Developing Teachers' Instructional Vision for Inclusive Math Practice:
The Role of Epistemic Experience[1]

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The term ambitious is often used to describe mathematics teaching that is responsive to student thinking, highlighting the challenge involved in engaging students in authentic problem solving while continually eliciting, making sense of, and responding to student ideas in pursuit of mathematical learning goals (Kazemi et al., 2009; Lampert & Graziani, 2009). In responsive teaching, students are positioned as sense-makers and their ideas and experiences are foregrounded (Robertson et al., 2016). Kavanagh (2020) describes responsive teaching as a "dynamic interplay" and "a collaborative negotiation between students and teachers that develops as students' ideas emerge and grow." (p. 94) Since most teachers did not learn math themselves in this way, learning to teach math responsively requires developing new visions of teaching and learning as well as new classroom practices (Munter, 2014). Responsive teaching cannot be reduced to a set of desired actions or practices and it cannot be scripted (Kavanagh, 2020). Rather, it is an overall stance towards student learners, involving genuine curiosity about students' ideas and being able to see their nascent understandings as sensible and worthy of building on, rather than in need of correction (Duckworth, 2006; Robertson et al., 2016). By recognizing and building on learner assets, teachers can provide entry points for students who are often marginalized or excluded by more traditional or prescriptive approaches to math instruction.

In this paper we focus on what a set of developing teacher leaders learned through experiencing responsive math instruction as learners in a collaborative learning community. More specifically, we investigated shifts in their instructional visions after participating in a series of facilitated professional development sessions where they collaboratively solved challenging open-ended tasks, engaged in productive struggle, participated in mathematical discussions, and reflected on the facilitation of the process. We then explore the influence of this experience on the development of their instructional visions over time, and more specifically, how they drew on their own learning experiences to think about teaching. Our analysis highlights an aspect of teacher learning of responsive teaching that is underexplored in mathematics education--the concept of *epistemic empathy*, both how it gets reified in a collaborative problem solving community and the role it plays in the development of more inclusive instructional visions.

Teacher Learning through Engaging in Disciplinary Practices

While responsive teaching approaches have become central in many efforts to improve mathematics education, most teachers have not had mathematical learning experiences like the ones they are being asked to facilitate for their students. In addition, their prior learning experiences have not resulted in developing a sense of either confidence or competence in the disciplinary practices. Mathematics educators have long argued that teacher preparation and professional learning opportunities need to engage teachers in learning to *do mathematics* rather than just learning mathematics content (the end product of doing mathematics) (Goldenberg et al., 2021). In fact, there is compelling evidence that engaging in "doing the math" together can support teacher learning, and the *Math Teachers' Circle* model, where teachers engage regularly in mathematical problem solving, has become an increasingly popular model for professional development (Donaldson et al., 2018).

Studies of teacher learning communities focused on doing mathematics have shown that the experience supports changes in beliefs about what it means to know math and how it is learned as well as the development of content knowledge, confidence, and mathematical knowledge for teaching (Borko et al., 2005; Borko et al., 2014; Elliot et al., 2009; Shifter & Fostnot, 1993; Taton, 2015; White & Donaldson, 2011; Wilcox et al., 1991). In a recent study of math coaches, Kane & Scalarades (2021) show that doing mathematics together as a regular routine opened up opportunities to discuss both mathematics and mathematics instruction.

An additional, but less explored benefit of participating in a learning community where teachers are positioned as learners experiencing the kind of teaching they are expected to implement, is that it can open up opportunities to develop understanding of the learner's experience of sensemaking and knowledge construction. Jaber and colleagues have shown in several studies that engaging in scientific inquiry allows teachers to develop *epistemic empathy* for learners which in turn supports responsive science teaching in the classroom (Jaber et al., 2018; Jaber, 2021; Jaber et al., 2021). Drawing on Horshtemke (2015), they define epistemic empathy as an act of "decentering from one's ways of understanding:"

> We define epistemic empathy as the act of understanding and appreciating someone's cognitive and emotional experience within an epistemic activity, meaning an activity aimed at the construction, communication, and critique of knowledge. Epistemic empathy entails an ability to take learner's perspectives and identify with their sense-making experiences, in service of fostering their inquiry (Jaber et al., 2018, p. 15).

Epistemic empathy, therefore, is an appreciation for the learner's experience, both cognitive and emotional, in the process of making sense, or coming to know.

Several recent studies emphasize the need to recognize the effects of math instruction on students' affect, identity development, and their overall relationship with mathematics (Battey, 2013, 2016; Martin, 2000; 2006; Myers et al., 2015). Yet current approaches to mathematics teacher education tend to focus on providing teachers with conceptual and practical tools for responsive instruction, with less attention to the affective aspects. There has

been little exploration of what teachers learn about these affective aspects from their own professional learning experiences.

