# Instructional Improvement and Teachers' Collaborative Conversations: The Role of Focus and Facilitation

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***Background/Context:*** *School districts are increasingly expected to support students in meeting ambitious mathematical learning goals. Many schools and districts are investing significant resources in the provision of time for teacher collaboration in the hope that this will help teachers improve their instruction in ways that support students in meeting ambitious learning goals. While existing research points to the potential of this collaboration time to support teacher learning, findings from previous work suggest that use of this time varies in ways that are likely to be consequential for teachers' learning.*

***Research Question:*** *In this analysis, we investigate the question: In what ways do focus and facilitation shape teachers' opportunities to learn during collaborative conversations?*

***Research Design:*** *The data for this analysis comes from a 4-year study of 4 large urban school districts that examines what it takes to improve the quality of middle school math instruction at scale. Our analysis draws on the broader data set by first using teacher-level data (observed instructional quality) from 30 schools to identify schools that exhibited the most growth in instructional quality. We then analyze audio recordings of teacher collaborative meetings at those schools to better understand how the conversations that take place in these meetings might function to support teachers' professional learning. In particular, we examine differences in facilitator questioning and subsequent facilitator press on teachers to elaborate their pedagogical reasoning.*

***Findings/Results:*** *We observed two foci in identified sessions: writing learning targets and lesson co-planning. As enacted, the lesson co-planning sessions held greater potential for supporting teachers' professional learning. Use of an activity-structuring tool was related to higher quality facilitator questions in these sessions but was not related to improved facilitator*

*Teachers College Record* Volume 119, 020301, February 2017, 37 pages

0161-4681

*press on teachers to elaborate on their responses to these questions. These facilitator moves are marked by (1) solicitation of detailed representations of teachers' classrooms and practice, (2) orientation toward students as sense-makers, and (3) press for teachers to articulate rationales for instructional decisions that are tied to goals for student learning. We provide examples of facilitator questioning and press that are generative for teacher learning.*

***Conclusions/Recommendations:*** *This work contributes to the research on the ways collaborative time can support teacher learning. It identifies specific practices that facilitators can draw on to support teachers' professional learning—which has the potential to inform both teacher learning and the training of facilitators. This work can additionally inform the design and use of tools (protocols) that can help productively structure teacher collaborative time and also reveal the limitations of such tools. Importantly, we offer a coding scheme for analyzing the quality of facilitation through questioning and press that can subsequently be challenged, problematized, and built upon in the field.*

## INTRODUCTION

School districts and their personnel are increasingly expected to support students in meeting ambitious mathematical learning goals including developing conceptual understanding, procedural fluency, and the ability to formulate and critique mathematical arguments (Common Core State Standards Initiative, 2010). Instruction that serves such learning goals has been characterized as "ambitious teaching" (Lampert, Beasley, Ghousseini, Kazemi, & Franke 2010; Lampert et al., 2013). Many schools and districts are investing significant resources in the provision of time for teacher collaboration in the hope that this will help teachers improve their instruction in ways that support students in meeting ambitious learning goals (Goddard, Goddard, & Tschannen-Moran, 2007; Louis, Marks, & Kruse, 1996). However, evidence suggests that this time is often used in ways that are unlikely to support the development of ambitious teaching (Graham, 2007; Larson, Wilson, Larbi-Cherif, & Horn, 2012).

Research on professional development and teacher learning points to the importance of providing teachers with content-specific time for collaboration. Corcoran's (1995) findings indicate that professional development (PD) focused on content and the ways in which students learn the content is important in changing teachers' instructional practices. By teachers' reports, their knowledge and skills are more likely to improve through sustained PD tied to their daily work in their school (Garet, Porter, Desimone, Birman, & Yoon, 2001). Site-based work is important in other ways as well, since schools with strong professional communities—communities with shared values, a focus on student learning, collaboration, deprivatized practice, and reflective dialogue—have demonstrated higher than expected student achievement (Bryk, Sebring, Allensworth, Luppescu, & Easton, 2010). This research suggests

the importance of sustained, content-focused, school-based PD and collaborative time for teachers. For the purpose of this paper, we will use the term teacher collaborative time (TCT) to refer to time allocated for math teachers to receive school-based PD or collaborate on issues of mathematics instruction.

While existing research points to the potential of TCT to support teacher learning, our findings from a previous analysis of four large urban school districts' policies for TCT suggest that the enactment of TCT varies widely in ways that are likely to be consequential for teachers' learning (Larson et al., 2012). Based on interview data from district leaders, principals, instructional coaches, and teachers, we identified a need to more closely consider observational data to assess the focus and facilitation of the conversations that took place during TCT—a central source of motivation for the current analysis.

In this analysis, we seek to better understand the ways in which teachers' collaborative conversations might support their development of ambitious teaching practices. More specifically, we investigate the question: In what ways do focus and facilitation shape teachers' opportunities to learn (OTL) during collaborative conversations? We operationalize this by first examining the ways in which facilitators structure teachers' opportunities to engage in collaborative conversations. We then characterize those facilitator moves that support teachers in engaging in these conversations in ways the research literature suggests are likely to be generative for teacher learning.

In order to understand how focus and facilitation might support teacher learning during TCT, we follow a "best case" logic, examining audio recordings of teachers' facilitated conversations in schools that exhibited atypical growth in instructional quality[1] among retained teachers. By only considering growth among retained teachers, we eliminate the possibility of identifying schools that exhibited instructional growth as a result of changes in personnel. While we do not attribute the growth in instructional quality to what we observe in TCT (as there could be other factors contributing to improved instructional quality in these schools such as instructional coaching that took place outside TCT, etc.), our selection criteria identify sites where we are likely to see rich collaborative conversations. These conversations are reflective of a school environment where growth in instructional quality occurred, and we seek to uncover the ways in which these conversations may have supported teachers' development of ambitious instruction.

## LITERATURE REVIEW AND THEORETICAL FRAMING

In this section, we first draw on the literature to characterize ambitious goals for student learning in mathematics, the nature of instruction that supports such student learning, why ambitious instruction is challenging for teachers to develop, and supports for developing ambitious instruction. We then summarize literature relevant to the focus and facilitation of TCT. Finally, we characterize the theoretical framework we will use in our analysis to conceptualize teachers' opportunities to learn in their collaborative conversations.

### AMBITIOUS MATHEMATICS INSTRUCTION

Students are increasingly expected to demonstrate conceptual understandings of key mathematical ideas as well as procedural fluency (Common Core State Standards Initiative, 2010; National Council of Teachers of Mathematics [NCTM], 2000). Development of these understandings entails students working in novel problem-solving situations, formulating mathematical arguments, and using and connecting multiple mathematical representations. Teaching that aims for these goals for students' learning has been called "ambitious" because of the high demands it places on teachers in supporting all students' development of enduring conceptual understandings in mathematics (Lampert et al., 2010; Lampert & Graziani, 2009). To accomplish such goals, teachers are challenged to foster learning environments that provide a wide range of learners with access to each other's mathematical ideas, and to be responsive to students' explanations of their solutions (Franke, Kazemi, & Battey, 2007; Lampert et al., 2010; Stein, Silver, & Smith, 1999).

There is a growing body of literature identifying ways in which teachers can support the kind of conceptual learning emphasized in these documents. Key aspects of ambitious instruction include providing opportunities for all students to engage in cognitively demanding tasks, and also to engage in discourse around their reasoning on these tasks (Stein, Engle, Smith, & Hughes, 2008; Stein, Grover, & Henningsen, 1996; Stein & Lane, 1996). In particular, the questions teachers pose to students and the ways in which they encourage and press students to further elaborate on their initial thinking and relate their thinking to that of others are consequential. Such teacher questioning and press function to support students' opportunities to engage in rigorous mathematical discussions (Boaler & Staples, 2008).

Ambitious instruction is challenging to develop and sustain. Stein et al. (1996) found that teachers often pose tasks of low cognitive demand

to their students. Further, they found that when teachers do select cognitively demanding tasks for their students, they tend to lower the cognitive demand of the task by either skipping the most challenging part of the problem or by suggesting a solution path for students to follow. When teachers successfully maintain the cognitive demand of a task, they are faced with the challenges of eliciting student thinking, pressing students to elaborate and justify that thinking, and drawing on students' ideas to move toward broader mathematical learning goals (Cohen, 2011; Kazemi & Stipek, 2001). When ambitious instruction is developed, access to expertise and ongoing collegial support are important for sustaining that kind of instruction over time (Coburn, Russell, Kaufman, & Stein, 2012). Thus, significant support is needed in order for teachers to develop and sustain ambitious instructional practices.

