: We didn't do that when I was a kid and I turned out fine. Nicole: That's what I'm saying.
>
> Signe: What?
>
> Nicole: Like this (pointing to the limitations of pulling sticks).
>
> Maddie: Like kids being sensitive. My teachers did that and I think I'm fine.
>
> Nicole: You have to teach responsibility.
>
> Maddie: I'm fine.
>
> Signe: Definitely, the other group was having a real idea about that. So that will be a good discussion item.

The two PT groups addressed the idea of "pulling sticks" differently, the first as an anxiety provoking experience and the second as an opportunity to teach academic responsibility. In small groups, PTs shared ideas freely. Yet when we reassembled as a class to talk across ideas from the gallery walk, groups remained silent. I did not point out the two different views of "pulling sticks" and neither did the PTs. Our silence raises questions about whether the PTs felt "conscious of a freedom to address anyone" (Dillon, 1994, p. 12) in the whole class that they seemed to feel in the small group. I see this play out every semester as groups of PTs from little communities that share food, talk about their lives between classes. In the whole class, this freedom does not belong to everyone. Does it belong to anyone?

Discussion

Our investigation was situated in our effort to build relational practice through constructivist teaching discussions that provoked PTs' "curiosity and interest" (Dillon, 1980, p. 17). However, evidence revealed that some questions with relational intent dampened discussion (Dillon, 1984), perhaps by triggering PTs' emotional responses to mathematics (as in Alyson's polygon question). Our first cycle of inquiry revealed that we used questions with relational intent to begin discussions, but in an effort to include many voices we often broadened the focus of the question by accepting responses outside the intended domain of inquiry (e.g., Kastberg et al., 2019). We were uncertain how to build PTs' curiosity and interest and often sought to "control" and guide discussions toward outcomes that would fulfill course objectives. In this second cycle of inquiry, we identified factors that support discussions aligned with the relational intent of our questions.

Phenomenological Characteristics for Discussions

Questions with relational intent that elicited discussions were not unlike those that provoked recitation, yet by exploring the phenomenological characteristics in the excerpts, we identified two factors that supported discussions. The first factor in all three discussions was the capture of PTs' "energy of wanting" (Schwab, 1954, p. 52). For example, Susan's question captured the PTs' desire to understand experiences and observations of adding and subtracting. Follow-up questions were unnecessary as the PTs built from each other's memories and noticings, searching for meaning in their own experience and children's mathematics. Underlying the discussion was a desire to make sense of strategies used to compute.

The second factor in all three discussions was, common experience. Alyson's students had engaged in a semester-long letter-writing activity to gain insight into the complex work of giving feedback. Signe's students had been wrestling with challenges to productive math talk. These common experiences set boundaries for the discussion rather than expanding the scope as we had done in the past. Discussions had a focus and PTs responded from common experience with ideas and insights that positioned each as corroborators for other's. For example, in Alyson's classes, PTs asked each other questions and responses illustrated similarities and differences in their common experiences. Building from common experience, PTs' addressed questions posed with relational intent in ways that explored dimensions of that experience from different perspectives.

Community Characteristics and Discussion

Using questions to initiate discussions has resulted in research evidence that questions may support or dampen discussions (Dillon, 1984; Kazemi et al., 2016; Olsher & Kantor, 2012). MTEs seeking to initiate and sustain discussions with questions, should first attend to relational intent of their questions. Such questions stand in contrast to those posed in mathematics classes where PTs are expected to efficiently communicate processes and answers. Questions drawing from PTs' experience can elicit recitations when MTEs broaden the scope of the question to include all PTs' answers. Initiating a discussion with a question involves understanding the community of PTs in the program context. Findings from this study suggest that community factors contributed to PTs' movement from addressing the question to making the question an object of group inquiry. Across our institutional contexts there are significant differences in the communities developed in our program areas. In Alyson's institution, PTs are in small cohorts and community building is a programmatic goal. Outside Alyson's class, PTs contribute to a social community, enabling them to feel that they can freely address Alyson's pedagogical questions. For Susan and Signe communities within programs are adhoc, thereby constraining PTs' freedom of address.

Participant Conditions for Discussions

Dillon (1994) described participant's consciousness that they are free "to address anyone in the class on any occasion" (p. 12) as one condition for discussions. In all three of our classes this freedom is represented in different moments and to different degrees. In Signe's class, PTs' openly disagree with colleagues in small group settings, yet resist sharing these disagreements in whole class conversations. Signe's challenge is supporting the development of freedom of address across small groups. Alyson and Susan's excerpts illustrate PTs' responding to each other freely. In Alyson's class, PTs positioned themselves as similar and different saying "I did the same thing" or "I did opposite." In Susan's class, PTs excitedly talked over each other about subtraction saying for example "I kind of do that but differently in my brain." In all three contexts, freedom of address allowed the PTs to

address the posed question, with recognition that different experiences would serve as part of the "answer" to the question.

Dillon further described participants' intentional "common search for meaning" (p. 12) as a second condition for discussions. The three discussion excerpts contain evidence of PTs discussing pedagogy to explore the meanings of learner's mathematics, pedagogy of feedback, and pedagogical choices to meet challenges to productive math talk. PTs in each excerpt describe their experiences with the object "in their understanding and life" (p. 12).

Questions with relational intent that capture PTs' "energy of wanting" (Schwab, 1954, p.52) and draw on common experience in communities where members feel free to address each other and are engaged in sense making are likely to result in discussions. Relational intent alone was not sufficient for us to use questions to elicit discussion. Having identified factors that contribute to discussions, we are now left wondering how to sustain and conclude discussions. As Brandenburg (2008) notes, understanding silences may be an important idea. Our models of PTs' conceptions of mathematics teaching and learning may be informed by silences in ways we are not aware. For example, Alyson had three PTs who did not talk during the whole class discussion. How do the PTs' silences influence her view of their ideas? Through our dialogues, we identified factors necessary, but not sufficient, for questions with relational intent to elicit discussion.

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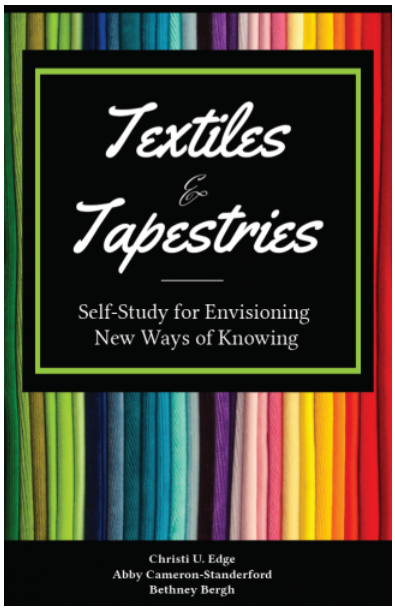

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