Instructional Vision

When introduced to new instructional approaches, teachers may embrace the underlying ideals, even if they are not yet able to enact them. Cobb & Smith (2008) define instructional vision as teachers' statements about "what is important for students to know and be able to do mathematically...and how students' development of these forms of mathematical knowledgeability can be effectively supported" (p.7).

Munter (2014), building on Hammerness's (2001) conceptualization of *teacher vision* along with Sherin's (2001) notion of the development of *professional vision*, developed an interview-based instrument to capture the developmental trajectories of teachers' *visions of high quality mathematics instruction* (VHMQI). Munter's rubrics draw on literature from mathematics education to characterize instructional vision in relation to the role of the teacher, classroom discourse, the nature of the mathematical tasks, and student engagement in discourse. Using these rubrics to measure teachers' VHMQI in a large scale study, Munter and Correnti (2017) show that instructional vision is predictive of teacher's take up of subsequent learning opportunities, supports, and resources (Munter & Correnti, 2017). In addition, they found that teachers' instructional vision was related to growth in the quality of instruction and often developed ahead of changes in actual practice.

In a study of recent graduates from a teacher education program, Jansen et al. (2020) show that teacher preparation experiences can influence teachers' instructional vision into their early years of teaching. Arbaugh et al. (2021) investigated the connections between pedagogies of practice (Grossman et al., 2009; Lampert et al., 2010) and changes in preservice teachers' instructional vision, which they characterize as "broadening visions" of the role of the teacher. Taken together, these studies suggest that engaging in professional learning opportunities can lead to changes in instructional vision as well as practice.

In this study, we explored what a group of emerging K-8 teacher leaders (ETLs) learned from engaging in a facilitated experience of doing mathematics and reflecting together on the experience. In particular, we explore the relationship between this experience and changes in their visions of mathematics instruction around the learner experience. Our research questions included:

- How did the ETL's visions of high-quality math instruction shift after participating in a facilitated problem solving community (PSC)?
- How did the experience of participating as learners support ETL's framing of the student role during math instruction?

Framing as a Lens to Understand Teacher Learning in a Community of Practice

We use a sociocultural framework to make sense of how ETLs' instructional visions shifted over time, and were related to their participation in the PSC's (Lave & Wenger, 1991). The PSC's reflected Wenger's (1998) three defining dimensions of a *community of practice*: members were *mutually engaged* in an activity (collaboratively solving mathematical tasks and engaging in discussion), focused on a *joint enterprise* (improving mathematics teaching and learning), with a *shared repertoire* (a

responsive instructional model provided a common vocabulary and consistent structure for monthly sessions). According to Wenger (1998), learning in such a community takes place through the dual processes of participation and *reification*, the process whereby experience is transformed into "objects that congeal this experience into 'thingness'" (p. 58). This framework helps us to understand how instructional visions are not just held by individuals but are "distributed across individuals and settings" (Horn, 2007, p. 38).

In addition, we draw on the sociological concept of *framing* (Goffman, 1974; Tannen, 1993) to understand how participants interpreted their experiences as learners and teachers in the context of the PSCs. Framing, as conceptualized by Goffman (1974), is a dynamic, interactive, and multi-layered process of collective sense-making, sometimes referred to as the answer to the question "what is it that is going on here?" Some mathematics education researchers have used frame analysis methods drawn from Goffman (1974) and Benford and Snow (2000) to understand participation in teachers communities of practice in terms of how teachers frame and interpret problems of practice (Bannister, 2018; Horn, 2007, 2010; Horn & Kane, 2015; Coburn, 2001; 2006). In the current study, we were not focusing on teachers' interpretations of problems, but rather their ways of understanding teaching and learning as processes. The PSCs were intentionally structured to frame the learning of mathematics as an active collaborative process of sensemaking and engaging in productive struggle to solve challenging tasks through developing, sharing, and refining strategies. However, participants come into this experience with very different expectations about learning mathematics as a result of their prior experiences as learners and teachers. We were interested, therefore, in how educators drew on both past and present experiences to conceptualize mathematics teaching and learning. We see these experiences as multi-layered, inclusive of their beliefs in their own capabilities and identities as mathematics learners, social positioning in relation to others, and affective aspects.

As Bannister (2015) asserts, using frame analysis along with a communities of practice framework is a useful way to understand teacher learning within the collaborative group context:

> The meaning-making process of framing within the teacher community complements and extends the dual processes of participation and reification in a community of practice; the reification of teachers' participation in a community of practice is rendered visible through framings of their shared work. It stands to reason that analysis of teachers' participation patterns within the professional teacher community alongside analysis of their framing patterns effectively documents changes in participation in a community of practice. (p. 133)