The literature points to three characteristics of the supports needed for the development of ambitious instruction: supports for teachers need to be ongoing (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Gallucci, 2008; Garet et al., 2001; Hill, 2007; Kazemi & Hubbard, 2008; Little, 1982; Stein et al., 1999), tied to teachers' day-to-day work (Darling-Hammond & McLaughlin, 1995; Franke et al., 2007; Putnam & Borko, 2000), and aligned with curriculum materials and instructional goals for students (Hill, 2007; Kazemi & Franke, 2004; Kazemi & Hubbard, 2008; Little, 1993). Furthermore, combining these three features increases the chances of influencing teachers' instructional practices (Cohen & Hill, 2001; Desimone, Porter, Garet, Yoon, & Birman, 2002; Garet et al., 2001; Knapp, 2003; Supovitz, Mayer, & Kahle, 2000). We argue that regularly scheduled time for content-specific teacher collaboration (or TCT) functions as a form of support that is likely to satisfy these criteria for developing teachers' instructional practices.

Our previous work indicates that the allocation of time for collaboration is necessary but not sufficient for supporting the development of ambitious teaching practices; the way in which this time is used is also critical (Larson et al., 2012). Thus, we now review literature on potentially productive foci for TCT. We consider the focus of teacher collaboration on two levels. From a broad perspective, we attend to activities that are potentially productive for helping teachers develop ambitious instructional practices. From a more fine-grained perspective, we attend to the *way* in which these activities are enacted—in other words, we attend to the interactions that take place in teachers' collaborative conversations in the context of particular activities. Further, we consider the role of the facilitator in enacting particular activities in ways that have the potential to impact teachers' opportunities for professional learning.

## FOCUS: ACTIVITIES THAT SUPPORT TEACHER LEARNING

Gibbons and Cobb (2013) reviewed the professional development, teacher learning, teacher education, and instructional coaching literature to identify activities with the potential to support teachers in developing more ambitious instructional practices as described above. In particular, Gibbons and Cobb identify four activities for groups of teachers that have the potential to support them in developing more ambitious instructional practices: doing math problems together, examining student work, analyzing videos of classroom instruction, and rehearsing aspects of classroom practice.[2, 3] Across this set of activities, it is emphasized that the *way* in which these activities are enacted plays a key role in the potential learning opportunities these hold for teachers. For instance, if teachers do not attend to multiple possible solution paths and make the connections among them when doing math problems together, this activity is less likely to support instruction in which teachers press students to share multiple solutions and make connections among them.

## FOCUS: INTERACTIONS IN TEACHERS' COLLABORATIVE CONVERSATIONS

In order to consider opportunities for teacher learning that take place in teachers' collaborative conversations, we found it helpful to examine the literature that attends to teacher learning in these settings and establishes specific constructs for documenting conversational resources for teacher learning in these settings. Little (2002) posits that representations of the classroom (including what aspects of the classroom are represented in teachers' conversations, and with what degree of specificity), orientation toward practice, and norms of interactions among teachers are consequential in shaping the potential of teachers' collaborative conversations for supporting their professional learning.

Horn and Kane (2012) identify key differences among unfacilitated teacher workgroups that are likely to result in different learning opportunities. Two key differences included the content of these conversations and the point of view represented in these conversations relative to the instructional triangle (teacher, students, content). Teacher groups with less sophisticated practice tended to focus on issues of pacing and coverage, whereas the more sophisticated group tended to focus on leveraging student thinking to move forward class learning goals. The less accomplished teachers tended to represent fewer "vertices" of the instructional triangle—meaning they might talk about students *or* content *or* teaching, but tended to address these as separate issues and most often focused on

the teacher. In contrast, the "sophisticated group" included conversations that considered teachers, students, and the mathematics together. Additionally, these more detailed representations of the classroom were more often explicitly linked to statements of instructional principles, showing a linking of general knowledge of teaching to specific teaching problems. Horn and Kane note that in sessions with an expert facilitator, the differences between the more and less sophisticated groups tended to disappear. Our analysis aims to explore what role the facilitator might play in helping teacher workgroups function in more sophisticated ways.

## FACILITATION OF ACTIVITIES THAT SUPPORT TEACHER LEARNING

Studies of teachers' professional relationships show that teachers' access to expertise is associated with instructional improvement (Penuel, Riel, Krause & Frank, 2009). Similarly, Coburn and Russell (2008) argue that teachers are supported in learning when a more knowledgeable other routinely presses them on key questions or issues. Thus, facilitators shape the activity structures and conversational processes of teacher conversations, and facilitator expertise is consequential for the potential of these conversations to support teacher learning (Horn & Kane, under review).

Across the set of activities identified by Gibbons and Cobb (2013), we note three themes regarding the role of facilitators. The first theme deals primarily with the *planning of activities* to be done with groups of teachers. The second theme deals with *establishing the purpose and goal* of an activity and *providing context* for that activity. The third theme focuses on *mediating teacher discussion* in the context of these activities. Our analysis of facilitation in this paper focuses primarily on the third theme (mediating teacher discussions), as we analyze only the interactions that took place during teacher collaborative meetings.

*Mediating teacher discussions.* The literature emphasizes the role of facilitators in guiding the construction of group norms, eliciting multiple points of view, and pressing teachers to explain their contributions to the discussion and connect them back to implications for classroom instruction (Cobb, Zhao, & Dean, 2009; Crespo & Featherstone, 2006; Little, Gearhart, Curry, & Kafka, 2003; Thompson et al., 2009). For instance, when supporting teacher discussions of math problems that groups of teachers have done together, facilitators play an important role in guiding the development of norms around what constitutes an adequate mathematical explanation or justification and in highlighting key ideas, connections, and important strategies that should be brought out in whole-class discussions with students (Elliott et al., 2009).

## THEORETICAL FRAMING: OPPORTUNITIES TO LEARN

We follow Horn and Little (2010) in adopting a broad view of opportunities for professional learning as they arise in teachers' collaborative conversations: "formally constructed workplace groups are more likely to prove generative for learning if they develop a capacity for talk that centers on dilemmas and problems of practice" (p. 184). In our analysis, we examine how focus (operationalized in terms of both activities and the interactions that take place in the context of those activities) and facilitation relate to teachers' talk in the context of TCT. More specifically, we consider the extent to which these conversations feature representations of the classroom, multidimensionality of talk (i.e., the extent to which teachers address multiple vertices of the instructional triangle), statements of instructional principles, and the extent to which rationales for pedagogical decisions are explicitly tied to ways of supporting student learning. According to the literature on teacher learning, conversations with these characteristics hold opportunities for teacher learning. We reiterate that we are not arguing that these conversations are the cause of the instructional growth observed, but rather that by selecting schools where instructional growth occurred we are likely to see rich conversations that have the potential to be generative for teachers' learning.

## DATA SOURCES AND STUDY CONTEXT

The data for this analysis comes from a larger study—Middle School Mathematics and the Institutional Setting of Teaching (MIST). The MIST study, funded by the National Science Foundation, examined what it takes to improve the quality of middle school math instruction at scale. Over a 4-year period, the MIST team studied four large urban districts selected on the basis of their commitment to instructional improvement aligned with the Principles and Standards of the National Council of Teachers of Mathematics (NCTM, 2000). These districts shared the vision of ambitious instruction described earlier and invested heavily in initiatives for supporting teacher learning aimed at improving their instructional practices in alignment with this vision. These investments included both district-based and school-based professional development, the provision of content-focused instructional coaches, and the allocation of time for teachers to meet and collaborate around instructional issues in all four districts. We use the term *instructional coaches* to refer to district- or school-based personnel for whom a portion of their time (typically at least 50% of their time) was devoted to assisting other teachers in improving their instructional practice. This was typically done by providing district or

school-based professional development, working with teachers during their planning time (e.g., co-planning with them), or observing teachers and providing them with feedback.