Methods

Context

This research was situated in a research-practice partnership with a network of 14 elementary schools in the same geographical area of a large urban district; in 12 of those schools 100% of students were classified as economically disadvantaged and more than 90% were students of color. The partnership focused on developing school-based teacher leaders through a multi-year professional development program. The first year focused on providing regular opportunities for educators to

experience responsive math teaching as learners through monthly problem-solving communities (PSCs). The second year focused on supporting classroom implementation of responsive math teaching, and the third year focused on learning to lead professional development around responsive math teaching. At the core of each of these professional learning experiences was a model of responsive mathematics instruction shown in Figure X, that specified common structures and core teaching practices (Responsive Math Teaching Project, 2021). PD facilitators used this model to anchor reflections at the end of each PSC, and it was used in subsequent years to support lesson planning, coaching, and PD planning.
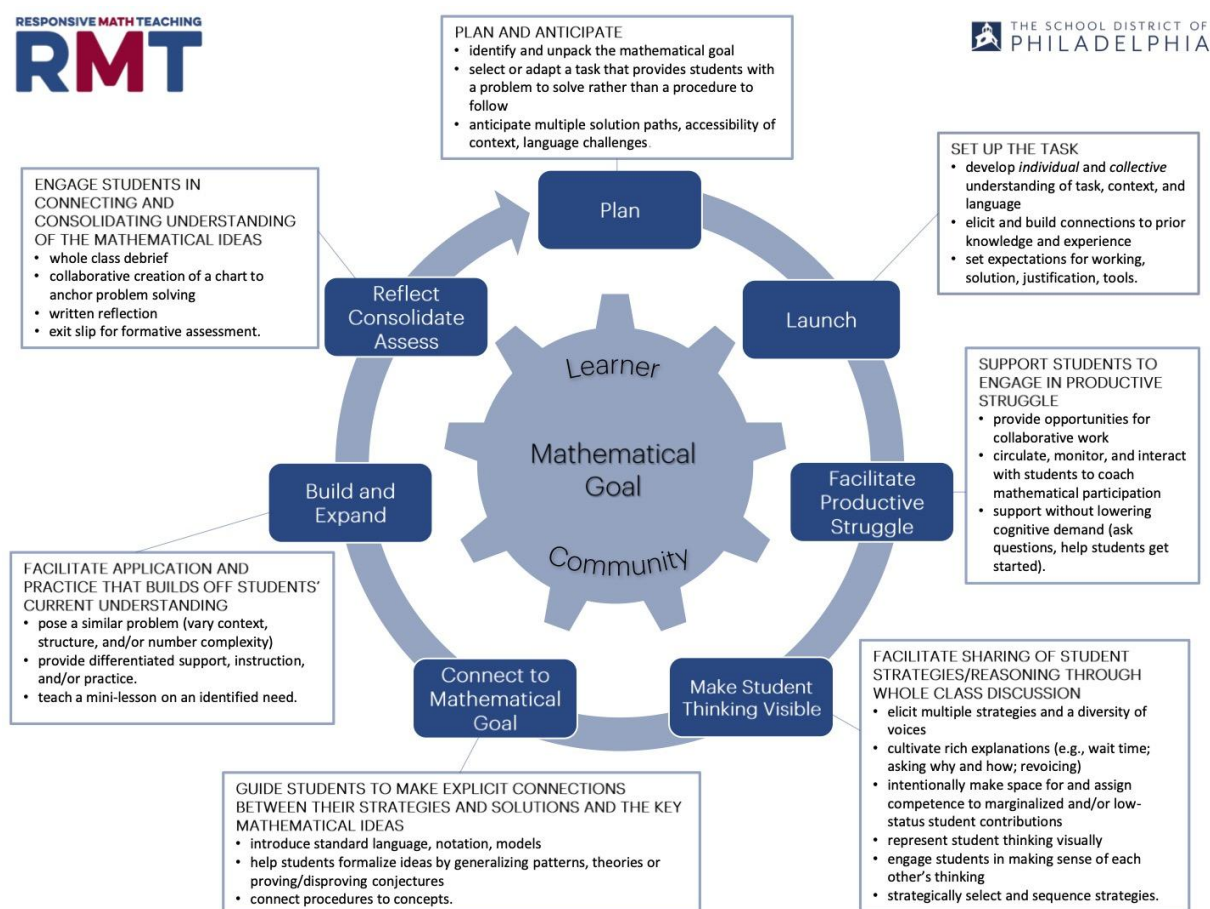

Figure 1. RMT Instructional Model[2]

During the year of this study, there were two PSC cohorts, each with between 13-15 first-year participants and a facilitator who was an experienced math educator. In each session, the facilitator launched a challenging mathematics task, facilitated participants' engagement in productive struggle, shared selected solutions for discussion, and supported connections to mathematical ideas. Each session ended with collaborative reflection on the experience in relation to the participants' experiences, the

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[2] This was the instructional model at the time of the study. A more recently revised version can be found on our project website at https://www.gse.upenn.edu/academics/research/responsive-math-teaching

pedagogical reasoning behind the facilitators moves, and the RMT instructional model. There were a total of 5 face-to-face sessions before COVID-19 school shut-downs caused the PD to shift to a virtual format.

Participants

The study participants came from one PSC cohort of 14 K-8 math classroom teachers and teacher-leaders who worked in 7 different schools. Their teaching experience ranged from 7 to 27 years with an average of 15.6 years. The PSCs took place after school, rotating each month to a different school site.

As part of a larger study on the development of teacher leadership, we selected six participants who had been identified by the principals as instructional leaders (or potential instructional leaders) to follow as case studies of emerging teacher leaders (ETLs). Of the six ETLs, two were fully-released K-8 teacher leaders and the remaining four were full-time grade level classroom teachers. Table 1 summarizes the backgrounds and roles of the six ETLs[3].

Table 1. Emerging Teacher Leader (ETL) Participants

Participant	Gender	Race/Ethnicity	Formal Role	Yrs of Teaching Experience (2019-20)
Brit	F	White	K-8 Math Lead	12
Carrie	F	Black/African American	Teacher leader/ 2nd grade Teacher*	23
Lillian	F	White	K-8 Math Lead	14
Olivia	F	White	8th grade Teacher	11
Sara Beth	F	White	5th/6th grade Teacher	19
Sheri	F	Black/African American	8th grade Teacher	24

*Role changed mid-way through the year from a released teacher leader to a 2nd grade teacher, due to staffing shortages

Data Sources

For the analysis in this paper, data sources included participant interviews and video-recordings of the five PSC sessions. In the Spring of 2020, audio-recorded semi-structured interviews were conducted with

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[3] All names are pseudonyms.

all PSC participants. The interview protocol included questions that asked them to describe their experience in the PSCs, what they learned, and what, if anything, they had applied to their own instructional practice.

The six ETLs (Table 1) participated in two additional interviews -- one in early fall, before the first PSC, and one in the summer, after the conclusion of their first year. These interviews consisted of an existing protocol on teachers' Visions of High-Quality Mathematics Instruction (VHMQI), or their perceptions of ideal classroom practice (Munter, 2014). We also collected and transcribed video recordings of the five face-to-face PSC sessions that took place in 2019-20 before COVID-19 school closures. Although there were additional PSC sessions that took place on Zoom, the structure, format, content and membership of those sessions changed significantly to accommodate the needs of schools and teachers during the COVID-19 shut down. We therefore focused our analysis on the 5 face-to-face sessions that followed a consistent format.

Analytical Approach

The analysis of the data used in this paper was conducted in several stages. We first examined the pre-and post-interview data on the 6 ETLs to look for changes in their instructional vision. At the same time, we began an initial analysis of the whole group discussions at the end of the five face-to-face PSC sessions. In the next phase, we looked for connections between changes in instructional vision and participation in the PSC reflection discussions. Finally, we looked at the Spring interviews, where the ETLs reflected on their experience in the PSCs, for points of triangulation.

To analyze changes in instructional vision, we decided not to use the existing VHMQI rubrics--which characterize the role of the teacher, classroom discourse, mathematical tasks, and student engagement into four broad levels of sophistication--because we wanted to be able to capture more fine-grained differences and changes in the developing visions of our participants. We felt that since the ETLs had either self-selected or been recommended by their principals, and because the RMT instructional model was closely aligned with the highest two levels on the VHMQI rubrics, we might not see as much variation as Munter found in his large scale study of teachers. We therefore read through the interview responses to develop inductive codes (See Table 2). Through this process we identified the construct of the learner's epistemic experience, an aspect of math instructional vision that is not fully captured by the existing VHMQI rubrics.

Once we developed and refined our codes for instructional vision, the pre- and post-VHMQI interviews were coded by two members of the research team and any disagreements were resolved. We then compared the codes for each teacher to look for changes from the beginning to end of year, evidenced by increase in depth of an idea, the emergence of a new idea, or replacement of an old idea with a new idea. Finally, we looked across all participants to identify common shifts.

Table 2. Emergent Instructional Vision Codes

Dimension	Code
Teacher Role	● Importance of planning and preparation ● Launching a task ● Facilitating small group or independent work ● Questioning ● Supporting students to make sense of each other's work ● Helping students make sense of the mathematics ● Formative assessment ● Creating equitable experiences
Task	● Open to multiple strategies ● Open to multiple entry points
Lesson Structure	● Whole class discussion at the end of a lesson ● Small groups for problem solving
Student Role	● Taking on cognitive load through productive struggle ● Collaboration with peers ● Making sense of each other's thinking ● Equity of participation
Classroom Environment	● Cultivating safe environment ● Building community

To analyze participation in the PSCs, we watched the videos of each session and narrowed the data to the whole group discussions that took place at the end of each session, where participants reflected on the experience of solving and discussing the problem in relation to the RMT instructional model. We then divided each transcript into episodes, or units of discussion where the focus was on one idea, and then into participant utterances. We first coded each episode by topic, using our instructional vision codes to characterize a primary and sometimes a secondary topic. We then coded each utterance in terms of (1) whether it was made by the facilitator or a participant (2) whether it referenced the participants' past experience as a learner, present experience as a learner in the PSC, and whether it referenced teaching and (3) the topic(s) of each episode. The next stage of analysis consisted of looking for connections between the shifts in teacher leader's instructional visions and the discussion of those ideas in the PSC episodes.