This analysis draws on the broader data set collected as part of the larger study by first using teacher-level data (observed instructional quality) to identify schools that exhibited the greatest level of growth in instructional quality among retained teachers, and then by using audio recordings of teacher collaborative meetings at those schools to better understand how the conversations that take place in these meetings might function to support teachers' professional learning. Thus, we note that the meetings examined here are likely "best case scenarios" in that they take place in districts focused on supporting the development of ambitious instruction and in schools that show evidence of developing ambitious instruction. Below we provide more detail about the data collected as part of the larger study, the way in which instructional quality was measured, and the way in which our cases were selected.

## DATA COLLECTED

In order to document each district's strategies for instructional improvement and the ways in which these strategies are playing out in schools, a variety of data were collected each year. Data sources collected as part of the larger project included interviews with all participants (~120 teachers across 30 schools, as well as their instructional coaches, principals, and district leaders), surveys (of teachers, instructional coaches, and principals), video recordings of classroom instruction, assessments of teachers' and instructional coaches' mathematical knowledge for teaching (MKT; Hill, Schilling, & Ball, 2004), video and/or audio recordings of professional development sessions and collaborative meetings, and student achievement data.

*Audio recordings.* Following the first year of the study, project leaders became convinced that collecting real-time data from teachers' school-based collaborative meetings could offer important insights into differences in professional learning opportunities among schools. Thus, we endeavored to audio record a sample of teacher meetings that focused on instructional issues at each school. We recruited a school contact at each school (usually an instructional coach or department head) to assist with this work. Our school contacts were asked to record three to five meetings that were focused on issues of instruction (rather than administrative issues) and fill out a short meeting summary sheet for each recorded meeting. On the meeting summary sheet, school contacts were asked to indicate which teachers participated in the meeting, provide an overview of meeting activities, and supply copies of any artifacts or protocols used during

the meeting. The meeting summary sheets provided valuable context to the audio recordings in the course of our analysis. The cases selected as part of this particular analysis come from Year 3 of the study, as this was the year for which we had the most complete sample of audio data. The criteria for our case selection are detailed below.

*Data sources for this analysis.* This analysis draws primarily on data from audio recordings of teachers' collaborative meetings. Case selection was based on the quality of teachers' instructional practices as documented through videotapes of their instruction and as quantified by the Instructional Quality Assessment (IQA; Boston & Wolf, 2006). Each year, we videotaped two consecutive days of instruction for each participating teacher. Our sampling attempted to document teachers' best attempt to implement the kind of ambitious instruction our districts aimed to support, so teachers were asked to schedule their taping on days during which they would engage their students in some sort of problem-solving activity with a related whole-class discussion. Information from interviews and surveys was used to provide contextual data as needed (e.g., for years of experience of teachers, training of facilitators, etc.).

## CASE SELECTION

We wanted to identify the schools in which we were most likely to see opportunities for teacher learning during TCT. In order to do so, we set out to identify the schools that exhibited the greatest school-level growth in instructional quality among retained teachers. While we do not claim that this growth can be attributed specifically to activities during taped teacher collaborative meetings, we do argue that these are schools in which there are likely to be conversations taking place during TCT that could contribute to teachers' professional learning and inform their instructional practices.

*Measuring instructional quality.* In order to assess instructional quality aligned with ambitious instruction, we follow Smith et al.'s (2012) method for aggregating a single measure of teachers' instructional practice as coded by the IQA (Boston & Wolf, 2006). This method considers two sets of rubrics from the IQA: one set assesses the cognitive demand of the task as it appears on paper and as it is implemented (Stein et al., 1996), and the other set assesses the quality of the concluding whole-class discussion (for example, by quantifying the number of students who contribute to whole-class discussion, the quality of students' contributions to the discussion, the quality of teacher press on student contributions to the conversation, and the extent to which teachers and students link their contributions to those of others). Task and discussion subscores were created and averaged to generate an aggregate score for instructional quality for each teacher in each year.

*Calculating school-level instructional growth.* After creating an aggregate measure of instructional quality for each teacher, we calculated school-level growth in instructional quality from Year 2 to Year 3 of the study. This was done by considering the change in the school mean of instructional quality of retained teachers from Year 2 to Year 3. We only considered retained teachers to eliminate the possibility that the change in instructional quality could be attributed to changes in our sample.

*Identifying case study schools.* We eliminated schools that did not have at least three teachers retained, as this seemed like a reasonable cut-off given that our sample included three to five teachers randomly selected from each school in our study. Next, we eliminated schools that did not have at least two audiotapes of teacher collaborative meetings for Year 3 of the study. This was to ensure we could get some sense of the typicality of the taped meetings. In order to minimize differences due to district context, we selected two schools in the same district for our comparative case study. In this way, we identified two schools ("Sycamore" and "Laurel") that were in the same district and were among the top five schools exhibiting instructional growth in a sample of 30 schools. Since the teachers in these schools had the same instructional materials (including district guidelines for coverage and pacing), the same opportunities for district PD, and comparable amounts of time for TCT, it is reasonable to use this setting to explore how focus and facilitation of teachers' collaborative conversations relate to teacher learning opportunities.

Having identified two schools that exhibited growth in instructional quality, we proceeded to examine the sample of audio recordings of TCT at those meetings. Our logic was that this would help us to better understand what happens in TCT at schools that exhibited growth in instructional quality—specifically examining focus and facilitation of that time. The sample of tapes at Sycamore included two audio recordings of teacher meetings, and the sample at Laurel included four audio recordings of teacher meetings. All of the tapes at both of these schools involved a facilitator working with a grade-level group of math teachers, and the tapes ranged in length from about 23 to 35 minutes. Note that both Sycamore and Laurel had daily common planning time by grade level, with a facilitator coming in to work with teachers in grade-level groups one to two times per month. Both facilitators in our sample are mathematics instructional coaches in the district assigned to spend time working with mathematics teachers in the selected schools, Sycamore and Laurel. Table 1 provides an overview of the set of tapes, identifying the facilitator, the group of participating teachers, and the topic of the session as characterized by the facilitator on the meeting summary sheet.

**Table 1. Summary of Audiotaped Meetings at Sycamore and Laurel**

| School | Facilitator | Participating Teachers | Topic |
|---|---|---|---|
| Sycamore | Kacey | Three 6th grade teachers | Co-planning |
| **Sycamore** | **Kacey** | **Three 8th grade teachers** | **Co-planning** |
| **Laurel** | **Jesse** | **Two 6th grade teachers** | **Co-planning** |
| **Laurel** | **Kacey** | **Two 6th grade teachers** | **Writing learning targets** |
| Laurel | Kacey | One 7th/8th grade teacher | Writing learning targets |
| Laurel | Kacey | One 8th grade teacher | Writing learning targets |

Note that we have audiotapes of the same facilitator, Kacey, working with groups of teachers at both Sycamore and Laurel. Our initial analysis indicated that Kacey's two co-planning sessions at Sycamore were quite similar to one another (both adhered closely to the same meeting structure for co-planning), and that Kacey's three sessions on writing learning targets at Laurel were also quite similar to one another (teachers contributed little to the conversation beyond stating what they had or had not already covered). We chose to limit our close analysis to Kacey's learning targets session with the pair of sixth-grade teachers, as we also have a tape of Jesse doing an activity (co-planning) with that same pair of teachers. This allowed us to minimize differences arising from meeting participants. We similarly limited our close analysis at Sycamore to Kacey's work co-planning with the eighth-grade teachers at Sycamore because Kacey submitted a copy of the co-planning tool that she used for this meeting (although the audio tape of the meeting with the sixth-grade teachers led us to believe she used the same co-planning tool to structure this meeting as well). Audiotapes selected for close analysis are shown in bold in Table 1.[4] Table 2 illustrates the way in which our case selection allows us to examine differences in activity (focus) with the same facilitator (Kacey), and differences in facilitation with the same activity (co-planning).