Finally, we analyzed the post-interviews of both cohorts, focusing on questions that were directly related to participants' experience of the PSCs: their descriptions of the experience, what they learned, and what, if anything, they had applied to their own instructional practice. We further organized those responses into experience as a learner, instructional vision, and classroom implementation and then looked for evidence of the instructional vision codes in each of those categories. Three members of the research team then each coded excerpts from one category and reviewed each other's coding; any disagreements were reconciled through discussion to look for disconfirming evidence.

The first author was overseeing the larger research project but was not directly involved in the planning or facilitation of the PSC sessions. The second author was the facilitator of the PSC cohort that we focus on in this paper, and worked closely with the facilitator of the other cohort on the content and planning of the PSC sessions. The third author coordinated, observed, video-recorded, and took field notes on all the PSC sessions. This engagement allowed for both insider and outsider perspectives on the participants and the analysis of the data. The analysis was conducted after the conclusion of the professional development to avoid potential bias or conflict.

Findings

We first examine shifts we identified in the ETL's instructional vision from the beginning to the end of the year, after participating in five PSC sessions. In this paper we focus on the shifts related to the learner's epistemic experience, since this is an underexplored area in the existing literature. We then explore how shifts in this understanding were connected to other shifts in their instructional vision as well as connected to their participation in the PSC sessions.

Shifts in Instructional Vision

We identified four common shifts across 3 or more of the teacher leaders' instructional visions that related to the learner's epistemic experience (Table 2): (1) taking on the cognitive load by engaging in productive struggle, (2) opportunities to collaborate with peers, (3) opportunities to make sense of someone else's thinking, and (4) opportunities to participate mathematically.

Table 2. Shifts in Teachers' Visions of Students' Epistemic Experiences

Shift	No. of Participants		Example from second interview
	Pre*	Post	
Students take on the cognitive load by engaging productive struggle	3	6	"I also think that [students] need to work. The task should promote some kind of productive struggle. And if it's not the first part of the problem that's a struggle, then there's something else that makes them think that has them pause and think about it. And not just "Here's the answer. I'm done." You know, that's what they say. You should never be done in math. There always should be something else for you to do, but something that's productive to do as well." (Lillian)

Students should have opportunities to collaborate with peers	2	6	"Then, of course, you want to make sure that the students are engaging with one another so that they have time to collaborate with one another. I think that can really come from your questioning, and you can create opportunities in which they can collaborate and then build in your questions to help facilitate those opportunities. I think that would be awesome." (Brit)
Students should have opportunities to make sense of someone else's thinking	2	5	"I would want to hear children talking through their process of how they attack the task. I would want to hear children agreeing with them or disagreeing with them and kind of clarifying a point. I think we should do this. You know maybe even arguments, I should say mathematical arguments. I would love to hear that. I would love to hear questions. Well, how did you, how did you do, things like that." (Sara Beth)
All students need to have opportunities to participate mathematically	0	3	"I don't think you should just hear classroom discussion from those three kids with their hands up. I think it is sharing from the different voices and the different perspectives and allowing it to show, allowing kids to show their work and explain their work and celebrate the differences in how we approach the problems." (Lillian)

*Although some teachers expressed these ideas in their first interview, they articulated it in more depth in the second interview

It is important to note that these ideas were often related and intertwined for participants as they talked about the ideal math classroom. For example, in Lilian's response in the last row of Table 2, she referenced equitable mathematical participation but also the idea that students should be making sense of different perspectives. In addition, these shifts were often tightly coupled with other shifts in instructional vision, around the nature of the task, the lesson structure, the teacher's role and the classroom environment. In the example in the first row of Table 2, Lillian focuses on the nature of the task, but this is framed in terms of learner's epistemic experience ("the task should promote some kind of productive struggle.")

In general, the ETL's framed the ideas that a task should be open to multiple solution strategies and open to multiple entry points in terms of opportunities for students to engage in productive struggle, as well as the idea that there should include time for students to engage in small group problem solving. In terms of our dimensions of instructional vision, student experience was central to the developing vision around the nature of the task and the lesson structure. Likewise the notion that there should be a whole class discussion was framed around the idea that students should have opportunities to make sense of each other's thinking. This was then related to acknowledging that an important part of the teacher role was supporting students to make sense of each other's work.

An illustrative example of these interconnections, and the centrality of the shifts around student experience, can be seen in the way ETL's shifted their visions of lesson structure around the role of small

group and whole class discussion. At the beginning of the year, four of the ETLs (Carrie, Lillian, Brit, and Sheri) talked about how small group instruction was important for differentiation and "closing gaps" in student learning. As Lillian explained in the first interview, she would "pull small groups and target specific instruction based on what [students] did and did not get." At the end of the year, her vision of small groups had shifted to center on the experience students should have in small groups:

> I think smaller groups allow more voices to be heard. . . . Sometimes when you're just talking about math, it gets really kind of complex. But if you see it and then someone can talk about what their approach was or even doing a gallery walk. So they're sharing their thoughts without saying anything.

Lillian's focus had shifted from small groups as a way to provide more targeted instruction, to small groups as a way for students to share their thinking with each other before being asked to share in a whole group discussion, a new aspect of her vision around lesson structure.

Patterns in Participation

To explore how these shifts in instruction vision were related to participants' experience in the PSCs, we selected a series of episodes from two sessions that illustrate some interesting dynamics at play. The vignettes illustrate how the discussion moved back and forth between the teacher moves depicted on the instructional model, the facilitator's actions during the PSC, and the participants' epistemic experiences as learners.

Vignette #1. Engaging in Productive Struggle

The first vignette took place in early December in the third PSC session. After solving and discussing solutions to the task, the facilitator handed out a copy of the instructional model and asked participants to reflect on the PSC experience in relation to the practices described on the model. After discussing several aspects of the launch of the task the group moved on to discuss *Facilitate Productive Struggle*. When Lillian asked for clarification on the term "lowering cognitive demand," the facilitator turned the question back to the group for a definition and then asked them to think about how they felt as learners.

Facilitator:	Anybody have thoughts on that? What that might mean? [reading from the handout] "Support without lowering cognitive command".
Kristi:	How to support students without taking away from them? What they may already know? Not thinking for them.
Facilitator:	Great. Anybody want to build on that? Add to it? I saw some other hands go up. Is that what you were going to say?
Helen:	Yeah, pretty much, without giving them the answer or without letting them struggle through it.

Facilitator: You know what? It is hard... it's really hard to not give someone like, what would be the key to helping them solve it? But how do you feel when you find out on your own?

Selena: You owned it.

When the facilitator asked, "what are some of the things that you remember happening during the time that you were working?" Selena responded first:

> So there was a time where you were doing the circulating, monitoring, interacting. I don't remember exactly what you said to me but you were pushing me to do something and I think what helped me is you said it and then you walked away. Because I was even thinking like, is she going to stay here the whole time while I try to figure this out? That would have added stress for me. But the fact that you gave me a hint, you walked away, and then by the time you came back, I had figured it out. And I do think if you would have stood over me, I don't know that I would have gotten through it.

The facilitator acknowledged the tension between wanting to stay with a learner and knowing you should walk away and then pressed the group for the pedagogical reasoning behind that move by asking, "So what do you think maybe are the reasonings behind that?"

Sara Beth (an ETL) responded by relating it to her own experience, not only solving the problem, but while working with a trainer at the gym, and then related this to how she thought her own students might feel:

> Well, the reasoning I mean, is to... you're not lowering, you're giving them the cognitive... they're lifting the cognitive load. [long pause] I mean, I'm just thinking about for myself, I'll move you, I want you to walk away. I was at the gym last night and I want you to give me feedback and then if I'm going to do the weightlifting move, go over there [pointing away while group laughs]. Do not stay and watch me do it! So I appreciate that. And I do have students who are the same way but I have different kids who want me to be... they just need my elbow on their desk until they're like, oh, I'm good, ok good you got it.

Kristi then added on to reflect on the teacher's role in either perpetuating or alleviating a learner's anxiety:

> It's also like standing over someone while they're trying to solve something can give them anxiety. So like giving kids some space without them thinking you're breathing down their neck, it has to be this way.

After the facilitator acknowledged, "Yeah, and I mean math anxiety is a real thing, right? And it starts so young," Sara Beth went on to talk about how she felt seeing that her colleague Sheri had solved the problem algebraically.

When I was looking at Sheri's explanation with the X's and the Y's and I just wrote out my thoughts and I thought to myself, this is a great problem to show people who are not automatic, like, who look at the X's and the Y's and go, uh-uh, I'm not a math person. . . So when I think about it, when you have that math trauma or when you have these multiple avenues, it's like you can avoid that traffic jam altogether.

The term "math trauma" was a phrase Brit had used in the first session to describe the way she herself, and many of her students, experienced mathematics instruction, and this idea had been picked up and used again in subsequent sessions.

This discussion about what it felt like as a learner to engage in productive struggle led participants to reflect both on how their students might feel and the implications for teaching moves--that sometimes it is important to walk away, and also the importance of having tasks that are open to multiple strategies. The discussion then turned to other aspects of *Facilitating Productive Struggle*, and Kristi shared how she felt working in a collaborative group, both in terms of when it was helpful, and when she needed to "pull back":

Something I noticed today was, we got together in our group and we started talking, people started sharing their solutions. I wasn't yet ready to hear them and I started listening and I was like, okay, I'm not sure what they're saying and I had to go back and look at mine and revisit what it was that I had done and then... someone was repeating how they solved theirs, something like that and then I was like, oh wait, that makes sense. I think the idea that kids are ready to listen at different times and they might want to pull back from that to work a little bit by themselves but also know that they have a group there if they need them.