**Table 2. Facilitator and Activity of Selected Cases**

| | | | |
|---|---|---|---|
| Facilitator | Jesse | No data | 6th grade teachers @Laurel |
| | Kacey | 6th grade teachers @Laurel | 8th grade teachers @Sycamore |
| | | Learning Targets | Co-planning |
| | Activity (focus) | | |

## CONTEXT FOR IDENTIFIED SESSIONS

Both Sycamore and Laurel are Title I schools in a large urban district that serve large populations of students receiving free and reduced-price lunch (FRL), and both were in their fifth year of sanctions (restructuring) for failing to meet annual yearly progress as mandated by No Child Left Behind legislation. Demographic information for the student population at Sycamore, Laurel, and the district in which both schools were situated is presented below in Table 3. As both Sycamore and Laurel were being restructured, there was a considerable amount of support allocated to both schools. This support included the provision of content-specific instructional coaches. Kacey was the only content-specific instructional coach that worked with mathematics teachers at Sycamore, whereas Kacey, Jesse, and one additional mathematics instructional coach worked with mathematics teachers at Laurel. (As a district coach, Kacey happened to be working with teachers at both Sycamore and Laurel.) However, we do not have any audio data documenting the third mathematics instructional coach's work with teachers at Laurel. This additional instructional coach was a school-based coach in the first year of transitioning from teaching to becoming an instructional coach.

**Table 3. Student Demographic Information for Case Study Schools and District**

| | % of students receiving free and reduced-price lunch | % of students identified as English Language Learners | % African American | % Hispanic | % White |
|---|---|---|---|---|---|
| Sycamore | 71% | 1% | 33% | 2% | 61% |
| Laurel | 73% | 10% | 64% | 7% | 25% |
| District | 62% | 6% | 35% | 5% | 53% |

Both sixth-grade teachers in the meetings analyzed at Laurel are relatively new: one is a first-year teacher, and the other is a second-year teacher. The eighth-grade teachers at Sycamore are more experienced, having 2, 3, and 10 years of teaching experience. Jesse is a first-year instructional coach. She taught middle grades math for 18 years before becoming an instructional coach. Kacey, on the other hand, has 9 years' experience as an instructional coach in the district and has focused on math for 2 years. Kacey also had 18 years of math teaching experience before becoming an instructional coach.

## METHODS

In order to examine the relationship between facilitation and teachers' opportunities to learn in our selected cases, we adapted Lesh and Lehrer's (2000) iterative approach to video analysis for use with our audio data. First, we created content logs of the selected audio recordings to document the events that took place during each recorded teacher collaborative meeting. There seemed to be important differences in the way the facilitator invited teachers to participate in the conversation, and the way the facilitator directed the focus of the conversation—for instance, toward issues of student thinking, or toward the question of what content would be included on state assessments. In order to better understand these differences, we examined the questions the facilitators asked (as an indication of opportunities facilitators provided for teachers to participate) and which teacher contributions the facilitator pursued or followed up on and how they did so (as an indication of how facilitators pressed teachers to elaborate or explain their thinking, or shaped expectations for the ways in which teachers should engage in and contribute to the conversation). In order capture these differences in facilitator questioning and facilitator follow-up (or facilitator press), we first examined the data and generated categories within each session to identify initial themes that might relate to teacher learning opportunities. Examples of these themes included how choices of manipulatives might affect the difficulty of a task for students, how students might approach particular tasks, how teachers decide what homework to assign, and what standards teachers have and have not covered. We then looked across the sessions and to the literature to identify categories that were present in our data, connected to the literature, and theoretically consistent with our conceptualization of opportunities to learn. This resulted in splitting our coding scheme for facilitator questioning and facilitator press into two broad categories: (1) facilitator questions and facilitator press dealing with pacing, coverage, or logistics, and (2) facilitator questions and facilitator press encouraging teachers to elaborate on representations of the classroom or to articulate or justify instructional principles. According to the literature, facilitator talk moves consistent with the latter category are more likely to support teachers' professional learning.

## CODING FACILITATOR QUESTIONS

In order to better understand the roles facilitators play in shaping teachers' collaborative conversations, we first identified all facilitator questions asked in each of the three sessions. We grouped facilitator

questions into two categories: pacing, coverage, and logistics (Pacing and Coverage), and representations of the classroom and instructional principles (Representations and Principles). The first category includes questions about what teachers have covered, when they intend to cover a standard or topic, and logistical issues. The second category includes questions in which facilitators ask teachers to elaborate on some aspect of a classroom representation (e.g., "How will you assess whether students are able to do that?") or articulate or justify an instructional principle (e.g., "How does the homework you assign support students' learning of what you do in class?")

## CODING FACILITATOR PRESS

To account for the fact that facilitators might help generate teachers' learning opportunities through conversational moves other than questioning, we also coded each teacher meeting for facilitator press and teacher provide. *Facilitator press* identifies facilitator moves that follow up on a teacher contribution—so when a facilitator initially asked a question, it was not coded for facilitator press (as that would have already been captured by coding facilitator questions). Rather, facilitator press was coded as either strong or weak based on the teacher response to the press.[5] We use the term *teacher provide* to refer to the teacher's response to facilitator press. In order for facilitator press to be coded as strong, two conditions had to be satisfied. First, the facilitator had to press teachers for evidence or reasoning (e.g., statement of instructional principles), or for more elaborate representations of their classroom. Second, the teacher actually had to respond to that strong press in a way that aligned with the request. If the teacher's response or facilitator's press requested details about pacing and coverage, or if instructional decisions and/or rationales were not tied to mathematical reasons or student thinking, we coded the teacher facilitator press as weak. The coding scheme used for facilitator press is shown below in Table 4.

After coding facilitator questions and facilitator press, we selected episodes to illustrate variation in facilitator questioning and facilitator press. We then used these episodes to examine the mechanisms by which these questioning and pressing strategies might be generative for teacher learning by connecting them back to our theoretical framework.

**Table 4. Coding Scheme for Facilitator Press**

| Facilitator Press Coding Scheme | |
|---|---|
| Strong | Facilitator presses for and teacher responds with:· |
| | • Evidence/reasoning· |
| | • Articulation of instructional principles· |
| | • Elaboration of representations of the classroom |
| Weak | Facilitator presses for and teacher responds with:· |
| | • Details about pacing/coverage OR· |
| | • Instructional decisions that are not explicitly tied to mathematical reasons or student thinking |

## FINDINGS

We organize this section by first identifying the central activity of each meeting (co-planning, writing learning targets). Drawing on the content logs, we provide context for our analysis of focus and facilitation by broadly characterizing what took place during each session. We then present a more fine-grained examination of the interactions that took place in the context of these activities, summarizing the findings from our analysis of facilitator questioning and facilitator press. To further unpack these findings, we present episodes with examples of questioning and press that have the potential to support teacher learning, attending to the ways in which facilitator moves support teacher engagement in the conversation.

Our central finding is that a well-designed activity-structuring tool has the potential to improve facilitator *questioning*, but not facilitator *press*. Examples and characteristics of facilitator questioning and facilitator press that have the potential to support teacher learning are subsequently discussed. These facilitator moves are marked by (1) solicitation of detailed representations of teachers' classrooms and practice, (2) orientation toward students as sense-makers, and (3) press for teachers to articulate rationales for instructional decisions that are tied to coherent goals for student learning.

### CONTENT LOGS: ACTIVITY AND BROAD CHARACTERIZATIONS OF MEETINGS ANALYZED

*Jesse co-planning with sixth-grade teachers at Laurel.* In this meeting, Jesse, an experienced math teacher who is a new math instructional coach, co-planned an instructional unit on perimeter and area with a pair of sixth-grade math teachers (a first-year teacher and a second-year teacher). Jesse began by asking what experience the teachers have teaching the unit (one has had training on it but not taught it before, the other has taught it

once). Jesse then directed teachers' attention to a couple of early problems in the investigation on "understanding area and perimeter." After some discussion of how students might approach the initial problem-solving task, how the choice of manipulatives might impact task difficulty, and how aspects of the problem-solving scenario are related to key mathematical ideas, Jesse engaged teachers in a conversation about how they make decisions regarding what homework to assign.

*Kacey writing learning targets with sixth-grade teachers at Laurel.* In this meeting, Kacey, an experienced math teacher who also has many years of experience as an instructional coach, worked with the same pair of sixth-grade teachers that Jesse did in the co-planning example above. The meeting broadly focused on rewriting state standards as daily learning targets for the current and subsequent instructional units. Learning targets had been an emphasis in the district, and principals expected teachers to post a learning target for each class period of instruction. The criteria given in the meeting by the facilitator for writing learning targets were that they should be written in "kid-friendly" language and in student voice ("I will…") and be measurable and attainable in one day. In the meeting, the facilitator began by reading the standards for the current unit of instruction and asking teachers which ones they have already covered. Once she determined which standards remain to be covered and the number of days of instruction remaining, she guided the teachers in writing one target for each remaining day of instruction. This was primarily done by changing the phrase "Students will…" to "I will..." Standards were split or combined to align with the number of days of instruction remaining.

*Kacey co-planning with eighth-grade teachers at Sycamore.* In this meeting, Kacey (the same facilitator as in the previous example) worked with three eighth-grade math teachers (who have 2, 3, and 10 years of experience teaching math) at a different school co-planning a lesson on line reflections. In this meeting, Kacey followed a protocol for co-planning a lesson. The protocol included sections focused on the learning objectives of the lesson, assessment of those objectives, prerequisite knowledge and skills, and familiar and unfamiliar vocabulary. In addition, the protocol included sections for the three phases of the lesson used by Connected Mathematics 2 (CMP2), the district-adopted curriculum: *launch* (in which the teacher is intended to help students develop a shared understanding of the context and goals of the lesson's central problem-solving task), *explore* (in which students are intended to develop their own approaches to the problem-solving task in small groups), and *summarize* (in which students are intended to share, justify and connect their solution strategies on the problem-solving task). As the facilitator guided them through the co-planning protocol, teachers discussed difficulties that often arise in

students' approaches to particular problems (both when selecting assessment items and when discussing the *explore* phase of the lesson), ways in which the manipulatives provided might affect the difficulty of particular tasks, and central mathematical goals of the lesson.

## FACILITATOR QUESTIONING

In order to better understand the facilitator's role in engaging teachers in the broad activities described above, we now summarize our findings about the facilitator's questioning in each of these sessions. For each meeting, we indicate the ratio of questions coded as Pacing and Coverage to those coded as Representations and Principles (see Table 5). Note that all 38 of Kacey's questions in the "learning targets" meeting were focused on pacing, coverage, and logistics. However, the ratio of Pacing and Coverage questions to Representations and Principles questions that Kacey asked during her "co-planning" meeting was much closer to that of the co-planning meeting led by Jesse. Examples of both kinds of questions are shown in Table 6.

**Table 5. Ratio of "Pacing and Coverage" to "Representations and Principles" Questions**

| | | | |
|---|---|---|---|
| Facilitator | Jesse | No data | 13:8 |
| | Kacey | 38:0 | 14:5 |
| | | Learning Targets | Co-planning |
| | Activity (focus) | | |

One might conjecture that this difference arises from the activity. However, we note that all five of the Representations and Principles questions that Kacey asked while co-planning can be linked back to questions that appear on the protocol for co-planning that she used while facilitating the meeting. This suggests that the improved questioning is related to the use of the protocol rather than simply the difference in activity.

To better illustrate how Kacey's questioning differed when using the protocol, we present episodes that exemplify Kacey's questioning in the learning targets session and her questioning in the co-planning session (which involved the use of a protocol).

EPISODE 1: QUESTIONING IN LEARNING TARGETS SESSION

This episode takes place about 4 minutes into the meeting on writing learning targets that Kacey has with two sixth-grade teachers at Laurel. We begin right after Kacey has established which of the algebra standards the teachers still need to cover in the remaining 3 days of the current instructional unit.

Kacey: So how many learning targets are we able to write then? Four or three?

Teacher 1: Three.

Kacey: Three. Ok. And, you want the first one to be, the model and solve real world equations and inequalities?

Teacher 2: Yeah. I was gonna do 5.4 first [5.4 is a reference to a section in the textbook], and then the equations. 5.4 is real world.

Kacey: So you write yours with the "I will" statements?

Teacher: Mmm hmm.

Kacey: Ok. So. I will model and solve real world problems with simple equations and inequalities? Is that what you want?

Teacher 1: That sounds good.

Kacey: And one day of that? Well we only have three days, three bullets. Ok. And then, which one did you want next?

This exchange is relatively typical of the interactions that take place in this meeting. We highlight that all questions asked by the facilitator in excerpt were coded as pacing, coverage, and logistics and that these questions were typical of questions coded in this category.

EPISODE 2: QUESTIONING IN KACEY'S CO-PLANNING SESSION (WITH PROTOCOL)

In this episode, we examine one of Kacey's questions, arising from the co-planning tool, and consider the ways in which the teachers and facilitator engaged in the subsequent conversation. In this session, Kacey and the three eighth-grade teachers participating spent approximately the first 10 minutes of the meeting identifying which lesson they wanted to co-plan. Using pacing issues as the primary criteria, they selected Lesson 2.1:

Describing Line Reflections. Kacey's co-planning protocol calls for identification of lesson goals, which Kacey summarizes by saying that students should "examine and describe the symmetries of a design made from a figure and its image under a line of reflection." While Kacey does not provide teachers an opportunity to weigh in on this stated goal, she follows her co-planning protocol, asking teachers how they plan to assess whether these lesson goals are met.

Kacey: All right and so then how would you want to assess that students are able to do that? …

Kacey: Okay. So is there an ACE question or something that

Teacher X: No, not in the teacher guide, it doesn't have it in there.

Kacey: Oh boo hiss. [Teacher X: Yeah.] Okay.

Teacher X: I don't know if you have it around there?

Kacey: I thought some ACE questions- Make sure I'm in the student edition. I am.

Teacher Z: Well first of all we probably ought to look at the lesson and make sure we know which ones are core.

[Teacher X: Yeah, yeah.]

Kacey: One through five, plus 16. Okay.

Note that in the curricular materials (CMP2), ACE stands for "Applications, Connections, and Extensions," which are questions teachers can assign to students; the textbook developers have identified a subset of these questions as relating to a core set of ideas important for conceptual understanding. Here we see teachers make use of this designation to guide their selection of an assessment item. As the teachers continue talking, they consider one option, focusing on the criterion that the selection be "quick and easy."

Teacher X: I'm pulling up number one over here.

Kacey: Describe how the vertices of the image of the triangle relate to the vertices of the original.

Teacher X: I get it

Teacher Z: Yeah that's pretty good.

Teacher X: All right so we want to like we need something that's not going to take them like- we want something quick

and easy [Kacey: Mmm hmm.] or we could write our own exit slip question. [Kacey: Right.] I just like that they already have 'em made for us. One of the reasons I *do* them.

As the group examines the set of core ACE questions, the teachers begin to consider the challenges that various choices might pose for students. Their discussion of one item in particular, question 4, includes consideration of what the problem asks of students, how students might approach the problem, things they might find difficult, and the ways in which particular resources (e.g., graph paper) might affect the difficulty of the problem or the way in which students approach the problem.

Kacey: Number 4 is a quadrilateral and so you're going to copy the diagram and draw the line of reflection, explain how you found it. Describe the relationship between a point on the original figure and its image so really it's just kind of the figure, which one because really to describe the relationship-

Teacher X: I kind of like 1 better, where they have to draw the reverse image

Teacher Z: It says draw the line of reflection

Teacher X: Right but it seems to me in my classes and maybe it's because it's me and I would not be able to draw that thing again, you know so I take anything. Mine have had an easier time drawing the line of reflection, because they can measure from C to C prime, D to D prime.

Teacher Z: So do you give 'em graph paper then with it on the there already?

Teacher X: I don't remember what I've done.

Note that this discussion touches on key concepts of the lesson about reflection—namely the idea that points on an image and its reflection are equidistant from the line of reflection, and that those distances are measured perpendicular to the line of reflection. However, the teachers' attention seems primarily focused on the difficulties students experience in drawing the reflected image, which is not specifically connected to conceptual aspects of the mathematics that serve as a source of challenge. Further, this discussion arose due to the way the teachers chose to engage in the conversation, not out of press from the facilitator. Thus, we argue

that while Kacey's question posed to teachers ("…how would you want to assess that students are able to do that?) opened some potential learning opportunities, what richness the conversation did hold beyond this arose largely from the way teachers elected to engage, rather than from press from the facilitator.