Other topics that emerged from this discussion included how there was no right way to solve the tasks they were doing in the PSCs, that every strategy is valued, and that having a possible extension to the problem would allow some students to go further. They also discussed how prepared the facilitator had to be, and what it means to "intentionally making space for and assigning competence to marginalized and/or low-status student contributions'', a descriptor on the third component of the instructional model, *Facilitate Sharing of Student Strategies/Reasoning*. (This connection to equitable instructional practices was picked up again in Session 5, as described in Vignette #2)

This first vignette illustrates how together the group grounded their reflections in both the instructional model and their epistemic experiences as learners, and through the process developed and articulated *epistemic empathy* -- ideas about the importance of students taking on the cognitive load, having opportunities to collaborate with peers while still maintaining ownership over their thinking, and having equitable opportunities to participate mathematically, three dimensions of instructional vision that we saw the teacher leaders adopt or refine over the year.

Vignette #2. Making Sense of Someone Else's Thinking

The second vignette illustrates similar dynamics around an additional shift that we found in the ETL's instructional visions, the need for learners to have the opportunity to make sense of someone else's thinking. This vignette took place in the fifth session at the end of February. After launching, solving and discussing their solutions to the Border Problem, the facilitator asked the group to reflect on *Making Student Thinking Visible* on the instructional model.

> So, remember that in this sort of section of our professional developments, we take off our learner hat and we put back on our teacher hat and we think about what we experienced, the things that you saw me do, the things that you heard me say, and then we also dig a little deeper and think about why, why do we think that that happened? What does that afford us in instruction, okay?

Sarah Beth responded first by reflecting on how the facilitator's facilitation illustrated the practice of "making space for and assigning competence to marginalized and/or low status students," drawing on how she felt as a learner when the task generated algebraic, as well as more concrete or visual solutions. She made sense of the facilitator's moves by reflecting on her own experience with the problem and using this to again empathize with students who have "math trauma" by reflecting on the way visual models helped her make sense of the algebraic solution to the problem as well as her growing confidence as a learner:

Sara Beth: So, throughout this whole process, one thing that I really felt that you do a great job of is making space for and assigning competence to marginalized and or low status students. So I think that the visualization really brought assistance to the 4n-4 for me. So throughout this whole process, I sort of, you know, I teach [grades] 5 and 6, so it's not algebra all day for me. And so when it comes to writing an equation from a story, that feels a little scary to me. So I can imagine how that feels for kids who, as you [looking at Brit] said on our first meeting, have math trauma.

Brit: [nods]

Sara Beth: And I feel like when we make these models and when we visualize, when we make student thinking visible, that it helps some people go "yeah, me too, I thought that too", and then build upon it for their own ideas. So I come into this, you guys have pumped me up because I came into this and I'm like, "I'm going to get it, I know I am, I got it the first time, I'm going to get it this time." So I feel like that making that student thinking visible brings everybody into the conversation and it doesn't make it super narrow in its focus.

The connection between her own epistemic experience using visual models to understand algebraic solutions to the Border Problem helped Sara Beth formulate implications for her developing vision of a more equitable and inclusive classroom. Helen then responded:

Well, I wanted to build on to another aspect of it. I liked that we had to look at it through somebody else's eyes. It's not just the author of that work that had to explain it, it was somebody else who had to get into their brain and it sort of forced them to look at things in another way. So I like that.

After both the facilitator and Carrie commented on this idea ("There is another way, you hear it many times") Brit then made a connection between these two ideas-- giving students opportunities to make sense of each other's thinking and positioning students as competent:

Brit: So what is really interesting is that you guys are really connecting in your thought process, because by allowing a different student to explain what some might perceive as a marginalized student's work, [it] really forces them to be empathetic towards that strategy, right? So they're stepping out of their perspective and they're taking on this other person's perspective and maybe enlightening others.

Helen: And validating.

Brit: And validating, right.

Lillian: I think when you have to explain someone else's work it's a really, it's a higher order task. So you're taking something that someone already did that's sometimes flat, and then it's becoming higher order because you have to perceive and jump into their shoes with it and think about it outside.

In this exchange, the participants drew on their experience as learners during the whole group discussion where the facilitator facilitated a discussion around their strategies, and more specifically, the epistemic experience of understanding someone else's solution, seeing value in visual, more intuitive strategies, and using those more accessible strategies to help make sense of more abstract or algebraic solutions. Perhaps more importantly, they connected these ideas to visions of more inclusive instruction, where students who might be "perceived as marginalized" or experiencing "math trauma" could be celebrated as valuable members of a learning community.

Discussion

Our analysis of the shifts in the instructional visions of the ETLs uncovered the dimension of student's experience of math instruction that is only addressed at a surface level in the existing VHMQI rubrics. Munter (2014) includes a rubric for "student engagement in classroom activity" in terms of two levels: (1) a focus on student behaviors and characteristics and (2) reform-oriented classroom activities (described with the example "students should be up, moving around, using manipulatives.".) The focus of this rubric is on *what* students do during math instruction, but does not necessarily capture the focus we

were seeing on how students *experience* or come to know mathematics, their epistemic experiences. Although there is some overlap around student engagement in the rubric for discourse, the focus is mainly on the students' contributions to whole class discussions. There is no focus on students' engagement in the solving of the problem.

In keeping with Munter's distinction between level 1 and 2 around student engagement, when the ETL's described their vision of an ideal math instruction in the first interview, they described student experiences in terms of features of a lesson (students should be working in small groups, engaging in discussion, explaining their thinking) or general descriptions of engagement (students should be "challenged" or all students should participate). After participating in the PSCs, their visions shifted and/or deepened to include the epistemological ideas that students should have opportunities to engage in productive struggle and take on the cognitive load, work collaboratively with others to solve problems, make sense of each other's thinking, and understand strategies that differed from the way they approached the problem. For three of the ETLS (Brit, Lillian, and Olivia), the idea that all students should have opportunities to participate mathematically--not just participation in a general sense, but engaging in sensemaking, discussion and sharing of strategies--also became a central part of their instructional vision. Notably, this framing of equitable instruction did not just focus on what the teachers and students should be doing, but rather centered the student experience of math instruction.

The analysis of participation in the PSC's and participants' reflections on that experience also illustrates the role of framing in the development of instructional vision and implications for instruction. Engaging as learners in the PSCs gave participants a new frame of reference to understand the process of learning mathematics, both epistemologically and in terms of the affective aspects. Understanding how it felt--to be confused, embarrassed, validated, and/or recognized as competent--helped teachers develop *epistemic empathy* for the learners in general and in their classrooms. This empathy in turn generated new considerations for their roles as teachers. Kristi, a kindergarten teacher, described this in terms of understanding "what it feels like:"

> What does it feel like to not understand something or to be confused about something I think is always an important position to put yourself in as a teacher because there's always going to be kids that are in that position in your class. You need to remind yourself of what that feels like and what is helpful for you when you were feeling that and what is not helpful for you when you are feeling that.

This framing was collectively constructed-- it was often prompted by the facilitator asking what it felt like as a learner or to "put on our teacher hats"--and participants sometimes drew from the technical language on the instructional model to make sense of both learning and teaching. At the same time, however, they made sense of this language by grounding it in the specifics of their own experiences (past and present).

Both vignettes illustrates how specific terms and phrases like "assign competence," "making student thinking visible," "facilitate productive struggle" and "support without lowering the cognitive demand" that appeared on the instructional model served as anchors for participants to name and draw connections between their own learning experience and inclusive teaching practice. In this way the instructional model functioned as a *boundary object* that supported connections between their framings

of learning and teaching. Participants made sense of these concepts by relating it to their personal experiences solving the problem, and then used that understanding to reflect on implications for equity in relation to their students and their teaching practice. In this way the discussions served as important opportunities to engage in sensemaking around core practices and "technical language" in the context of the particulars of their own experiences as learners and teachers (Horn & Kane, 2019).

In addition, both vignettes illustrate how a term introduced by one of the participants, "math trauma" emerged and was taken up by participants in the PSCs through the *reification* of their own experiences as learners. Participants frequently referenced their own vulnerabilities as learners, (e.g., "I was never good at algebra"), and in the discussion at the end of the first session, Brit introduced the term "math trauma" to describe the way many students experience mathematics instruction. Importantly, this framing positioned students as having been impacted by instruction rather than in terms of innate ability, an inherent trait, or a personal deficit. Sara Beth brought this term up again in a subsequent sessions to reflect on the importance of students seeing multiple ways to solve a problem and in the final session again to make sense of an idea that was written on the instructional model, assigning competence, or publicly recognizing the intellectual contributions different students make to the learning community (Cohen & Lotan, 1995).

All of the shifts we identified in the instructional visions of the ETLs were also found to emerge more than once as topics of discussion in the five PSC whole group reflections. Sometimes we could directly connect an idea in a participant's vision to their own verbal contributions in these discussions, but oftentimes the idea was voiced by one or more of their colleagues. In other words, ETLs did not have to be a vocal participant in the discussion of a specific idea in order to have it show up in their instructional vision. There was therefore an aspect of these framings of mathematics teaching and learning that was collectively constructed by the group.

Implications

Our study suggests that teachers can draw on their personal learning experiences to identify with their own students as learners and that as a result students' epistemic experience becomes more central to their instructional visions. Building understanding of teaching practices around understanding of the learner's epistemic experience can highlight the affective aspects of teaching and learning and support teachers in making sense of inclusive teaching practices. Given that research suggests that teachers' instructional vision develops ahead of actual practice and predicts subsequent pedagogical development (Munter & Correnti, 2017), this is an important step towards developing more inclusive teaching practices.

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