Table 6 below provides examples of questions Kacey posed to teachers in each of the two sessions. Note that in the absence of a protocol, Kacey's questions focus on logistical issues, coverage, and pacing, and the questions are posed such that they can be answered with one-word responses. Further, in none of the questions posed without the protocol was there a follow-up request from Kacey for teachers to provide any evidence or rationale for their responses that went beyond issues of pacing to address how that choice would support students' learning. In fact, the only question Kacey posed in the meeting without the protocol that addressed the *how* or *why* of teachers' decisions was focused on how teachers wanted to organize the document where they were keeping track of the learning targets they were working to align with their daily teaching schedules. However, in the meeting where she used the protocol, a number of questions posed by Kacey offered teachers the opportunity to weigh in on key instructional decisions and issues: how to assess student learning, skills students need to engage in the lesson, ways to support students' learning of vocabulary, and potential student misunderstandings.

**Table 6. Kacey's Questions With and Without Co-Planning Protocol**

| Questions without protocol (coded for Pacing and Coverage) | Questions linked to co-planning protocol (coded for Representations and Principles) |
|---|---|
| • So, have you all kind of already looked at that extend and describe rules for patterns? And then, find the missing term?· | • All right and so then how would you want to assess that students are able to do that?· |
| • And you're doing that on what day?· | • So what skills do you think they're going to need to have in order to do this?· |
| • So, how many learning targets are we able to write then? Four or three?· | • All right, are there creative ways that you practice vocabulary?· |
| • But is it still attainable in one day? You know, and can you measure it? | • Any other misunderstandings or issues that they might, that you might anticipate? |

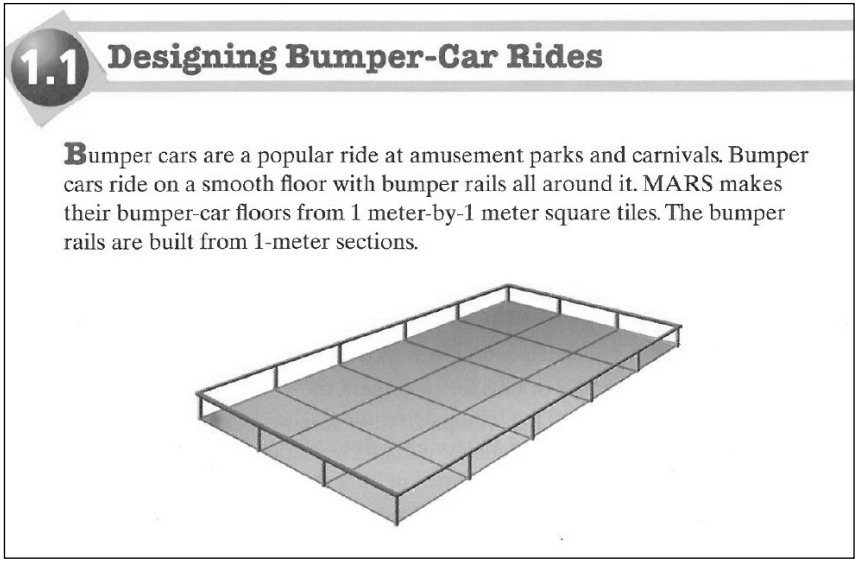
In addition to the differences we observed between sessions in which Kacey used a protocol and sessions in which she did not, we observed differences in the way the two facilitators framed their questions. Jesse's initial questions were framed with hypothetical scenarios organized around detailed representations of a classroom in a way that anticipated teacher

concerns and positioned students as sense-makers. Later questions probed for increasingly detailed representations of the classrooms of the teachers in the meeting. We posit that this strategy of questioning functioned to uncover variation in what teachers did instructionally when teaching the same topic. Episode 3 (below) highlights Jesse's questioning and further explores the ways in which particular forms of facilitator questioning can foster teacher conversations involving relatively detailed representations of the classroom and multiple vertices of the instructional triangle.

## EPISODE 3: EXAMPLE OF PRODUCTIVE QUESTIONING WITHOUT PROTOCOL

This episode highlights productive question posing that supports teachers' opportunities to learn. This episode takes place in the context of a meeting devoted to co-planning for a CMP2 unit in which students explore introductory ideas about perimeter and area (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2006).

**Figure 1. Context for investigation about area and perimeter**

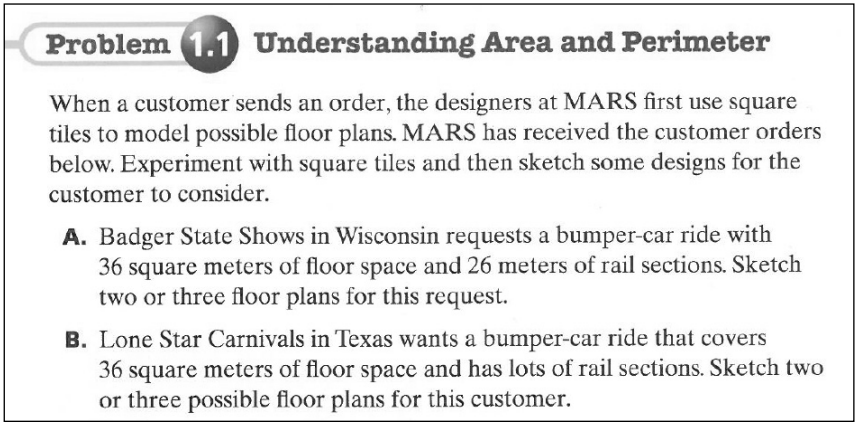

1.1 Designing Bumper-Car Rides

Bumper cars are a popular ride at amusement parks and carnivals. Bumper cars ride on a smooth floor with bumper rails all around it. MARS makes their bumper-car floors from 1 meter-by-1 meter square tiles. The bumper rails are built from 1-meter sections.

From *Connected Mathematics Grade 6 Student Edition Covering and Surrounding* by Lappan, Fey, Fitzgerald, Friel, Phillips, (p. 5, Bumper-Car ride scenario from Investigation 1), Prentice Hall. Copyright © 2009 by Michigan State University, published by Pearson Education, Inc. Used by permission. All Rights Reserved.

*Establishing context.* The episode takes place about 4 minutes into the meeting, after teachers engage in a top-level conversation about pacing (what sections of CMP2 they can finish covering prior to winter break). Immediately prior to this exchange, the facilitator, Jesse, asked the two sixth-grade teachers if they've taught from this book before. The first-year teacher (Teacher 1) had not. The second-year teacher (Teacher 2) had not taught it either but said she had previously received some professional development focused on teaching this unit. Jesse then instructed the teachers to turn to page 6 (see Figure 2) of the student edition of the text and asked them to consider the following conundrum regarding what the book asks students to do.

**Figure 2. Parts A and B on page 6**



**Problem 1.1 Understanding Area and Perimeter**

When a customer sends an order, the designers at MARS first use square tiles to model possible floor plans. MARS has received the customer orders below. Experiment with square tiles and then sketch some designs for the customer to consider.

**A.** Badger State Shows in Wisconsin requests a bumper-car ride with 36 square meters of floor space and 26 meters of rail sections. Sketch two or three floor plans for this request.

**B.** Lone Star Carnivals in Texas wants a bumper-car ride that covers 36 square meters of floor space and has lots of rail sections. Sketch two or three possible floor plans for this customer.

From *Connected Mathematics Grade 6 Student Edition Covering and Surrounding* by Lappan, Fey, Fitzgerald, Friel, Phillips, (p. 6, Bumper-Car ride scenario from Investigation 1 & Problem 1.1 with parts A and B), Prentice Hall. Copyright © 2009 by Michigan State University, published by Pearson Education, Inc. Used by permission. All Rights Reserved.

Jesse: It says, "Experiment with square tiles," and that's what I was thinking I might use these for. "Sketch some designs for the customer to consider." And it wants them to make a bumper car ride with 36 square meters of floor space and 26 meters of rail sections. So, obviously, they're gonna get 36 of these, but they've got to come up with a perimeter of 26. And then, they have to do the same thing for B. They still get 36 square meters, but, you know, it talks about something else, three possible floor plans. I just thought that would take 'em a while. I mean, what do y'all think?

Richness and complexity are lost if we consider only the question posed by Jesse, "I mean, what do y'all think?" Thus, we treat this entire turn of talk as part of Jesse's question. (Note that we similarly accounted for complexity of posed questions across our coding scheme.)

In posing this question, Jesse paints a representation of a classroom that incorporates all three vertices of the instructional triangle: a particular mathematical task, students' expected activity in the context of that task, and a pragmatic instructional concern a teacher might have in this particular situation. Namely, the task asks students to find multiple ways of constructing a shape with a given area and perimeter—and the concern is that this may take students a long time. Note that the problem is posed in a way that highlights the instructional decisions teachers make about *how* to implement curricular materials in their classrooms. Jesse asks the teachers to weigh in on how they might handle this concern. The exchange continues with Teacher 2 offering a possible solution, and Teacher 1 expressing a concern:

Teacher 2: Depending if they work in groups, if they come up, like one group comes up with one. And then, an other group comes up with a different one, then, you can kind of like discuss it. It'd take 'em a while if you were like, "All right, start over and try again." But if one group comes up with like hope-, hoping because you never know what's gonna happen.

Jesse: Right.

Teacher 2: I don't know.

Teacher 1: I think it's kind of hard to explain just, getting to start.

Jesse: I mean, I thought about, I was gonna draw it instead of using tiles. I didn't want to go get 'em today. I was just gonna draw it. And I was like, "Okay, I'm just gonna get 36 so I can have six by six," I'm like, "But that's not a perimeter of 26." So, drawing it was more complicated probably than using the tiles and you can actually move 'em around, but anyway, I just thought that might take a while. And it's just kind of, you know, the beginning of the lesson.

Teacher 2's initial suggestion is one that aligns with the intent of the text—namely, that students experience opportunities to engage in multiple solution paths, and see approaches developed by their peers. Teacher

1, on the other hand, seems concerned with how her students would get started on the task. Jesse takes up her concern by explaining how she herself thought through the problem. This move on Jesse's part might be interpreted as an implicit way of modeling a particular planning practice in which a teacher thinks through a task from a student point of view (positioning herself as the problem solver). In doing so, she highlights a specific difficulty she encountered, noting that the choice of using manipulatives can impact the complexity of the task. Teacher 2 continues the conversation, shifting attention toward a mathematical concern:

Teacher 2: I think, do you think that they'll understand, under stand the table? Like multiplying? Like four down and six across would be four times six?

Jesse: I don't think they're there yet. I think that comes later, like in the next Investigation, they start doing the table.

Teacher 2: Well then, how, maybe it's a pattern they find.

Jesse: See th-, I think it's just playing around with the tiles. If you look at [part] C, that's where they introduce area and perimeter. And if you look back at page five, I guess that gives 'em kind of a visual of bumper car ride and what they mean by, you know, the tiles and the rail. I think they're just supposed to see the tiles as, it's gonna be like the floor space, the area.

Teacher 1: That's right.

Jesse: And then, the edges will be the rails on the outside. So, what they're getting at is area and perimeter, but they haven't talked about it or talked about patterns, or

Teacher 2: It's not until [part] D, on page nine where the ta-, introduce the length and width.

Teacher 1: So, that's [Investigation] 1.3.

Jesse: Yeah.

Teacher 2: And finding, you're writing a rule for finding the area of a rectangle.

Jesse: Right. Right. So, they've got another couple Investigations kinda to get through before they actually get to that.

In this exchange, Teacher 2 pushes the question of how this activity of exploring ideas about area and perimeter connects to the eventual goal that students will come to learn that, in the case of rectangular shapes, the area can be computed by multiplying the length and the width. It is interesting to note that Jesse does not fully take up Teacher 2's concern here. Rather, Jesse's response directs the conversation to the context of the current investigation, focusing on ways in which manipulatives and aspects of the problem scenario in the first investigation connect to the mathematical ideas of area and perimeter. For instance, Jesse's comment that the "edges will be the rails on the outside" points to the broader mathematical idea of perimeter as the distance around a shape, rather than the specific pattern that leads to a formula for perimeter in the case of rectangular shapes. The teachers continue to discuss how ideas unfold across the unit, noting when students are asked to find a rule for finding the area of a rectangle—and Jesse chimes in to agree that the rule isn't found until a lesson later in the unit.

In the above episode, we see Jesse set up a rich representation of the classroom that entailed all three vertices of the instructional triangle (the teacher's concern and student work on a specific math task). This setup was followed by an exploration of these multiple points of view: what the teacher might do to get multiple solutions, how students might get started on the task, and the mathematical ideas that are to be developed across the unit. In addition, the facilitator provided crucial expertise in shaping this conversation—crafting and posing the initial question, and subsequently guiding the conversation to attend to ways of approaching the task, potential sources of difficulty (e.g., those that arise from drawing without using manipulatives), and connections between the problem scenario and key mathematical ideas (e.g., tiles correspond to area and rails correspond to perimeter).

## FACILITATOR PRESS

While Kacey exhibited richer questioning when using a protocol for coplanning, there was not a difference in her press. Across both sessions, Kacey exhibited consistently weak press—meaning she Kacey accepted whatever responses teachers gave to her questions without request for elaboration or refinement. Jesse, on the other hand, consistently pressed teachers to elaborate on and justify their contributions to the conversation, which pushed teachers to provide more detailed representations of their classroom, consider students' points of view, and articulate rationales for their instructional decisions in terms of how those decisions supported students' learning. An example of Jesse's sustained press is further detailed in Episode 4 below.

## EPISODE 4: EXAMPLE OF SUSTAINED PRESS

In this episode, we see Jesse raise an issue—how teachers decide what homework to assign—around which she presses the teachers to explain the factors informing their decision-making. As Jesse presses teachers to articulate the set of factors informing their choices, the teachers cite logistical issues (when they see students, when students turn the work in, schedule changes). Under further press from Jesse, Teacher 2 elaborates on aspects of her instructional practice, and both teachers indicate that they aim to assign homework that provides students with opportunities for additional practice. In the end, Jesse encourages the teachers to consider how the homework they assign supports what they do in class to further students' learning—and highlights strategies for identifying components of their instructional resources that align with their stated goals.

After the discussion of the unit on area and perimeter (from Episode 3 above), Jesse raised the issue of how the teachers decide what homework to assign.

Jesse: So, do you all normally give the ACE for homework, or what do you all normally do with those?

Teacher 1: So like, we give it on Monday and it's not due 'til Friday. So by then, we would've, we'd have done

Jesse: Does it have to be done that way?

Teacher 1: Well, that's our routine right now.

Jesse: So, what if you're starting a new book? You're gonna give 'em homework from the last book? That would be confusing to me as a kid because you know, I'm thinking homework reinforces what they have learned that day. (*talking over one another*) But it's not necessarily been connected completely to that particularly, right, if it's more like skill driven. Like what might be homework you would give for this book on say today? Say introduce this on a Monday, do you have an idea like what would you all do for homework for that week?

While Jesse initially asks the teachers what problems they assign for homework, Teacher 1 responds with an explanation of when homework is assigned and collected. Rather than pressing further on the content of the homework at this point, Jesse works to bridge issues of learning to the logistically based instructional choices raised by the teachers. Jesse presses

the teachers to further consider this structure from a student perspective, noting, "That would be confusing to me as a kid." She asks for further elaboration on this representation of Teacher 1's practice by posing a question based on a particular scenario that draws on Teacher 1's contribution: "Say introduce this on a Monday, do you have an idea like what would you all do for homework for that week?" The exchange continues with the teachers considering Jesse's question relative to specific content:

Teacher 1: This week it may be something with fractions, the unit before. Or we may just do multiplication, adding.

Jesse: Well, knowing that this book is kinda like area and perimeter of, really, quadrilaterals, triangles, and circles.

Teacher 2: Is it circles?

Jesse: Yeah, I think Unit 5, I mean, Investigation 5 they do circles.

Teacher 1: So, it's triangles, parallelograms, I like circles. I like teaching circles.

Jesse: But I was just trying to think of like how the homework would tie in and be reinforcing what they've learned but give 'em some independent practice or if they need extra time because sometimes, you know, the bell rings and

Teacher 2: So, we do that all during class. We do, well, not every class, but like we'll do like 20, 25 minutes of teaching instruction, depending on the lesson, and then, they'll do, we'll do a couple problems with them. And then, we'll give them some guided practice, or I mean, independent practice. Or, you know, work with your partner and walk around and assess them. And then, their homework is just week-long reinforcing things that we've done before. And sometimes I know like the couple times we've been putting on problems that maybe we haven't hit on yet. And we'll, you know, "Pull out your homework and these are, this is how you need to do problems," whatever, "three and four."

Here, we see Jesse push the teachers to characterize their current practice in terms of how the homework they assign relates to what is done in

class. Jesse offers an instructional principle—that homework should "reinforce what they've learned." We posit that Jesse's image of the bell ringing may help cue the level of specificity she wants. In response, Teacher 2 offers a representation of her classroom practice, specifically describing the structure of a typical day and the way in which independent practice and homework fit into that typical day. Following this exchange, Jesse presses further, asking the teachers to relate their decisions about homework to the specific instructional unit focused on area and perimeter that they had been discussing earlier in the meeting. As the exchange continues, teachers describe how they might implement the beginning of the unit, noting that they no longer assign ACE questions due to scheduling changes. The teachers explain that assigning ACE questions was something they did in the past, when they saw all their students every day. Due to schedule changes, they no longer see students every day and thus do not assign daily homework. After relating this back to the discussion of when students actually turn in their weekly homework, Jesse returns again to the question of what type of homework the teachers *do* assign:

Jesse: So, I guess then, let's pretend it's Monday and you all did 1.2 or we would do 1.1, but that's what you kinda went to. So, what kind of homework might they have with that?

Teacher 2: Probably finding, doing area and perimeter.

Teacher 1: We'll probably choose something out that's like simi lar more of a skill type of thing.

Jesse: Where did you all get that? I'm just wondering, the ACE questions, they're a lot like that. So, I'm just wondering why maybe you all wouldn't use the ACE questions if they're like this. You know what I mean? Wrack your brain to find something like that.

The discussion continues as Jesse points out that the "core" ACE questions offer students opportunities for practice as the teachers hope; she also points out examples of other ACE questions that work well as in-class extensions that would be hard to assign as homework because they rely on manipulatives that are only available in the classroom.

This episode highlights how, through press, Jesse supports teachers in articulating and refining the rationales behind their instructional decisions while also pointing them to resources in their instructional materials that align with their goals. Jesse's press functioned to sharpen the focus of the subsequent conversation while broadening the set of conversational

resources and encouraging teachers to link representations of their classroom (e.g., what homework they choose to assign when) to instructional principles (e.g., the homework should reinforce ideas learned in class). When she questioned the logic of the routine and posed a more specific scenario of how they would assign homework for a particular timeframe and lesson, the teachers elaborated on representations of their classrooms. When Jesse pressed teachers to articulate how the homework they assign supports the learning that takes place in the classroom, Teacher 2 linked the description of her classroom to the principle that homework should reinforce in-class learning. As the teachers responded to Jesse's prompts she continually pressed them to give explicit support for their contributions and provide examples or representations of the practices they described.

## DISCUSSION

In this study, we examined the relationship between focus and facilitation of teachers' collaborative conversations and teachers' opportunities to learn in that context. Specifically, we operationalized this relationship by analyzing facilitator questioning and facilitator press, as this lens offered insight into the mechanisms through which facilitators can support teachers in productively engaging in pedagogical reasoning (thus supporting their opportunities to learn). Our findings indicate that focus and facilitation shape teachers' collaborative conversations, and thus opportunities to learn, in consequential ways. Importantly, we observed the potential of a well-designed protocol to support facilitators in reorganizing teachers' activity in ways that were productive for their opportunities to learn—as well as the limitations of such a protocol. More specifically, protocol use was tied to improved facilitator questioning but not improved facilitator press.

In our analysis, we observed facilitation that supports teachers in engaging in pedagogical reasoning related to their day-to-day instructional practices. In these observations, we noted aspects of the facilitator's role that are documented in the literature, particularly with regard to establishing purpose and context. Additionally, we identified features of facilitators' conversational moves that created space for teachers to contribute to conversations in meaningful ways. These moves were marked by (1) solicitation of detailed representations of teachers' classrooms and practice, (2) orientation toward students as sense-makers, and (3) press for teachers to articulate rationales for instructional decisions that are tied to coherent goals for student learning. We note that these moves took place in the context of conversations that were organized around the instructional

materials provided to teachers by their schools and district. Indeed, these teacher conversations revealed that logistical aspects of their school setting (e.g., the school schedule) consequentially impacted the way in which they made use of the instructional materials.

The protocol that was linked to improved facilitator questioning is focused on the activity of co-planning a lesson. This particular activity is tied to teachers' local instructional context and day-to-day work in that it is organized around the planning of a lesson that the teachers will teach using instructional materials they are intended to use. The tool provided structure for discussion around key aspects of lesson planning (learning objectives, assessment of those objectives, prerequisite knowledge and skills, familiar and unfamiliar vocabulary, and the phases of the lesson)—with question prompts to consider for each. The facilitator organized teachers' activity around the co-planning protocol in a way that supported teachers in engaging meaningfully in the conversation (e.g., by providing opportunities for them to discuss how they wanted to assess students, which led to discussions of common student struggles). The tool did not, however, support the facilitator in pressing teachers to elaborate on, justify, or problematize the ideas they brought forward—suggesting that there is a limit to the extent to which such a tool can impact the focus and facilitation of teachers' collaborative conversations.

This work contributes to the research on ways of supporting teacher learning in several ways. First, it informs our understanding of the ways in which facilitators can support teachers' opportunities to learn through their collaborative conversations, in part by offering a concrete image of what this looks like in practice. Second, it offers insight into the design and use of tools (protocols) that can help productively structure TCT and also reveals the limitations of such tools. Third, it contributes a construct for measuring the quality of facilitation through questioning and press that can subsequently be challenged, problematized, and built upon in the field. Finally, this work has the potential to inform our understanding of the knowledge and skills needed by facilitators to support teacher learning. This can carry implications for hiring decisions as well as the design of professional development to enable facilitators to learn how to support teachers' learning by productively engaging them in pedagogical reasoning. However, more work is needed to better understand the full scope of knowledge and skills needed by facilitators, as well as the mechanisms through which the necessary knowledge and skills can be developed.

## ACKNOWLEDGMENTS

This work was supported by the National Science Foundation (NSF) grant number ESI-0554535. Christine Andrews-Larson and Jonee Wilson's contributions were supported by the Institute of Educational Sciences (IES) postdoctoral and predoctoral research training grants, respectively, #R305B080008 and #R305B080025. The views expressed in this paper do not necessarily reflect the opinions of NSF or IES. We would like to thank Ilana Horn, Annie Garrison, and Paul Cobb and all the other members of the MIST team.

## NOTES

1. Instructional quality was measured using the Instructional Quality Assessment Instrument (IQA; Boston & Wolf, 2006).

2. Gibbons and Cobb (2013) note that co-planning instruction and book study were also considered to be activities with the potential to support teacher learning, but they were not included in their review due to a lack of existing literature.

3. Our data come from a sample of teacher collaborative meetings that took place partway through the school year. We found that the extent to which our sample documented the work facilitators did to establish purpose and provide context was limited; we posit that this is because our sample provided only a snapshot of the types of interactions that took place during TCT. We cannot make claims as to whether the rationales for specific activities were established within teacher workgroups earlier in the year.

4. Note that, at Sycamore, our audiotaped sample of teacher meetings includes four of the five teachers in the retained teacher sample used to measure IQA growth for the school. Three of those teachers are present in the grade-level meeting selected for close analysis at Sycamore, and these account for 100% (all 3) of the teachers who participated in this meeting. At Laurel, our audiotaped sample of teacher meetings includes all three teachers in the retained teacher sample used to measure IQA growth for the school. One of those teachers is present in the grade-level meetings selected for close analysis at Laurel, and this teacher accounted for 50% (1 of the 2) teachers who participated in these meetings. Every single one of these teachers who was both in the retained sample and in the audiotaped meetings exhibited growth in instructional quality as evidenced by the selection and implementation of more cognitively demanding tasks and/or higher quality whole-class discussions.

5. This scheme was adapted from Boston and Wolf's (2006) notion of teacher press and student provide, which was used for coding instructional quality of videos of mathematics classroom instruction.

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